UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D.C. 20523

PROJECT PAPER

INDIA: Center for Technology
Development (386-0507)

UNCLASSIFIED

PROJECT PAPER

CENTER FOR TECHNOLOGY DEVELOPMENT

(386-0507)

Dated: July 19, 1989

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: — DOCUMENT CODE: 3

2. COUNTRY/ENTITY: INDIA

3. PROJECT NUMBER: 386-0507

4. BUREAU/OFFICE: ANE — 03

5. PROJECT TITLE (maximum 40 characters): CENTER FOR TECHNOLOGY DEVELOPMENT

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09, DD 30, YY 95

7. ESTIMATED DATE OF OBLIGATION (Under "B." below, enter 1, 2, 3, or 4)
A. Initial FY 89 — B. Quarter 4 — C. Final FY 94

8. COSTS ($000 OR EQUIVALENT $1 = Rs.14.00)

A. FUNDING SOURCE	FIRST FY 1989 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	1,620	1,380	3,000	5,400	4,600	10,000
(Grant)	(1,620)	(1,380)	(3,000)	(5,400)	(4,600)	(10,000
(Loan)	(-)	(-)	(-)	(-)	(-)	(-
Other U.S. 1.						
Other U.S. 2.						
Host Country	-	1,135	1,135	-	7,450	7,450
Other Donor(s)						
TOTALS	1,620	2,515	4,135	5,400	12,050	17,450

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	C. 2. Loan	D. OBLIGATIONS TO DATE 1. Grant	D. 2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	E. 2. Loan	F. LIFE OF PROJECT 1. Grant	F. 2. Loan
(1) EN	B 161	873	-	-	-	1,000	-	2,000	-
(2) SD	B 753	873	-	-	-	2,000	-	2,000	-
(3) DP	B 753	873				-		6,000	-
(4)									
TOTALS						3,000	-	10,000	-

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 840 | 879 | 968

11. SECONDARY PURPOSE CODE: 751

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	RGEN						
B. Amount							

13. PROJECT PURPOSE (maximum 480 characters)

To stimulate the process of technology development and the commercial use of that technology in India.

14. SCHEDULED EVALUATIONS: Interim MM 09 YY 91 | MM YY | Final MM 09 YY 95

15. SOURCE/ORIGIN OF GOODS AND SERVICES: [X] 000 [X] 941 [X] Local [ ] Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

Clearance : GO:GAEidet

17. APPROVED BY — Signature: Robert N. Bakley — Title: Robert N. Bakley, Director, USAID/India — Date Signed: MM 07 DD 29 YY 89

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM DD YY

AID 1330-4 (8-79)

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LIST OF ACRONYMS

ADL	Arthur D. Little, Inc.
AID	Agency for International Development
AID/W	Agency for International Development/Washington
ATCs	Applied Technology Centers
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CDSS	Country Development Strategy Statement
CEI	Confederation of Engineering Industry
CPs	Conditions Precedent to Disbursement of Funds
CTD	Center for Technology Development
FSN	Foreign Service National
FY	Fiscal Year
GOI	Government of India
GOK	Government of Karnataka
HC	Host Country
HRD	Human Resource Development
ICICI	Industrial Credit and Investment Corporation of India
IIM	Indian Institute of Management
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
KSFC	Karnataka State Financial Corporation
KSIIDC	Karnataka State Industrial Investment & Development Corp. Ltd.
LOP	Life of the Project
MSSs	Mission and Scope Studies
NAL	National Aeronautical Laboratory
NASPAA	National Association of Schools of Public Affairs & Admin.
ODA	Official Development Assistance
PACER	Program for the Acceleration of Commercial Energy Research
PACT	Program for the Advancement of Commercial Technology
PASA	Participating Agency Services Agreement
PID	Project Identification Document
PIL	Project Implementation Letter
PIO	Project Implementation Order
PP	Project Paper
PIR	Project Implementation Review
PSC	Personal Services Contract
PW	Price Waterhouse
R&D	Research & Development
S&T	Science and Technology
SRI	Stanford Research Institute
TA	Technical Assistance
TD&E	Technology Development & Enterprise Office of USAID/I
TDICI	Technology Development and Information Company of India
UNDP	United Nations Development Program
USAID/I	United States Agency for International Development in India

MONETARY DEFINITIONS

1 Crore = 10,000,000
1 Lakh = 100,000
Exchange Rate: 1.00 Dollar = Rupees 14.00

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

NEW DELHI, INDIA

PROJECT AUTHORIZATION

Country: **INDIA**

CENTER FOR TECHNOLOGY DEVELOPMENT
Project Number: **386-0507**

1. Pursuant to Section 106 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Center for Technology Development Project (the "Project") for India (the "Cooperating Country") involving planned obligations of not to exceed Ten Million United States Dollars ($10,000,000) in grant funds over a five year period from the date of this authorization. Of this amount, Three Million United States Dollars ($3,000,000) are being obligated during Fiscal Year 1989. Additional funds will be obligated subject to the availability of funds in accordance with the A.I.D. OYB/allotment process to help in financing foreign exchange and local currency costs of the project. The planned life of the project (LOP) is six years from the initial obligation.

2. The Project is an experimental undertaking designed to develop and improve technology infrastructure reserves essential for economic growth in India. To start with, the project will be implemented in the state of Karnataka. With potential for adaptation by other States it is designed to contribute to the broad Science and Technology Sector goal of accelerating the pace and improving the quality of technology application to product and production process development in existing and new businesses in Industry, Health, Agriculture and other areas important to Indian development.

The Project consists of providing assistance to the Cooperating Country for funding subproject proposals which aim at strengthening, within the State of Karnataka, the capacity of technical institutions to stimulate the process of technology development and the commercial use of that technology in India. This purpose will be achieved by providing support to develop and coordinate elements of Karnataka's technology infrastructure emphasizing four main areas: (a) Applied Technology Centers; (b) Human Resource Development; (c) Venture Capital Funding; and (d) Satellite-based Technical Information Linkages.

USAID/I will channel $10 Million of grant funds for the aforesaid purpose, through the Industrial Credit and Investment Corporation of India (ICICI), to the Center for Technology Development, a non-profit private Society recently registered and established at Bangalore.

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The A.I.D. grant funds will finance: Technical Assistance; Human Resource Training; Commodity Procurement; and Other Costs including the development of Publicity Materials for Technical Information Exchange, Project Monitoring, Project Evaluation and audits of the CTD organization. Except for those expenditures incurred by A.I.D. under direct contracts, all other A.I.D. funded expenditures will be first borne by the CTD which will then seek reimbursement of eligible project expenditures from the ICICI. The ICICI will in turn be reimbursed directly by A.I.D.

The Host Country contributions to the project, an estimated total of $7.45 million, will consist of an estimated $7.0 million "in-kind" contributions by Private Sector Organizations participating in CTD's activities, and an estimated $450,000 from the Government of Karnataka and from private local Industry Associations to finance the CTD's recurrent cost expenses.

3. The expected project outputs will include: (a) an operationally effective CTD engaged in stimulating the process of technology development and commercial use of that technology; (b) an expanded and strengthened Research & Development base for technological development; (c) an expanded and enhanced Human Resource base for improved technological applications; (d) an effective network among key institutions supporting increasing technology development & application; (e) a regular updated Technical Information System for Karnataka Industry & Research Groups; and (f) a strengthened entrepreneurship environment, particularly at the small/medium scale level.

4. The Project Agreement which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following essential terms, covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

A. Source/Origin of Commodities and Nationality of Services: Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their Source and Origin in the Cooperating Country or selected Free World Countries (Code 941) or the United States, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States or the Cooperating Country.

B. Conditions Precedent to Disbursement: In addition to the standard Conditions Precedent (CPs) to the disbursement of project funds, the Project Agreement will contain additional CPs to the initial disbursement of funds which state that the ICICI will, except as the Parties may otherwise agree in writing, furnish to A.I.D., through the DEA, in form and substance satisfactory to A.I.D. the following:

(i) The "Memorandum of Understanding" between the ICICI and the CTD which describes the procedures and mechanisms that will be employed to reimburse the CTD for eligible expenditures under the project;

(ii) A written confirmation of the fact that the CTD has in place a staff of at least three persons, including the Honorary Director of the CTD, which is required to implement the initial stages of the project. The ICICI's written confirmation should also indicate that the CTD is prepared to hire a minimum of two additional persons by the end of the second year of the project; and

(iii) A copy of the CTD's "Management Plan" for the initial eighteen months of project. Such a plan will include the estimated amounts and timings of the Host Country and/or Direct A.I.D. contracts during this eighteen months period and will specify the manner in which the CTD will insure that it establishes acceptable financial management and control mechanisms for the funding provided by A.I.D. under the project.

C. <u>Covenants</u>: Except as A.I.D. may otherwise agree in writing, the CTD will agree to:

(i) Establish an Evaluation Program to be financed out of project funds;

(ii) Finance and secure in a timely manner, any exemption from GOI import duties, all import licenses and/or other GOI clearances required for the importation of any goods to be financed under the project; and

(iii) Maintain or increase the existing level of representation of the Private Sector and/or Non-Government Organizations on the Governing Board of the CTD.

Robert N. Bakley
Director
USAID/India

Date July 29, 1989

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I. SUMMARY PROJECT DESCRIPTION

1.00 A. General Project Description: The Center for Technology Development (CTD) project is an experimental undertaking designed to contribute to the broad science and technology sector goal of accelerating the pace and improving the quality of technology application to product and production process development in existing and new businesses in Industry, Health, Agriculture and other areas important to Indian development. The purpose of the project is to stimulate the process of technology development and the commercial use of that technology in India. The project's efforts will initially be focussed on the Bangalore area of Karnataka. This purpose will be achieved by providing support to develop and coordinate elements of the region's technology infrastructure through the funding of: (a) Applied Technology Centers; (b) Human Resource training; and (c) The procurement of a variety of physical and technical resources.

1.01 As the Indian economy has been increasingly liberalized, it has been recognized that there is a built in limitation in a strategy of relying on technology imports as the main source of technological innovation. Though India has some key building blocks that can stimulate major advances in the pace and quality of indigenous technology development, it has yet to reap significant commercial benefits from Research and Development (R&D) efforts. This problem, addressed by the CTD project, is the weak link between the nature and availability of India's technological infrastructure and the market driven needs of its businesses.

1.02 The CTD project is in conformity with the U.S. Agency for International Development in India's (USAID/I's) Country Development Strategy Statement (CDSS) which emphasizes the importance of the entire Science and Technology (S&T) process. It is one of a series of bilateral projects focussed on the same sector goal. CTD follows the Program for the Advancement of Commercial Technology (PACT) project and the Program for the Acceleration of Commercial Energy Research (PACER) project by contributing to the enhancement of the overall process of technology change with a focus on improving linkages between numerous groups involved in the movement of technology to the marketplace.

1.03 B. Responsibilities of the Participants: The project is a regionally based technology development effort having potential for adaptation by other Indian states. The CTD will serve as a forum through which leaders from business, financial institutions, government, and academia can work to strengthen and coordinate Karnataka's technological infrastructure. Efforts to improve Karnataka's ability to use technology to develop products and improve production processes will be driven by business demand. The Center's agenda will emphasize four main areas: (a) Applied Technology Centers (ATCs); (b) Human Resource Development (HRD); (c) Venture Capital Funding; and (d) Satellite-based Technical Information Exchanges.

1.04 Although the Center is registered as a nonprofit society under the Laws of Karnataka and is located in Bangalore, it will have an explicitly all India dimension. The seven member Governing Board will include representatives of the Indian Institute of Science, the Industrial Credit and Investment Corporation of India (ICICI), the Confederation of Engineering Industry (CEI), the Indian Institute of Management (IIM), Bangalore, and two representatives of the Government of Karnataka (GOK). The CTD's Honorary Director will serve as member Secretary.

1.05 Project proposals will be developed by industry oriented "Focus Groups" for review and approval by the CTD Secretariat, the CTD Governing Board, and USAID/I's Office of Technology Development and Enterprise (TD&E). Such proposals will address the following criteria: (a) Overall Economic Rationale; (b) Market Demand; (c) Structure and Organization; (d) Business Participation; (e) Institutional Autonomy; (f) Use and Adaptation of Existing Technology; (g) The utilization of the "Best Practices"; (h) Intellectual Property Rights; and (i) Environment/Health.

1.06 C. Illustrative Financial Plan: A.I.D. assistance to the project will support the growth and maturation of the CTD organization and specific initial activities of the CTD. The A.I.D. grant of $10.0 million, over a six-year period, will finance: an estimated $3.0 million of Technical Assistance; an estimated $2.5 million of Human Resource training; an estimated $3.8 million of Commodity Procurement; an estimated $0.4 million for Other Costs including the development of publicity materials for Technical Information Exchange; and an estimated $0.3 million for Project Monitoring, Evaluation and audits of the CTD. With the exception of those expenditures incurred by A.I.D. under direct contracts, all other expenditures will be first borne by the CTD which will then seek reimbursement of eligible expenditures from the ICICI. The ICICI will in turn be reimbursed directly by USAID/I.

1.07 The recurrent costs related to the support of the CTD will be provided as a contribution from the GOK (estimated as the equivalent of $37,500 per year) and from local Industrial Associations (estimated as the equivalent of $37,500 per year).

1.08 In addition to this project and in general support of the technology development objectives in Karnataka, donors other than A.I.D. are expected to provide up to $44.8 million, including substantial funding for venture capital, assuming bilateral agreements for the same are concluded. In addition, it is anticipated that the ICICI, through its subsidiary the Technology Development and Information Company of India (TDICI), will provide an estimated Rs.200 million (approximately U.S. $15.4 million) as a Venture Capital Fund to finance new business investment proposals including CTD sponsored proposals, provided these proposals reach a "bankable" stage.

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1.09 It is anticipated that most of the procurement required under the project will be accomplished through Host Country contracting procedures with only a limited amount of procurement for U.S. and other foreign technical assistance, training and commodities being accomplished through direct A.I.D. contracts.

1.10 D. Financing Methods: The details of the disbursement methods that will be employed under the project will be provided in the basic Project Implementation Letter that will be issued, with GOI concurrence, subsequent to the signing of the Project Agreement.

1.11 E. Evaluation and Monitoring: Evaluation and Monitoring of the CTD project will be achieved through a system of ongoing data collection and reporting designed to track project process and results. Information on CTD activities will be collected by the "Focus Groups" and recorded and summarized by the Secretariat of the CTD on a quarterly basis.

1.12 A minimum of two independent Project Evaluations will be conducted by teams of A.I.D. specialists, foreign and local consultants, and CTD staff in years three and six of the project. These Project Evaluations will focus on both the technology development and coordination process as well as on the results of specific CTD sponsored activities. Of the $300,000 set aside in the Evaluation and Monitoring line item of the Illustrative Budget of the Financial Plan section of the Project Paper, at least $200,000 is reserved for the costs of direct A.I.D. contracts for consultant services required to conduct Project Evaluations.

1.13 F. Special Considerations: In addition to the standard Conditions Precedent to the disbursement of project funds, it is anticipated that the Project Agreement will contain the following special Conditions Precedent (CPs) to the initial disbursement of funds:

1.14 1. A requirement that the ICICI provide, for the approval of A.I.D., a copy of the "Memorandum of Understanding" between the ICICI and the CTD which describes the procedures and mechanisms that will be employed to reimburse the CTD for eligible expenditures under the project;

1.15 2. A requirement that the ICICI provide, for the approval of A.I.D., a written confirmation of the fact that the CTD has in place a staff of at least three persons, including the Honorary Director of the CTD, which is required to implement the initial stages of the project. The ICICI's written confirmations should also indicate that the CTD is prepared to hire a minimum of two additional professionals by the end of the second year of the project; and

1.16 3. A requirement that the ICICI provide, for the approval of A.I.D., a copy of the CTD's "Management Plan" for the

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initial eighteen months of the project. Such a Plan should include the estimated amounts and timings of the Host Country and/or Direct A.I.D. contracts anticipated during this eighteen month period and should specifically indicate the manner in which the CTD will insure that it establishes acceptable financial management and control mechanisms for the funding provided by A.I.D. under the project.

1.17 In addition, it is anticipated that the Project Agreement will contain the following Special Covenants:

1.18 1. That the CTD will be responsible for securing and arranging for financing, in a timely manner, of any and all import duties and/or other GOI levies and clearances required for the importation of any goods to be financed under the project; and

1.19 2. That the CTD agrees to either maintain or increase the existing level of representation of the Private Sector and/or Non-Government Organizations on the Governing Board of the CTD.

II. RATIONALE

2.00 A. The Role of Science and Technology in Development: Sustained technological innovation is one of the salient characteristics of the developed countries of North America, Europe, and East Asia. The successful transition of countries in these regions from traditional agricultural to modern industrial societies has been accompanied by a fundamental change in the general availability of food, shelter, health services, and material goods. Application of S&T has been a key factor in and symbol of that change.

2.01 India, despite its considerable progress in the industrial sector, is still predominantly a rural, agrarian society trying to transform itself into a modern industrial society in which basic necessities are widely available. Since independence, the Government of India (GOI) has invested steadily and heavily in creating S&T infrastructure. In 1984-85, India spent approximately 1% of GNP on R&D activities and now has the fifth largest pool of technical personnel in the world.

2.02 Clearly, India has in place an S&T capability unique for a country at its level of development. After more than fifteen years of slow growth and a public policy commitment to improve economic efficiency, the country's industrial sector has started to expand rapidly in the last decade. However, though India has some key building blocks that could stimulate major advances in the pace and quality of economic development, the country has yet to reap significant commercial benefits from R&D.

2.03 A major reason for this failure is the weak link between basic research and industry needs. In general, Indian research has not been driven by market needs. Therefore research and technology communities have been physically and philosophically isolated from industry. Also, until recently, businesses have not had the competitive need to develop new technologies to improve product quality or reduce production costs.

2.04 Because the commercial output of India's national R&D network is meagre, technology imports are the main source of technological innovation. India is aware of the limitations of this reliance. This awareness, coupled with a keen desire to rapidly modernize the industrial sector, is reflected in the GOI's Seventh Five Year Plan, 1985-1990. For example, the Plan states that:

2.05 "The coupling between the science and technology infrastructure and capabilities and the production system in the country is weak...there is often a feeling that the fruits of science and technology are not reaching the bulk of the population and not contributing in sufficient measure to economic and social growth."

2.06 The same argument has been expressed, over the last decade, numerous times in different ways by persons both in and out of government. Indeed, the recent opening up of the Indian economy to technological competition as part of a broad liberalization program provides an ideal window of opportunity in which to stimulate a commercially oriented R&D culture.

2.07 B. USAID/I's Science and Technology Initiatives: Recognizing the importance of technological change and innovation for economic growth USAID/I, over the last four years, has developed a series of projects with this focus. The CTD is the third project in this series.

2.08 The first project was the PACT project. As with CTD, PACT's overall objective is to enhance both the pace and quality of commercial technology development and innovation. The PACT project provides financial support in the form of conditional grants for the preprocessing costs of Indo-U.S. joint ventures. The second project in this series was PACER. With a similar overall objective, PACER focuses on the energy sector, seeking to promote the link between technology and enterprise. Initially with a regional focus, the CTD project focuses on helping India exploit its own capacity for commercial technology development, so that the country can become less dependent on adapting foreign sourced technologies to business or government needs.

2.09 The project in many ways anticipated the development of USAID/I's new S&T strategy which was approved by AID/W in July of 1988. The basis for this strategy is the conclusion that the most appropriate focus for U.S. assistance to India in the 1990's is in the area of science and technology which is broadly defined to include: research; technology development and commercialization; and S&T systems strengthening.

2.10 The analysis which supports the selection of this strategy identifies important weaknesses in the "process" of S&T development in India. These include the absence of effective linkages among government, academia, and private enterprise that are necessary tofoster the development and commercialization of technologies important to India's economic development. By addressing these weaknesses, initially in Bangalore, USAID/I will help strengthen the Indian S&T process. Hopefully the subsequent replication of the successful CTD model in other parts of the country will result in a spread effect that will increase productivity and economic growth across India.

2.11 C. The U.S. Model: Economic Development at the Regional Level: The CTD initiative is based on a model that links technology to economic development. The framework suggests that regional or state economies that comprise a nation are themselves dynamic. That is, they are composed of many different industries whose development is often uneven from place to place. The economic health of these regions depends on nurturing, directing, and reacting to economic activity in a defined geographic area as global competition increases the rate of regional economic change.

2.12 Businesses, on the other hand, are not geographically limited in how they can increase competitiveness, and therefore are not tied to a particular region or state. Businesses can seek strategic alliances, establish joint ventures, license technology, acquire firms, set up new plants, and close down others.

2.13 Technological challenges confront industries as they adapt to competition and move through their life cycles. These technology challenges occur at three different levels: (1) Technology Deployment - putting existing, "off the shelf" technology to work (i.e. Computer Aided Design); (2) Technology Application and Adaptation - taking scientific and technical discoveries or tools and applying or adapting them for specific purposes in products or processes; and (3) Technology Discovery - fundamental basic research designed to discover new principles (i.e. superconductivity) and new tools (i.e. rapid solidification technology).

2.14 To respond to these technology challenges, industry draws on the "technology infrastructure" that exists in the economy. There are four types of technology infrastructure resource needs for each level of technology challenge. The components are: (1) Physical Resources-- buildings, laboratory equipments, instruments, production machinery, and technical components for discovering, developing and using technology; (2) Human Resources - preparation of knowledge and technology skills for development, application, and use of technology; (3) Financial Resources - financing for different stages of technology development and incorporation into business activities; and (4) Technology Institution Resources - technical institutions that address the actual development or adoption and application of technology for products or production processes and catalytic institutions that provide a forum for the analysis and coordination of all technology infrastructure components described above. (**NOTE:** For a more detailed description of these resource needs at each order of technology challenge, see Annex C).

2.15 To ensure regional economic health, public and private sector leadership can develop this technology infrastructure and increase its responsiveness to changing market needs. Indeed, the CTD took its inspiration in part from the activities of U.S. state governments that evolved to address problems of industrial competitiveness. Many states, such as Ohio, Indiana, and Pennsylvania, have established their own innovative development programs to foster rapid adaptation to technological change. A commonly found denominator of these programs is the creation of a forum, such as the CTD, through which business, government, and academic leaders can develop and then strengthen linkages between the key resources of technology infrastructure. (**NOTE:** For a more detailed description of public and private actions to enhance technology infrastructure and lessons learned, see Annex D).

2.16 D. <u>Project Development and PID approval issues:</u> In addition to the activities of U.S. state governments, USAID/I took inspiration from the concern both at India's Center and state levels with industrial modernization and regional economic development. In preliminary discussions with government officials, businessmen, bankers, and researchers, USAID/I staff found a high level of receptivity to the concept of a state level program aimed at application of S&T to problems of economic development.

2.17 Four sites were considered for the location of the CTD project: Hyderabad, Andhra Pradesh; Ahmedabad, Gujarat; Pune, Maharashtra; and Bangalore, Karnataka. Initial visits to these areas resulted in the selection of Karnataka as the most appropriate site for USAID/I funded effort. The survey of Karnataka (See Annex N), prepared by Rao Associates combined with USAID/I's staff site visits revealed that Bangalore was the best candidate for the establishment of regional technology development project. The state's strengths are rooted in its long history of interaction between business, academia, and government; its solid base of research capacity; and the keen interest on the part of state and local leaders in launching such a project.

2.18 A three day workshop on "Technology Development, Finance and Human Resources in Karnataka", sponsored by USAID/I and the CEI, was held in Bangalore in March of 1987. Three industry focus groups, e.g. Informatics; Food Technology; Industrial Machinery & Equipment; Chemical System Suppliers/Fabricators and Dry Land Agriculture; met for working sessions. A.D. Little, Inc. (ADL) prepared a report on the Conference (See Annex O) and followed up immediately with key participants to determine next steps. In response to ADL's Report, the GOK proposed the purposes, scope, and composition of a Technology Development Board and a secretariat, having an all India mandate with an initial focus on the Bangalore area.

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2.19 USAID/I then contracted with the Stanford Research Institute (SRI) International to study Karnataka's regional economic infrastructure and make specific recommendations for CTD action program. The SRI Report, "Karnataka in Transformation" (See Annex P), served as the basis for the writing of the Project Identification Document (PID) in December of 1987.

2.20 1. PID Issues: The PID was approved by AID/W in February of 1988 without any major issues and USAID/I was authorized to proceed with the development and approval of the CTD Project Paper (PP). Notwithstanding this, a number of concerns were raised in the AID/W approval cable which were to be addressed during the PP design process. In July of 1988, USAID/I contracted for the services of three consultants to assist the Project design team in finalizing the PP. During this process, the team took into consideration AID/W's concerns. A summary of the status of these concerns follows:

2.21 a. Policy Environment and Dialogue: An analysis of the policy issues related to the CTD project by Price Waterhouse, India is included as Annex Q. The analysis outlines the Center and state policy environment in which the CTD project will operate. It highlights recent measures that have been initiated: to liberalize the state economy; to encourage competition; to allow businesses greater freedom and flexibility; and to encourage improvements to technology quality, the economic of scale of production, and export initiatives. The analysis also notes that the activities sponsored by USAID/I during the project development phase seem to have already influenced Karnataka's June 1988 policy on high technology industries.

2.22 Although policy change is not a formal mandate of the CTD, continued policy liberalization will be a likely outgrowth of the CTD project because members of CTD's Governing Board, Secretariat, and Focus Groups hold key positions in government and industry. Thus the actions of the CTD will of themselves constitute a major positive policy impact on the economy of the state of Karnataka and if successful in Karnataka, in other states of India.

2.23 b. Project Focus and Sustainability: The focus of CTD project is to support the growth and maturation of the CTD organization by financing specific initial activities of the CTD, including the planning and equipping of Applied Technology Centers (ATCs). By the end of the project, industry groups, including start-up firms, will be served by: a fully operational CTD; new ATCs; and new or enhanced technology training programs. All of these will be self sustaining through a combination of collection of business fees for services provided and receipt of grant support from financial institutions, foreign donors, state government, and Industry Associations. An elaborate summary of CTD's

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role and process and how the success of the project is to be measured are provided in the PP's "Detailed Description" and "Monitoring and Evaluation" sections while a more detailed exposition of questions related to the project's sustainability can be found in the "Financial Plan" section of the PP.

2.24 c. Competition with U.S. Exports and Intellectual Property Rights: Implementation of the project should not result in any serious competition with U.S. exports. In fact it is anticipated that CTD programs in helping Indian companies serve indigenous markets, will create a positive demand for U.S. goods (capital equipment, components) and services (technical assistance, training).

2.25 In the area of Indo-U.S. S&T cooperation, the question of Intellectual Property Rights and adequate protection of those rights is becoming increasingly important. However, it is not the goal of this project to foster the creation of intellectual property or the transfer of technology through S&T cooperation. Rather the CTD project is envisioned as primarily an effort in development and coordination of local technology resources. CTD sponsored activities will support the integration of Indian developed technology into the Indian market and focus on developing commercially applicable indigenous technologies.

2.26 Notwithstanding the above, to ensure that the issue of Intellectual Property Rights is sufficiently addressed, the Proposal Selection Criteria to be used by the CTD to evaluate and approve proposal for project funding will include criteria assuring adequate protection of Intellectual Property Rights.

2.27 d. Proposed Level of Technical Assistance (TA): The details of the methods to be used in contracting and approving TA and Training is described in the "Procurement and Contracting" section of the PP. The Detailed Project Description includes a thorough exposition of the TA and Training requirements to be financed by the project. Therefore, the GOI's signing of the Project Agreement will serve as an indication that USAID/I and the GOI have come to agreement and there is full understanding of the level and type of TA and Training that will be funded by the project.

2.28 2. PID Concerns: The "additional guidance for PP development" provided in the AID/W PID approval cable has been addressed as follows:

2.29 a. Funding Mechanism and Budget: The funding mechanism and budget are outlined in section IV. of the PP, "Financial Plan."

6.30 b. Private Sector Participation: Evidence of Private Sector participation in CTD planning, activities, and program funding is an important criterion that will be used to develop and review proposals for project funding. The idea of having more explicitly Private Sector membership on the Governing Board of the CTD has been incorporated into the Project Agreement as a covenant. The current Board, on which three of the six members are from the Private Sector, reflects an appropriate mixture of institutional representatives from business, academia, finance, and government. The covenant in the Project Agreement indicates that this mixture will be maintained or improved during the life of the project. In addition, the Chairman of the Bangalore Chapter of the Indo-American Chamber of Commerce will participate in Focus Group activities and thus the Chamber will continue to play a useful role in facilitating contacts between Indian and U.S. firms generated through CTD activities.

2.31 c. Small Scale Business Participation: The SRI Report (See Annex P), based on four person months of interviews with Bangalore business and government leaders, indicates an extremely strong demand by small scale industry for the types of services anticipated to be coordinated through the CTD. Evidence of sufficient and appropriate demand and description of anticipated clientele are criteria for proposal evaluation. "Crowding out" of services by large companies is not anticipated to be a problem, as the role of the CTD is to serve small and medium sized companies with large companies generally having their own internal applied R&D capability. Also, the industries served by the CTD are characterized by an abundance of small and medium sized, relatively young firms. If large scale firms demonstrate interest in CTD funded projects and there is room or cause for such participation, Service Fees will be charged on an "ability to pay" basis.

2.32 d. Training: Training Programs funded by the project will focus on widely applicable skills and educational manpower requirements, e.g. training design engineers to use Computer Aided Design (CAD) equipment. Even if training provided to industry is of a general type which is characterized by market externalities, employers will be expected to pay a portion of the costs. If training programs evolve that provide training specific only to a certain company, the company will pay at least the full cost of providing the TA required to initiate the training programs.

2.33 e. Monitoring and Evaluation: The project design team included a monitoring and evaluation specialist. Her report is included in Annex K and summarized in Section IV. "Implementation Plan" of the PP.

E. Project Design Team: The Project Design Team consisted of the following individuals:

R. W. Beckman, TD&E (Chairman)
R. K. Berry, TD&E
K. Walesh, TD&E (summer intern with USAID/I)
K. Jones, TD&E (PSC)
H. Iyer, CO
J. Perianayagam, PRJ
S. J. Freundlich, PRJ

Consultants that assisted the Team's efforts included:

J.O. Gollub, SRI International
A. Puri, Price Waterhouse
K. Anderson, Washington Consulting Group
R. Fehnel, National Association of Schools of Public Affairs and Administration, NASPAA

III. DETAILED PROJECT DESCRIPTION

3.00 A. Goal: The project will contribute to the broad S&T sector goal of accelerating the pace and improving the quality of technology application to product and production process development in existing and new business in industry, health, agriculture, and in other areas important to Indian development.

3.01 B. Purpose: The purpose of the CTD project is to stimulate the process of technology development and commercial use of that technology in India. The project's efforts will initially be focussed on the Bangalore area of Karnataka and will be achieved by providing support to develop and coordinate elements of theregion's technology infrastructure through the funding of: (a) Applied Technology Centers; (b) Human Resource training; and (c) the procurement of a variety of physical and technical resources.

3.02 C. Detailed Description: The following narrative provides a detailed description of how the various components of the project will function.

3.03 1. The CTD Organization - At the core of the CTD project is the establishment of the Center for Technology Development. The CTD, registered under the laws of the state of Karnataka on June 27, 1988 as a nonprofit, autonomous institution, will stimulate and coordinate technology activities in the Bangalore area.

3.04 a. CTD Functions include the following: (i) serve as an intermediary planning and oversight body for identifying and responding to technology infrastructure problems in India; (ii) as a facilitating organization, bring together leading representatives of industry, science and technology, and financial institutions to collaboratively perform analysis and planning for a specific program of near-term and medium-term technology infrastructure development and coordination initiatives; (iii) provide oversight in implementation of CTD sponsored projects and technology institution building initiatives, but will not, itself, receive support for technology infrastructure initiatives, other than planning; (iv) seek out and coordinate use of assistance from other foreign donors; (v) develop organizational capacity to contract both locally and overseas, to ensure adequate financial accounting and control, and to monitor CTD sponsored activities; (vi) insure that technology infrastructure development initiatives emphasize first and second level technology challenges supporting Technology Institution, Human Resource and/or Physical Resource Development; and (vii) initiate activities in institution, human resource, and physical resource development that focus on organizations that assist small and medium-sized enterprises, including suppliers.

3.05 b. The CTD Organization Structure: is comprised of a Governing Board, two National Committees, a Secretariat, and Industry Focus Groups (see Chart 1: Organization of CTD).

3.06 The Governing Board will have at least six members, representing the business, financial, academic and government communities. The Board will be chaired by the Chairman of the Indian Institute of Science, Bangalore, and will include the following members: Chairman, ICICI; the National President, CEI; the Chairman, IIM, Bangalore; the Chief Secretary, GOK; the Secretary of Industry and Commerce, GOK; and the Honorary Director of the CTD who will serve as Secretary of the Governing Board. The Board is expected to meet four times per year and will have two main functions. It will provide guidance to the CTD Secretariat and will review and approve proposals presented by the Secretariat under the USAID/I project.

3.07 Two nationally-oriented Steering Committees are planned to provide a forum for discussion of issues common to all states. The first will be comprised of the Secretaries of Industry and Commerce from all interested states. The Chairman of the IIM is expected to be committee chairman. The second committee chaired by the Chairman of the ICICI, will focus on venture capital. Membership will be open to members of all state Finance Corporations and Industrial Investment and Development Corporations.

3.08 The Governing Board is supported by a full-time Secretariat that oversees the day-to-day operations of the CTD. The Secretariat is under the leadership of the CTD Honorary Director. Including the Director, the CTD staff currently consists of only three persons. Nonetheless, it is expected that this staff will increase by at least two more over

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the life of the project. The Secretariat has four main functions: (i) Proposal Review; (ii) Contracting; (iii) Financial Accounting and Control; and (iv) Evaluation and Monitoring.

3.09 Five industry-oriented Focus Groups will develop proposals for CTD sponsored activities and channel monitoring data on these activities to the Secretariat. The Focus Groups are technical working groups made up of leaders from local industry, academia, and financial institutions. Groups are currently active in Informatics and Food Processing while groups in Industrial Machinery & Equipment, Chemical System Suppliers/Fabricators, and Dry Land Agriculture are expected to become active in the near future. It is anticipated that Focus Groups will meet at least once a month throughout the life of the project.

3.10 c. CTD Focus - Industrial Technology: The CTD's focus on industrial technology will concentrate effort on applications, rather than on basic research and development. Proposed activities will be driven by market concerns related to both existing and emerging industrial sectors. Five broad industrial areas have been suggested as likely beneficiaries of improved technology infrastructure in Bangalore. While these areas are by no means exclusive, they represent areas in which local strength and future prospects might develop more rapidly if technology infrastructure was enhanced. Moreover, most of these areas have strong potential for small and medium size industry development. These areas are: (i) Food Processing; (ii) Informatics (Computer hardware and software); (iii) Dry Land Agriculture; (iv) Industrial Machinery and Durable Equipment; and (v) Chemical System Suppliers/Fabricators. (For an analysis of current needs and prospects for growth in each industry, see section VI. D. of the PP, Economic Analysis).

3.11 d. CTD - Applied Technology Centers: One of the CTD's primary activities will be to support the development of Applied Technology Centers (ATC's). The purpose of an ATC is to provide a central facility where a specific industry can obtain required technical services. These services are likely to include: (i) technology applications research for specific product markets; (ii) product prototype development; (iii) production technology planning, including design of processes and manufacturing systems; (iv) market analysis and strategic planning for introduction of technology products; and (v) ATC's may also provide training.

3.12 The ATC's will be managerially and financially autonomous, though they are likely to be affiliated with an existing parent institution to maximize use of existing facilities

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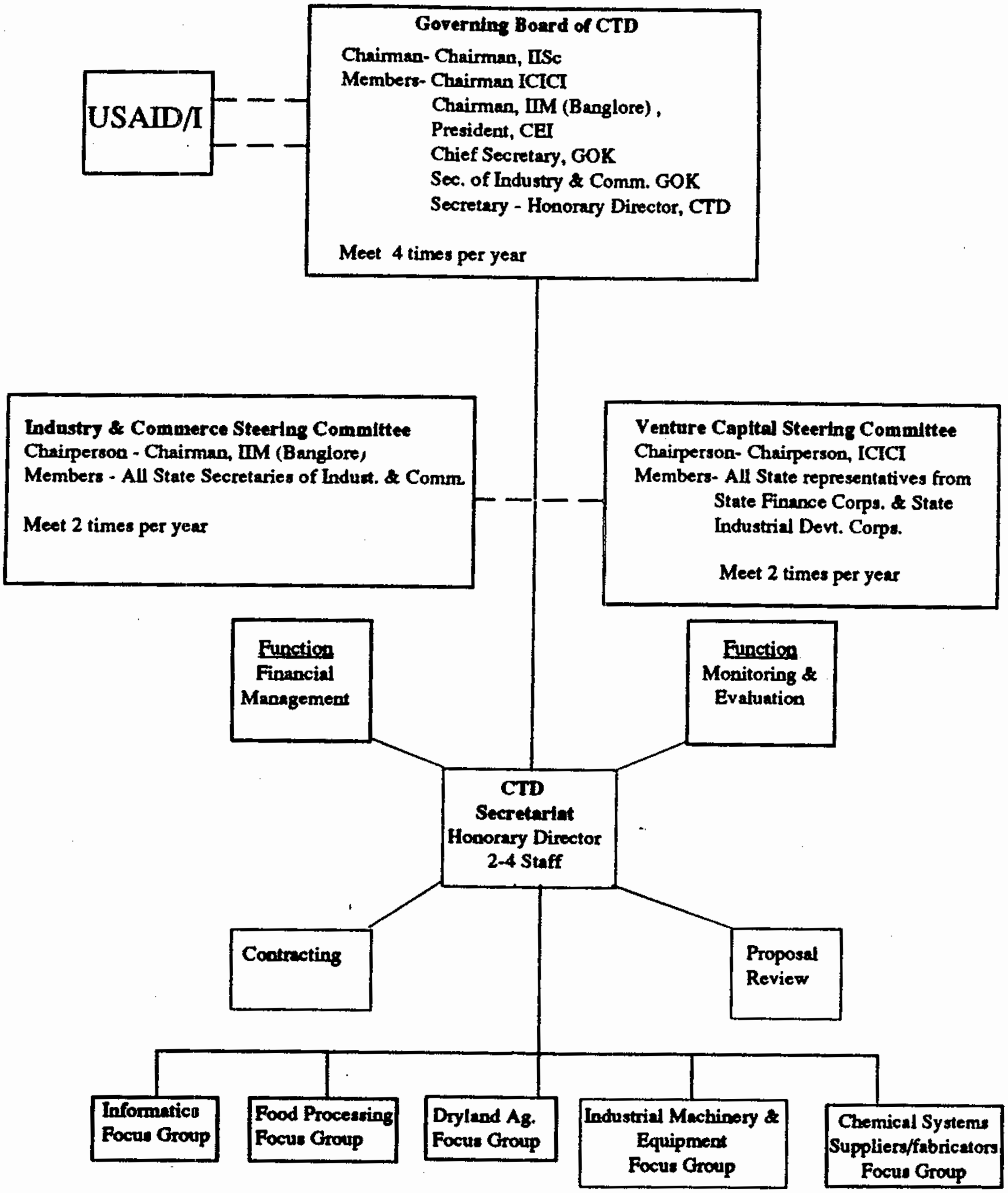
Chart 1 : ORGANIZATION OF CTD



and technical resources. The establishment of ATC's will not, therefore, involve the building of entirely new structures and facilities.

3.13 ATC operations and services will be financed by a broad combination of funding methods, including start-up funding from donor assistance programs, single or multiple business research contracts, government research contracts, sponsoring institutions (business or academic), other service and consulting fees, and profits or royalties from licensed products or technology. Public funding should be a minor part of operational support.

3.14 2. The Role of USAID/I: A.I.D. will provide up to $10 million in grant funding over a six-year period with an initial Fiscal Year (FY) 1989 obligation of $3 million. This contribution will serve both as a funding source to improve the functioning of the CTD as a regional technology clearing house and coordinator as well as a primer of specific technical advances. Examples of the kinds of activities that the project may support cover a wide range. e.g. training may be required for CTD staff, in order to ensure that the organization can handle its managerial responsibilities. If Focus Groups determine that an industrial sector is in need of an ATC, the project may support a "Mission and Scope Study" to determine the best way to operate, equip and finance such an ATC. Once an ATC is established, the project may finance procurement of specific pieces of equipment. If a Focus Group determines that an insufficient number of individuals are proficient in an important technical skill, the project may finance equipment for a local training course or support a program to train trainers either in India or overseas. The project may also finance required TA for the study of a particular technical problem that is hindering an industry. Therefore, project assistance falls into three major categories: TA ($3 million), Training ($2.5 million), and Commodity Procurement ($3.8 million).

3.15 The expected technology activities which the project may support can also be described in terms of the industrial technology infrastructure needs within specific technology levels. In these terms the CTD will focus on either first level technology (technology "off the shelf") or on second level technology (application or adaptation of existing technology tools). Third level technology (fundamental basic research) will not be a CTD focus, as it is longer-term and more loosely related to market needs (See Section V. of the PP, Implementation Plan, for examples of specific proposals likely to be submitted in the first year of CTD project).

3.16 3. Technology Infrastructure Activities: The technology infrastructure activities that are to be supported by the CTD project cover a wide range including:

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3.17 a. <u>First Level</u>: These activities include:

i) <u>Technology Institution Development</u> - Proposals can be submitted to form new technology applications and training organizations or to develop programs to meet industrial needs for first level technology factory manufacturing capabilities. The focus in these proposals should be on building organizational capacity to provide first level technology design and use capability (the emphasis here is on organizational development, not the training itself). For example, a manufacturing technology training program or focus could be formed within existing Technology Centers, industrial organizations or through affiliations with appropriate Institutions (e.g., a Continuing Education Program through IISc).

3.18 ii) <u>Human Resources Development</u> - Proposals can be submitted for the direct support of training and TA for development of capabilities in use of first level technology skills, such as design, fabrication, equipment operation, quality control and technology management across a variety of industries. Support can be available for: development of training curriculum; hiring expertise for conducting specific seminars either in India or at specified Training Centers in the U.S. or Europe; training trainers in specific disciplines at centers in India or overseas; holding seminars or conferences at a national or regional level to share developments in technology applications, with participation from domestic and overseas experts from industry and the applied research community; and provision of TA in organizing and implementing technical training and equipment setup.

3.19 iii) <u>Physical Resources Development</u> - Proposals for the purchase of equipment or for receipt of procurement services (e.g., specifications for equipment, shipping and installation) for first order technology training, as well as for use in demonstrating existing technology applications and processes will be eligible for project funding. Examples of equipment for training include: personal computers and software for training in technology management; CAD workstations and software for training in product engineering in equipment design, prototype product development and production equipment design; specific pieces of equipment to use in demonstration of manufacturing processes, including testing and evaluation equipment, actual manufacturing equipment (e.g., tool changers, industrial process controls, and food processing equipment). TA in equipment set up and integration into facilities will also be considered as part of the procurement for physical resources.

3.20 b. <u>Second Level</u>: These activities include:

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i) Technology Institution Development - Proposals are expected to help establish ATCs to address market gaps in R&D. These can be subsidiaries of, or affiliated with, parent institutions as long as the ATCs maintain managerial and financial autonomy. These institutions will be expected to focus on such activities as: technology applications research for specific product markets, under contract to firms or groups of firms; product prototype development for specific clients; production technology planning, including design of processes and manufacturing systems; and market analysis and strategy for technology products.

3.21 ii) Human Resources Development - ATCs and existing technology institutions (e.g., IISc) will be expected to submit proposals for TA and training in fields related to their mission. This will include support for: TA in specific fields of technology application provided by domestic or overseas technology experts from industry and research (e.g., experts in semiconductor design and fabrication, food processing technology, agricultural genetics, advanced materials systems); training for ATC staff at "centers of excellence" in India or overseas, including at Technology Centers, Industry, Research Institutions and Universities; study tours for ATC staff or industry staff that are clients or affiliates of ATCs, focusing on design of the ATCs and their working elements, including visits to Applied Research Institutes, Technology Parks, Technology Incubators, and Technology Commercialization and Management Programs in other countries; and development and implementation of training on-site through Technology Centers or affiliated institutions on applied technologies, product development, design and manufacturing, provided by domestic or overseas experts.

3.22 iii) Physical Resources Development - ATCs and other technology institutions will be expected to submit proposals for technical equipment and procurement services essential to their missions. Such proposals may include the procurement of: information technologies, such as computer work stations and software; product prototype development equipment, for eg., equipment for small-scale microprocessor and printed circuit development, gene splicing, separation and fermentation, precision machining, injection molding and extrusion, compression and lay-up, food cooking, extrusion and packaging; measurement, testing and evaluation equipment for electronics and machinery; and/or larger scale equipment, the cost of which could be shared by subscribers or shareholders from industry, possibly including a semiconductor foundry.

3.23 The project is expected to have an impact on both the overall regional technology process and on specific technological advances. The specific effects can be measured quantitatively by noting how many people are

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trained, how many businesses use the ATC's, how many ATC's are established, and how productivity has increased. Assessing the project's effect on the technology process will be more difficult. Nonetheless, if all the indicators related to specific industries are improving, it is assumed that the CTD initiated process as a whole is improving. Thus the functioning of the CTD will signal improved communication in the technology community. Increased membership in CTD will also indicate industries' interest in using technology to their benefit. Efforts will be made during baseline studies to identify benchmarks that will indicate progress in the S&T process. (**NOTE:** Additional details related to the measurement of success of the project are provided in Annex A: Logical Framework and in Annex K: Detailed Monitoring and Evaluation Plan of this PP).

3.24 4. Relationship of USAID/I Funds to Support by Other Donors: An important function of the CTD is to seek out and coordinate assistance from the foreign donor community. By assuming this role, the CTD will help centralize efforts to attract technology development funds to the Bangalore area and help ensure that outside funds are used strategically and efficiently.

3.25 Project funds will provide TA to help the CTD write proposals for donor funding. In effect, in the early years, project funds will be used to leverage other donor contributions. For example, in the first year the CTD may use project funds to finance "Mission and Scope Study" that will result in a detailed implementation plan for an Informatics ATC. The CTD can then present this plan to foreign donors such as the Canadian government, who have expressed an interest in funding such an Informatics ATC to develop software applications for the railways, banking, and telecommunications industries.

3.26 The CTD project will finance the development of the CTD and its initial programs. Although other foreign donor assistance may prove to be helpful in enhancing the success of specific CTD activities, such assistance does not represent a formal cofinancing arrangement which is essential to the success of CTD project. Recognizing this, USAID/I will encourage other foreign donors to contribute to CTD sponsored projects and CTD, in turn, will provide USAID/I with information on foreign donor activities in its quarterly administrative reports.

3.27 5. The Proposal Selection Process: At the beginning of or prior to each phase of the project (See Implementation Plan Section V. of the PP), the CTD Secretariat will submit an Action Plan to USAID/I. The Action Plan will list and briefly describe those activities for which proposals for project funding will be developed in the coming year. The Plan must include activity cost estimates and anticipated financing for

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associated costs that the project can not pay. For example, requests for project funding of equipment must include financing sources for excise taxes and custom duties. The TD&E Office of USAID/I will review and approve the Action Plan and initiate the actions needed to earmark/commit project funds for approved activities.

3.28 Focus Groups will develop proposals for project funding, either by themselves or with outside TA. Each proposal must address the following Selection Criteria that have been developed cooperatively by USAID/I and the CTD leadership.

3.29 a. Overall Economic Rationale - Each proposal must discuss how the actions and results anticipated fit into broad trends in the regional economy. Each proposal should start by establishing the basic rationale for the initiative, including an assessment of its economic (as opposed to financial) feasibility. The focus should be on the strategic objectives for developing the specific industrial sector of the economy to be assisted. Discussion should provide an overview of the industrial sector that is the focus for the activity, the trends in the sector and the forces shaping it within the region, nationally and internationally, that relate to the need and opportunity for action.

3.30 b. Market Demand - Each proposal will be reviewed in terms of how well it demonstrates market demand for the action to be supported. Proposals will need to document the fundamental need for the proposed activity based on a mismatch between demand and supply, and the emergence of new technology needs. The need must be based on an assessment of the requirements of industry for which the existing private sector marketplace or set of existing public sector institutions are not able to provide suitable quality or sufficient levels of technology resources.

3.31 The level of documentation required should be proportional to the level of effort and financial support involved in the proposed activity. For example, a proposal for ATC development efforts will require a higher level of market analysis than will a proposal for a one time training program or purchase of a single piece of equipment.

3.32 i) ATC Development Proposals - should be based on a Mission and Scope Study that is analogous to preparation of a Business Plan for a new business to be financed by investors. Initial proposals should be for the Mission and Scope Study, rather than for the Center itself. (For examples of issues typically addressed by an applied technology center mission and scope study, see Annex F of the PP). Those involved with preparation of the Mission and Scope Study should be prepared to document the nature

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of business demand, both current and expected. For example, an ATC, like a business, will need to serve the special needs of anticipated clients. These needs should be identified, and, if current demand is unclear (e.g., some companies are not used to buying technical services in some fields, such as informatics or food processing), then the Mission and Scope Study will need to demonstrate how market resistance will be overcome. Attention must also be given to documenting existing sources of supply and why they are not responsive to market needs.

3.33 ii) Human Resource Development Proposals - should be based on an assessment of both the current level of technical competence in specific technical fields and expected growth that cannot be met by current supply. Sources of documentation do not need to be highly rigorous, but should be premised on estimates of categories of skill needs of corporations in the sector that would benefit from training provided. Again, documentation of the inadequacy of existing public training or corporate training resources is important to help justify new programs. Overall, proposals for Human Resource Development should reflect a broader perspective on the trends in skill need at various levels and should show, to the extent feasible, a coordinated approach that avoids fragmentation and duplication of effort.

3.34 iii) Physical Resource Development Proposals - should be based both on an analysis of the demand and supply for the required types of equipment, i.e., CAD equipment. However, the proposal should also focus on the strategic use of the equipment, as equipment that exists may not be accessible to specific programs. Planned procurement approaches should also be provided. For example, while some equipment is available in India (e.g., Personal Computers and minicomputers), other equipment is only available overseas, or on a custom design basis and therefore will require relatively unique procurement plans. In addition, where there is an opportunity for a larger scale procurement of equipment that can be used by more than one program or set of small-scale industry participants, this should be reviewed.

3.35 c. Structure and Organization - Proposals will be reviewed for the coherence and soundness of the activity's overall organization. Proposals need to discuss: (i) basic assumptions for ATCs and programs; (ii) administrative structure; (iii) program structure, including the role of key actors, primary objectives, work plan, staffing, management support structure, laboratories and facilities; (iv) ATC or program clients and characteristics; (v) sponsors; (vi) budgets; and (vii) sources of revenue. It is anticipated that additional details will be made available for ATC development proposals subsequent to the completion of an appropriate Mission and Scope Study.

3.36 d. <u>Business Participation</u> - Proposals will be reviewed in terms of the extent and quality of business participation in proposal development, proposed activities and activity financing. Proposals should describe how Private Sector representatives participated in the proposal generation process. Proposals should discuss the extent to which activities will emphasize financing by the Private Sector and specific clients. Proposals for ongoing training programs and for ATC support should outline their initial and medium-term financial structure, including pro-formed projections with expected sources of revenue. If totally market-based financing of programs and services is not feasible for small and medium scale industries, the proposal should discuss methods of financing their participation.

3.37 e. <u>Autonomy of Proposed Institutions</u> - Proposed institutions are expected to be independent organizations. They may be subsidiaries of other institutions, but they must have their own chairperson and board. They may be for-profit or not-for-profit registered societies. The operation of each institution must be under the control of its owners and managers. Autonomy is not a criteria for training programs or a requirement for equipment proposals.

3.38 f. <u>Emphasis on Use and Adaptation of Existing Technology</u> - Proposals are expected to focus on making the most use of existing technologies and adapting them to applications for Indian markets. Proposals that stress advanced research or technology research without a specific market are unlikely to be supported.

3.39 g. <u>Utilization of "Best Practices"</u> - To maximize the competitive relevance of technology initiatives, all proposals for development of institutional capacity, human resources and for purchase of equipment need to be based on a high-level of familiarity with "state-of-the-art" and "best practices" in each area of technology activity. Proposals will be expected to demonstrate how the most current understanding of technologies and their use will be developed.

3.40 Proposals need to document how experts from India will work with sources of TA in India and overseas to plan and implement technology activities. Proposals should specify methods, such as study tours, international conferences and symposia, use of consultants, TA from technology organizations, use of technology information systems, and equipment vendors.

3.41 Proposals need to specify sources of the information and TA to be utilized. Examples of arrangements could include A.I.D supported TA agreements with U.S. technology institutions or consulting organizations that would provide direct planning and TA, as well as coordination of access to a broad range of global information or technology initiatives (e.g., technology institutes, applied technology programs, specific technology trends, and technology vendors).

3.42 h. Intellectual Property Rights - Since the basic goal of this project is technology coordination, it is unlikely that the issue of allocation and protection of U.S. intellectual property rights will arise. However, in the event that some of the TA required in coordination efforts is proprietary in nature, that particular exchange will be reviewed during proposal evaluation to see if such a proposal is appropriate for project funding.

3.43 i. Environment/Health - The proposal must indicate if the proposed activity could have adverse effects on the environment or on consumer's health. For food processing and other health related activities, activities must be consistent with Indian and/or World Health Organization policies related to product and product use and their impact on health.

3.44 Proposals developed with attention to the above Selection Criteria will be delivered to the CTD Secretariat. The Secretariat will review the proposal for compliance with project funding Selection Criteria and coordination with the overall Action Plan and will determine and obtain additional technical review if it is required. After review, the Secretariat will present the proposals to the Governing Board, which will review and approve groups of proposals at its quarterly meeting.

3.45 The Secretariat will forward proposals approved by the Governing Board to TD&E Office of USAID/I for administrative review and approval focussed on: compliance with Selection Criteria; acceptability in regard to A.I.D. regulations and policies; and coordination with other USAID/I projects or programs. After approval, USAID/I will send a letter of concurrence to the ICICI with a copy to CTD Secretariat. (**NOTE:** For information on contracting procedures, see Section V., Implementation Plan of the PP).

3.46 Areas that are unacceptable for funding under the CTD project include activities related to: Defense, Aerospace, Nuclear, Weather Modification or other areas in which there are not economically significant concentrations of industry.

IV. FINANCIAL PLAN

4.00 The total budget of the project over its six-year life is estimated to be $17.45 million. Of this total, A.I.D. will provide a grant of $10.00 million (57%) and the Host Country will provide the balance $7.45 million (43%). The Host Country contribution is

4.04 3. <u>Commodities ($3.8 million)</u> - Project funded commodity procurement is estimated at $3.8 million, of which approximately $1.2 million will be local procurement and approximately $2.6 million is anticipated to be offshore procurement. Included in these estimates is the possible cost of contracting for Procurement Service Agency and other associate costs such as clearing, warehousing, and transport. Commodities will include equipment for ATCs, training programs, computer hardware and software, etc.

4.05 4. <u>Project Evaluations, Monitoring & Audits ($0.3 million)</u> - Project evaluations will be conducted during projects years three and six (see Section V. and Annex K of the PP for details). These evaluations will be implemented through contracts with appropriate institutional and/or through Personal Services Contracts. The evaluation team will consist of outside and local consultants, representatives of A.I.D. and CTD. The total cost of such Project Evaluations and Monitoring is estimated at $300,000, of which $200,000 will be in foreign exchange, contracted directly by USAID/I. The remaining $100,000 in local currency includes funding for any required Non-Federal Audits of the CTD.

4.06 5. <u>Other Costs ($0.4 million)</u> - One of the outputs of the project is Technical Information Exchange. It is anticipated that funding in this category will be used to obtain technical and commercial information from libraries, universities, and other organizations in the U.S. and exchange research findings/updates through satellite communication channels. The project envisages utilization of a satellite network on a time-sharing basis. Accordingly, this category of funding also includes the satellite time charges, royalties/fees payable to obtain copyrights and local printing and distribution costs of these materials and the anticipated Focus Group expenses for conducting appropriate Mission and Scope Studies. The budget for this line item is estimated at $400,000, of which approximately $300,000 will be in foreign exchange and $100,000 in local currency costs.

4.07 B. <u>Host Country Contribution:</u> The Host Country will contribute approximately $7.45 million. This contribution will include $225,000 from the GOK; and $225,000 from private sources to fund CTD operations costs. In addition, the private industry groups will be providing an estimated $7 million (Rs.100.0 million) of in-kind contributions.

4.08 1. <u>Recurrent Costs</u> - The recurrent costs of the CTD are estimated at Rs.1.0 million ($75,000) per annum which will be met from funds made available from two sources. Fifty percent of the recurrent expenditure will be met by the GOK from its annual budgetary allocation and the remaining fifty percent will be met from the funds to be raised by the CTD through membership and service fees. Project funds will not finance any part of the CTD's recurrent costs.

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comprised of $225,000 each to be provided by the GOK and private industry associations to fund the operating expenses of CTD and $7.0 million of in-kind contributions. Additionally, but not included in these estimates because of its contingent nature, is the ICICI sponsored Venture Capital Fund of Rs. 200 million or $15.4 million to be availabe for support of CTD sponsored proposals which reach a "bankable" stage. Also note that the OECF of Japan is expected to provide the equivalent of $25 million to the Karnataka State Finance Corporation to finance new high-tech start-ups in Karnataka. While this project's success does not depend on either funding source the greater likelihood of such money being available for high-tech start-ups and significant expansions on account of CTD represents the synergetic aspect of this activity we are most interested in seeing reach maturity. TABLE 1 below is a Summary of Budget Estimates by Project Components and Source. TABLE 2 shows the time phased project Financial Expenditure for each U.S. fiscal year by source of funding. TABLE 3 shows Costing of Project Inputs and Outputs by source of funding and TABLE 4 shows Methods of Implementation and Financing of the project.

4.01 A. A.I.D. Contribution: The major components of A.I.D. financing are: TA; Training; Commodity Procurement; Monitoring and Evaluation; and Other Project Specific Costs.

4.02 1. Technical Assistance ($3.0 million) - The project provides for an estimated 75 person-months of U.S. and Third Country TA and an estimated 375 person-months of local TA (institutional and PSC). Both the long and short-term TA will continue throughout the project's six year life. The total estimated cost of $3.0 million has been arrived at using a 1987 base cost of $18,000 per person-month for U.S. and Third country TA and $3,000 per person-month for local TA. These estimated costs were inflated at an annually compounded rate of 10% over the LOP. The cost per person-month computed above includes a provision for overheads, in the case of institutional contracts.

4.03 2. Training ($2.5 million) - Training, both short-term and long-term, will be conducted in U.S./Third Countries and in India. The project provides for approximately 80 person-months of U.S. and Third Country training and approximately 425 person months of local training. The training, as in the case of TA, will continue throughout the project's six year life. The total estimated cost of $2.5 million has been arrived at using 1987 base estimates of $8,000 per person-month for U.S./Third Country and $3,000 per person-month for local training, inflated at an annually compounded rate of 10% over the life-of the-project (LOP). The cost per person-month computed above includes tuition, per diem, transportation, and materials. Funding is also included for a number of in-country workshops/ seminars. The number of such workshops/seminars to be conducted in different focus areas will have to be determined collaboratively as events unfold over the LOP of the project.

4.09 The CTD will solicit membership from businesses, business associations, educational institutions, and financial institutions. The onetime membership fee for the different groups is fixed as follows: Small industry - Rs.1,000; Large industry - Rs.10,000; and Institutional/Patron - Rs.50,000. It is estimated that approximately 100 members from small industry (including individuals), 50 members from large industry, and 20 members from institutional/patron groups will be enrolled initially. The membership fees will be invested and the income earned will be used to meet the recurrent costs of CTD. Businesses and entrepreneurs using CTD services and facilities, such as the ATCs and training programs, will be charged between 50% and 100% of the cost of such services.

4.10 2. <u>In-Kind Contributions</u> - Private Users of CTD's services are <u>being expected to</u> carry significant costs including staff costs, imputed values of use of laboratory, training and other facilities, management contributions and general "running" costs. These in-kind contributions by private industry groups have been quantified as approximately $7 million over the Life of Project. Significant local cost sharing by the users of CTD's services is required for the activity to work. The CTD is financing only its own recurrent core costs and AID is financing primarily "off-shore" costs and some local training. (See para 4.02 to 4.06).

4.11 3. <u>Venture Capital Funds</u> - ICICI's contribution of $15.4 million <u>as a Venture Capital</u> Fund for business development projects sponsored by CTD, will be made available through its subsidiary, the TDICI. The $15.4 million represents initial share capital raised for TDICI. By March of 1990, this share capital is expected to be increased by an additional $20 million. This additional capital can also be made available for CTD sponsored business development projects subject to demand.

4.12 This TDICI Venture Capital Fund is also expected to be supplemented by a contribution from the World Bank ($20 million) and by a $40 million contribution from the ICICI which consists of a $20 million matching contribution fund and a $20 million loan fund. (**NOTE:** For more detailed information on use of the TDICI funds see "Institutional Analysis ICICI/TDICI" in Annex R of the PP).

4.13 Based on the average size of ICICI's previous Venture Capital Financing proposals (approximately $500,000 or Rs.7 million), it is anticipated that the TDICI fund will support about 30 new entrepreneurial activities from out of various focus areas during the LOP subject to "bankable" proposals being presented.

4.14 It is also envisaged that funds from other foreign donors will be provided to the CTD for its technology promotion activities. Although the levels of funding from such sources are presently

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not known, the CTD estimates that up to $44.85 million may be provided over the life of the CTD project. Present estimates of such possible contributions include: U.K.(ODA)-$3.50 million; West Germany-$3.00 million; Canada-$3.00 million; UNDP-$0.35 million; The World Bank-$10.00 million; Japan (OCEF)-$25.00 million.

4.15 C. Reimbursement - The ICICI will initially provide the CTD with an Advance of funds equal to the estimated expenditure for the eligible project costs for a three month period. Prior to the end of the initial three month period the CTD will submit to ICICI a Quarterly Statement of Expenditures showing: (a) the opening balance of Advance; (b) the actual expenditure during that quarter; (c) the balance of advance still available; (d) requirements for the next quarter; and (e) the additional advance requested, which will be (d) minus (c). The ICICI will provide the CTD with the requested Advance within two weeks of receipt of the Quarterly Statement of Expenditure. ICICI will in turn prepare a Quarterly Statement of Expenditure and forward it to USAID/I to claim reimbursement.

4.16 D. Audit - The CTD will be required to maintain separate books and records related to the utilization of the A.I.D. grant funds. These shall provide records of the activities financed under the Project relating to the administration, monitoring and evaluation of the project; the nature and extent of the solicitation of prospective suppliers of required goods and services; the basis of awarding Host Country (HC) contracts; and the overall progress of the project. The CTD will also be required to establish a system for contracting, audit, and payment verification procedures in line with A.I.D. requirements and GOI/GOK guidelines. The books and records of the CTD will be audited by a Chartered Accountant at the end of every financial year. In addition, the CTD's books and records will also be available for inspection and audit by A.I.D. Inspector-General. A.I.D. funding for the project includes the provision of approximately $100,000 for Non-Federal Audits.

4.17 The ICICI is a public financial institution registered under the Indian Companies Act of 1956. The various books and records to be maintained are laid down by the statute. Under Section 226 of the Companies Act, the ICICI is statutorily required to have its accounts audited by a Chartered Accountant every year. Therefore, project funds will not be allocated to finance a Non-Federal Audit of the ICICI. A.I.D. will, however, have access to all ICICI's records and operations pertaining to the project. To assist A.I.D. in evaluating the success of strenghtening the capacity of the CTD to achieve the purpose and goal of the project, the ICICI will also periodically provide A.I.D. with information and reports on activities that are financed under the Venture Capital Fund.

TABLE 1
ILLUSTRATIVE SUMMARY OF PROJECT BUDGET
($000)*

COMPONENT	A.I.D. FX	A.I.D. LC	HOST COUNTRY ICICI or LC**	HOST COUNTRY GOK LC	PVT.SECTOR IND ASSO. LC	TOTAL
Technical Assistance	1,500	1,500	-	-	-	3,000
Training	800	1,700	-	-	-	2,500
Commodities	2,600	1,200	-	-	-	3,800
Project Evaluation Monitoring & Audits	200	100	-	-	-	300
Other Costs	300	100	-	-	-	400
CTD Mgt. & Adm.	-	-	-	225	225	450
In-Kind Contribution	-	-	-	-	7,000	7,000
Venture Capital Fund**		-	-	-	-	-
	5,400	4,600	-	225	7,225	17,450

NOTE: A.I.D. funding for the above Illustrative Budget is subject to the availability of funds in accordance with the A.I.D. OYB/allotment process.

- The (*) indicates that the rate of exchange used in developing these estimates was $1.00 = Rs.14.00

- LC represents the Local Currency Costs of the project.

- FX represents the Foreign Currency Costs of the project.

** ICICI has capitalized the TDICI Venture Capital fund at Rs. 200 million or US $ 15,400,000. This money will be made available for "bankable" venture proposals which flow from the CTD process. Additionally other venture capital funding is being put in place in Karnataka (see para 4.14). However, these funds while supportive of project objectives, are not considered by USAID to be a direct Host Country contribution to this project.

TABLE 2

TIME-PHASED PROJECT FINANCIAL EXPENDITURE (US FY)
In $000

SOURCE	FISCAL YEARS 1989	1990	1991	1992	1993	1994	1995	TOTAL
A.I.D.	-	500	1,500	3,000	2,500	1,500	1,000	10,000
Host Country	-	75	75	75	75	75	75	450
Private Industry Groups in-kind Contributions	-	-	700	1,400	2,100	2,100	700	7,000
TOTAL	-	575	2,275	4,475	4,675	3,675	1,775	17,450

TABLE 3

COSTING OF PROJECT INPUTS & OUTPUTS
In $000

PROJECT INPUTS	PROJECT OUTPUTS* (ATC/CTD) FX	(ATC/CTD) LC	(HRD) FX	(HRD) LC	(TIE) FX	(TIE) LC	(PS) LC	SUB-TOTAL FX	SUB-TOTAL LC	TOTAL AMOUNT
A.I.D. FUNDS										
Technical Assistance	750	750	750	750	-	-		1,500	1,500	3,000
Training										
U.S./Third Country	350	-	450	-	-	-		800	-	800
In-Country	-	650	-	850	-	200		-	1,700	1,700
Commodities	1000	500	1400	600	200	100		2,600	1,200	3,800
Others Costs	-	-	200	100	300	100		500	200	700
Sub-Total	2100	1900	2800	2300	500	400		5,400	4,600	10,000
HOST COUNTRY FUNDS										
Govt. of Karnataka		225							225	225
Industry Assns.		225							225	225
H.C. Private Organizations							7,000		7,000	7,000
Sub-Total		450					7,000		7,450	7,450
GRAND TOTAL	2100	2350	2800	2300	500	400	7,000	5,400	12,050	17,450

*ATC = Applied Technology Centers
TIE = Technical Information Exchange
PS = Project Support Costs
HRD = Human Resource Development
CTD = Center for Technology Development

TABLE 4
PROPOSED METHODS OF IMPLEMENTATION OF FINANCING

($000)

Method of Implementation	Method of Financing	Approx. Amount
TA (US) -HC Contracts*	Direct payment	1,500
TA (Local) - HC Contracts	HC reimbursement	1,500
Training (US) - HC Contracts*	Direct payment	800
Training (Local) - HC Contracts	HC reimbursement	1,700
Commodities (US) HC Contracts*	Direct payment	2,600
Commodities (Local) - HC Contracts	HC reimbursement	1,200
Others (US) - HC Contracts*	Direct payment	500
Others (Local) - HC Contracts/Direct Contracts	HC reimbursement/ Direct payment	200
TOTAL		10,000

*In exceptional cases there might be some direct A.I.D. contracting.

V. IMPLEMENTATION PLAN

5.00 A. Illustrative Anticipated Sequence of Events: The following is an illustrative description of the implementation steps arranged sequentially. The Life of Project (LOP) is divided into three phases and a tentative time frame has been indicated. (See the following Implementation Chart).

5.01 1. Phase I: Phase I will run for the Project's first 18 months (from October 1, 1989 to March 31, 1991). During this phase the project will focus basically on "HRD & Technical Studies" and will cover activities such as CTD staff orientation, Trainers' Training and Mission Scope Studies (MSSs).

5.02 2. Phase II: Phase II of the project will run for the next 24 months (from April 1, 1991 to March 31, 1993). It will be primarily a "Technology Institution Development Phase" and will focus on establishing Applied Technology Centers as support bases for prototype development, production design, etc. The efforts of the CTD and the ATCs in this phase to actively coordinate different technology infrastructure resources are likely to lead to setting up new ventures and/or start-up firms.

5.03 3. Phase III: Phase III of the project will run for the final 30 months (from April 1, 1993 to September 30, 1995). It will be basically an "Intensified Technology Application Phase". In this phase, the ATCs, besides their product development work, will actively assist entrepreneurs in technology application attempts/ventures. In phase III, the CTD's focus will be not only on the ATCs but also on encouraging the development of new ventures to be supported through ICICI Venture Capital Fund.

5.04 The following is a listing of the various activities that are anticipated during the three phases of project implementation:

LIST OF ACTIVITIES

PHASE I

1. USAID/I SENDS BASIC PIL & APPROVED GUIDELINES TO CTD	1 Oct-29 Nov '89
2. FOCUS GROUPS COMPLETE BASELINE SURVEY	1 Oct-30 Mar '90
3. FOCUS GROUPS COMPLETE PHASE I ACTION PLAN	1 Oct-30 Jan '90
4. CTD MEETS CONDITIONS PRECEDENT/CTD STAFF IN PLACE	30 Nov-27 Feb '90
5. CTD SENDS QUARTERLY ADMINISTRATIVE REPORTS TO USAID/I	31 Dec all quatrs
6. USAID/I'S QUARTERLY MONITORING REPORTS	31 Dec all quatrs
7. CTD APPROVES & SENDS PHASE I ACTION PLAN TO USAID/I	31 Jan-27 Feb '90
8. USAID/I REVIEWS PHASE I ACTION PLAN & CONCURS	28 Feb-30 Mar '90
9. TRAINING FOR CTD STAFF IN AID PROCEDURES/CONTRACTING	28 Feb-30 Mar '90
10. BASED ON ACTION PLAN CTD PREPARES NEAR-TERM PROPOSALS	31 Mar-30 May '90
11. USAID REVIEWS SPECIFIC PROPOSALS & ISSUES PIL	31 May-29 Jun '90
12. CTD IMPLEMENTS NEAR-TERM PROPOSALS (e.g. given below)	30 Jun-30 Dec '90
-Seminars, & Study Tours for CTD & other personnel	
-Preliminary Training Schemes	
-Hire T.A. for MSSs	
-Procure Equipment for Training & Demonstration	
13. COMPLETE MSSs	31 Jul-30 Dec '90
14. BASED ON MSSs CTD IMPLEMENTS OTHER PROPOSALS (e.g.)	31 Dec'90 ongoing throughout LOP
A. Procure Equipment for ATCs	
B. HRD/Curriculum Dev/Scholar-in Residence	
C. Trainer's & Other Training Using Local & US T.A.	
D. Start Applied Technology Centers (ATCs)	

PHASE II

15. FOCUS GROUPS' PHASE II ACTION PLAN/CTD APPROVES	1 Apr-29 Jun '91
16. USAID GIVES CONCURRENCE TO PHASE II ACTION PLAN	30 Jun- 1 Aug '91
17. CTD PREPARES PHASE II PROPOSALS FOR USAID FUNDING	2 Aug-30 Nov '91
18. USAID/I REVIEWS PROPOSALS/ISSUES PIL COVERING USAID/I FUNDS	31 Nov-30 Dec '91
19. CTD IMPLEMENTS PHASE II PROPOSALS (e.g.)	31 Dec'91 ongoing throughout LOP
A. CTD/ATCs Coordinate for New Ventures	-Do-
B. T.A. (On & Off) for Starting New Ventures	-Do-
C. New Ventures started/Increase Product Market	1 Apr'92 ongoing
D. On-Site Training(On & Off)for Various Personnel	1 Apr'92 ongoing
20. MID-TERM EVALUATION	1 Sep-30 Sep '92

PHASE III

21. FOCUS GROUPS' PHASE III ACTION PLAN/CTD APPROVES	1 Apr-29 Jun '93
22. USAID GIVES CONCURRENCE TO PHASE III ACTION PLAN	30 Jun- 1 Aug '93
23. CTD PREPARES PHASE III PROPOSALS FOR USAID FUNDING	2 Aug- 30 Nov'93
24. USAID REVIEWS PROPOSALS/ISSUES PIL COVERING AID FUNDS	31 Nov-30 Dec '93
25. CTD IMPLEMENTS PHASE III PROPOSALS (e.g. given below)	31 Dec'93 ongoing
A. Multi-Donor Effort for Research & Training	throughout LOP
B. Start more Ventures/Enhance Earlier Ones	-Do-
26. FINAL EVALUATION	1Sep'95-30 Sep'95

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IMPLEMENTATION STEPS	1989 SEP	Year 1 (A.I.D. FISCAL YEAR 1990) OCT NOV DEC JAN FEB MAR APR MAY JUN JUL..SEP	Year 2 (A.I.D. FY 1991) OCT DEC FEB APR JUN AUG SEP	Year 3 (A.I.D. FY 1992) OCT NOV DEC FEB APR JUN AUG SEP	Year 4 (A.I.D. FY 1993) DEC FEB APR JUN AUG SEP	Year 5-A.I..D. FY 94 OCT DEC FEB..JUN..SEP	Year 6 (FY 1995) DEC FEB..JUN..SEP
** APPROVE $10 M PP/SIGN PROAG/SEND DRAFT BASIC PIL	X						
PHASE I							
* 1. USAID FORMALLY ISSUES BASIC PIL/GUIDELINES TO CTD		XXXXXXXX					
* 2. FOCUS GROUPS COMPLETE BASELINE SURVEY		XXXXXXXXXXXXXXXXXXXXXX					
* 3. FOCUS GROUPS COMPLETE PHASE I ACTION PLAN		XXXXXXXXXXXXXX					
* 4. CTD MEETS CONDITION PRECEDENTS/CTD STAFF IN PLACE		XXXXXXXXXXXX					
* 5. CTD SENDS QUARTERLY ADMINISTRATIVE REPORTS TO USAID		X X X X	X X X X X	X X X X	X X X X	X X X X X	X X X
* 6. USAID'S QUARTERLY MONITORING REPORTS		X X X X	X X X X X	X X X X	X X X X	X X X X X	X X X
* 7. CTD APPROVES & SENDS PHASE I ACTION PLAN TO USAID		XXXXX					
* 8. USAID REVIEWS PHASE I ACTION PLAN & CONCURS		XXXXX					
* 9. TRAINING FOR CTD STAFF IN USAID PROCEDURES/CONTRACTING		XXXXX					
*10. BASED ON ACTION PLAN CTD PREPARES NEAR-TERM PROPOSALS		XXXXXXXXX					
*11. USAID REVIEWS SPECIFIC PROPOSALS & ISSUES PIL		XXXXX					
*12. CTD IMPLEMENTS NEAR-TERM PROPOSALS (e.g. given below)		XXXXXXXXXX	XXXXXX				
--Seminars; Study Tours & Orientation courses							
--Preliminary Training Schemes (entrepreneurship etc)							
--Hire T.A for Mission Scope Studies (MSSs)							
--Procure Equipment for Training & Demonstration							
*13. COMPLETE MSSs		13 XXXXXXX	XXXXX				
*14. BASED ON MSSs CTD IMPLEMENTS OTHER PROPOSALS (e.g.)			14 XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
A. PROCURE EQUIPMENT FOR ATCs			14A XXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
B. HRD/CURRICULUM DEV./SCHOLAR-IN-RESID. etc.			14B XXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
C. TRAINERS' & OTHER TRAINING USING LOCAL & US T.A.			14C XXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
D. START APPLIED TECHNOLOGY CENTERS (ATCs)			14D XXXXXX	XXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
PHASE II							
*15. FOCUS GROUPS' PHASE II ACTION PLAN/CTD APPROVES			15 XXXXXX				
*16. USAID GIVES CONCURRENCE TO PHASE II ACTION PLAN			16 XXX				
*17. CTD PREPARES PHASE II PROPOSALS FOR USAID FUNDING			17 XXXXXX	XXXXXXX			
*18. USAID REVIEWS PROPOSALS/ISSUES PIL COVERING AID FUNDS			18	XXXXX			
*19. CTD IMPLEMENTS PHASE II PROPOSALS (e.g.)				19 XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
A. CTD/ATCs COORDINATING FOR NEW VENTURES				19A XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
B. T.A. (ON & OFF) FOR STARTING NEW VENTURES				19B XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
C. NEW VENTURES STARTED/INCREASE MARKET FOR PRODUCT				19C XXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
D. ON-SITE TRAINING (ON & OFF) FOR VARIOUS PERSONNE				19D XXXXXXXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
*20. MID-TERM EVALUATION				20 XXXX			
PHASE III							
*21. FOCUS GROUPS' PHASE III ACTION PLAN/CTD APPROVES					21 XXXXXX		
*22. USAID GIVES CONCURRENCE TO PHASE III ACTION PLAN					22 XXX		
*23. CTD PREPARES PHASE III PROPOSALS FOR USAID FUNDING					23 XXXXXXX	XXXX	
*24. USAID REVIEWS PROPOSALS/ISSUES PIL COVERING AID FUNDS					24	XXXX	
*25. CTD IMPLEMENTS PHASE III PROPOSALS (e.g)					25	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
A. MULTI-DONOR EFFORT FOR RESEARCH & TRAINING					25A	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
B. MORE VENTURES STARTED/ENHANCE EARLIER ONES					25B	XXXXXXXXXXXXXX	XXXXXXXXXXXXXX
*26. FINAL EVALUATION							26 XX

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5.05 B. Anticipated First Year Proposals: Examples of types of proposals for CTD projects and for MSSs that might be submitted in the initial year of the CTD project may include the following:

5.06 1. First Level Technology:

a. Technology Institution Development: Examples of anticipated organizational development for first order technology include: (i) establishing technology information exchange; (ii) forming a bakery training program; (iii) establishing a biotechnology/technician training program; (iv) a MSS for upgrading and modernizing the State Government Industrial Training Institutes; and (v) preparation of a MSS for establishing a training institute for tool and die making for the electronics industry.

5.07 b. Human Resources Development: Examples of HRD initiatives likely to be proposed include: (i) implementing bakery training; (ii) orientation tours in food processing technology; (iii) miscellaneous orientation tours on industrial technology practices.

5.08 c. Physical Resources Development: Examples of likely proposals for equipment include: (i) personal computers and software for use in training programs on computer use and maintenance; (ii) computers and software for use in training public and private sector personnel in computer aided management practices; (iii) preparation of a MSS for planned equipment purchase and integration into a proposed program of training in use of CAD-CAM equipment (training to be supported by British aid through a new institute).

5.09 2. Second Level Technology:

a. Applied Technology Center Development: Proposals to prepare MSS for ATC's are expected in a number of areas including:

5.10 (i) Informatics Center - A center for informatics that is an independent entity affiliated with the Indian Institute of Science (IISc) will be proposed. This center is likely to have as its mission the provision of technology support to industry in the growing informatics field in India. Activities likely to be proposed include: applications research for clients in emerging information technology market areas (such as voice recognition); rapid product prototype development for industry clients; and product manufacturing technology assistance (focusing initially on silicon water fabrication and microprocessor production).

5.11 (ii) Food Processing Center - A Food Processing Technology Center is the likely to be proposed for development as an independent institution affiliated with the Central Food

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Research Institute. This center would emphasize a mix of first and second generation technology applications, as Indian food processing technology is at an early stage of growth and applications need to be adapted to Indian markets. This center would emphasize a range of activities including: provision of assistance in identification of markets and product development; assistance in design of manufacturing process equipment for producers; and assistance in prototype packaging for beta site testing in Indian markets. First level training activities, such as bakery technology and production, would be either through or in affiliation with this center.

5.12 (iii) Dry land Technology Center - A new center designed to apply a wide spectrum of technologies to the problem of improving dry land agriculture would be proposed. The institution would work in coordination with agricultural colleges in India, emphasizing direct applications to dry land needs. This center would bring biotechnology applications in tissue culture and protoplasm fusion to develop dry land tolerant strains of crop, as well as address first level technology solutions, by applying existing techniques to the specific needs of dry land cultivation.

5.13 (iv) Advanced Materials Centers - One or more proposals for developing advanced materials centers may be submitted. One proposal may be for a center on advanced polymer applications and fabrication. This center could be an independent subsidiary or an affiliate of the National Aeronautical Laboratory (NAL), building on its experience and expertise in fields of advanced plastics and composites. This center would provide product development, engineering, and production fabrication services to individual industries or groups of industries both in chemical systems and in plastics fabrication. The center would help to commercialize or license appropriate chemical systems, or specific production techniques and products. A second center may be proposed, at some point, focusing on applied ceramics technologies. This center would be part of a larger initiative funded by domestic and international assistance, stressing applications in heat, corrosion and water resistant ceramics, as well as in electronics.

5.14 b. Human Resources Development: The major requests for HRD support in the area of first generation technology are likely to be for assistance to the CTD Focus Groups as they prepare their proposals for CTD funding for MSSs. Specifically, the range of expected proposals include support to the Focus Groups:

5.15 (i) to assist in the initial development of technology center objectives, prior to preparation of MSSs;

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(ii) to organize and finance overseas Orientation Tours to visit specific Applied Technology Institutions;

(iii) to hold national/international seminars in applied technology;

(iv) for procurement of specific technology information and initial consultation from Advanced Technology Centers in India and overseas; and

(v) for direct support for local and overseas technological and industrial expertise in the preparation of MSSs for the ATCs. It is anticipated that there will be few proposals in the area of second order technology training during the initial stage of project implementation.

5.16 c. Physical Resources Development: The primary requests for assistance in the area of first order physical resources in the early stages of the CTD initiative are likely to be for CAD-CAM equipment for training advanced applied engineering skills, through the 8 module post graduate one year training program in the area of computer science for industry and educational institutions, to be provided by the IISc. The majority of other equipment requests are anticipated to be for support of first generation training programs (see previous discussion). However, requests for equipment for each institution will be developed in the course of preparing MSS statements. These requests will be for the set of engineering, product development, testing and evaluation equipment essential to applied research in fields of Informatics, Food Processing, Dry Land Agriculture, Industrial Machinery & Equipment, and Chemical System Suppliers/Fabricators.

5.17 C. Procurement and Contracting Procedures: One of the goals of the project is for CTD to become a fully operational organization, with the capability to handle all of its contracting requirements. Both the CTD secretary and the program assistant are experienced in GOI and GOK contracting procedures. They will head up the Contracting Cell of the CTD. The USAID/I Regional Contracting Officer will be able to provide training in A.I.D. contracting procedures as required. Specifications for procurements will be developed by the Focus Groups with assistance as required from the CTD.

5.18 The Contracting Cell will be fully staffed and approved by the Board of Governors by December 1989. Following training it is anticipated that the Cell will be fully operational by March 1990 and capable of handling all project contracting and procurement. It is further anticipated that very little contracting will be required prior to March 1990. The USAID/I Regional Contracting Officer will handle any procurements that will arise during this period.

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5.19 Where appropriate USAID/I will suggest minority or other eligible Gray Amendment firms to the CTD for consultancies and as agents for the procurement of imported commodities. In addition it should be noted that procurements of either goods or services to be financed under the project from other than U.S. or Indian source/origin will require specific waivers as outlined in the Project Agreement and also that the project funded procurement of any computers or related equipment in excess of $100,000 will require AID/W concurrence prior to approval of such procurements by USAID/I.

5.20 D. Monitoring and Evaluation: The CTD project design team included a monitoring and evaluation specialist. The consultant's "Detailed Monitoring and Evaluation Plan" is included as Annex K of the PP and is summarized below.

5.21 The monitoring and evaluation program to be used by the project will serve three purposes: (1) Identify how CTD-sponsored activities are affecting technology institutions, HRD, and physical and technical resource availability; (2) Identify problem areas that arise during implementation; and (3) Provide a record of activities that will help in the replication of the model in other states in India.

5.22 The monitoring and evaluation budget is $300,000. Of this amount, $200,000 in foreign exchange will be reserved for direct USAID/I contracts related to Project Evaluation. The remaining $100,000 will be used for local currency expenditures related to Project Monitoring and Audits. Although not mandatory, these L.C. expenditures may be incurred under direct AID contracts.

5.23 The Focus Groups will conduct appropriate base line surveys of their sectors during the initial phase of project implementation. The Monitoring Plan will focus mainly on the development of periodic reports and ongoing data collection by the CTD for USAID/I. In addition, the Implementation Plan includes notations for periodic site visits by the USAID/I Project Officer responsible for the oversight of the CTD project monitoring system. This officer will be a FSN in the Directorate of Technology Development and Enterprise. The CTD Secretariat will be responsible for collecting data from the Focus Groups and reporting to USAID/I on a quarterly basis. The Secretariat will determine the data reporting requirements for each CTD sponsored activity. Focus Groups will then channel data from the managers of activities in each industry area to the Secretariat as well as report on their own activities.

5.24 Thus, two types of data will be collected: (1) Information on Focus Group activities (e.g., number of meetings, number of proposals developed, number of seminars held or attended); and (2) Data on CTD-sponsored activities (e.g., results of post-activity questionnaires, types of equipment procured, data on

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individuals trained, and businesses assisted). CTD will establish a computerized database to record and summarize this data.

5.25 The project will be evaluated, at least twice, during years three and six by USAID/I using both outside and local consultants. The Mid-Term Evaluation will focus on the process of technology program coordination. (e.g. How smoothly is CTD operating? Are the proposals received by USAID/I of sufficient quality and quantity? Are the appropriate types of people involved in the proposal selection process and in project implementation? etc.) The Final Evaluation will examine both the technology process and project results.

5.26 The Evaluations will use as an empirical base the data described above. This information will be used to identify beneficiaries for case study. Interviews with representatives of target institutions in industry, academia, government, and financial institutions will help assess the CTD's impact on productive interaction among these groups.

VI. ANALYSES

6.00 A. Environmental: Pursuant to Sections 216.2(c) (2) (ii) and 212.2(c) (2) (X) of AID Regulation 16, it was determined prior to approval of the PID for the CTD project that a detailed environmental analysis was not required in connection with the design and implementation of the project. The project will support the goal of accelerating the development and use of indigenous technology primarily by financing HRD and technical innovation in industry. Thus, the project is not anticipated to have any direct negative environmental effects, such as soil erosion, water or air pollution, displacement of population, or destruction of flora and fauna. In actuality, a possible outcome of the technological innovation supported by the CTD project may be the improvement of Karnataka's environment due to less polluting production processes. However, to be certain that the CTD project does not provide funding for proposals that might have an adverse environmental or health impact, the proposal selection criteria require Focus Groups to exclude possible environmentally damaging proposals from the lists provided to the CTD for financing.

6.01 B. Energy: Though once a power surplus state, Karnataka is now energy deficient. Barring substantial investment, by the turn of the century Karnataka is projected to have a 65% energy deficit and, by 1990, will be struggling to meet even the energy requirements of its non-industrial sectors. With demand for electricity growing at over 9% per year, the state finds it increasingly difficult to expand its generation, transmission and distribution capacity to keep up with the demand. As a result, power shortages have become increasingly common, resulting in tremendous losses to the state economy. The CTD project, through its role as a catalyst for technology innovation, will encourage R&D efforts leading to more energy efficient production processes.

6.02 C. Technical: While there are substantial sources of advanced technology capability in India and in Bangalore, the depth of capability varies from industry to industry and across technology fields. Indian science, technology and industry experts do not have easy access to "State of the Art" technologies and "Best Practices" in industry and technology. This is particularly true in the area of development of market oriented Applied Technology Centers and associated technology enterprises, including: technology commercialization; technology parks; and technology based business incubators.

6.03 As a result, an important emphasis in the USAID/I supported CTD efforts is providing improved technology access. To achieve easy and enhanced technology access USAID/I will encourage CTD members, including the leaders of the various Focus Groups, to establish direct relationships with U.S. based technology institutions that are able to provide, assemble, or broker technological information exchange.

6.04 Such an intermediary relationship might be for general, crosscutting assistance, where multidisciplinary, market oriented technological capabilities exist in one institution. Or, the relationship could be specific to individual ATC developments. For example, the Informatics Focus Group might have a technical assistance relationship with a U.S. based organization with leading edge capability in electronics and computer technologies and in development of institutions in this field.

6.05 To the extent that leading U.S. Applied Research Institutions have the capacity to provide TA and information assembly and brokerage for Indian initiatives, it will be cost effective for them to do so, because of savings of time and effort for the CTD Focus Groups. Where the Group has limitations in technical information, expertise in specific production technologies, or in training capability, U.S. institutions would be called upon to arrange appropriate Study Tours, training and TA from university programs or from private firms (e.g., equipment companies).

6.06 USAID/I might initiate an agreement with one or more U.S. Technology Institutions to provide appropriate TA to the CTD. Such an agreement would provide a designated minimum level of effort over a given period of time and permit the CTD to request of a number of specific tasks or projects on technology issues, within a specified time frame (similar to a Task Order Agreement or an Indefinite Quantity Contract). Within such agreements the prime provider of technology services could then arrange for consultative services, training, or procurement of equipment for the CTD from other institutions.

6.07 Technology information services provided would not be likely to encounter any restrictions, unless involving proprietary technologies. Where these are involved licensing arrangements would be required. Technologies subject to national security

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restrictions would not be subject to transfer. These same arrangements would apply to any service equipment vendors that would work with the CTD.

6.08 D. Economic:

1. Consultants' Economic Analyses: Two studies on technology and economic development in the State of Karnataka provide extensive analysis of current and future technology needs for economic growth. The first, "Technology Development on a State Level Focused on National Goals: a Concept Paper Applied to the State of Karnataka" by Arthur D. Little, Inc., provided the initial rationale for establishing the CTD Governing Board. The second report, "Karnataka in Transformation: a Blueprint for Action" by SRI International with assistance from Price Waterhouse, India, provided a framework for understanding Karnataka's economic infrastructure and developed the specific recommendations for the CTD focus.

6.09 2. Industrial Analysis: A brief analysis of the needs and prospects for growth through increased technology application for the five focus industries follows:

6.10 a. Food Processing: India's food industries are beginning to grow as the structure of the Indian family evolves and the overall economy industrializes. As a result, the need for easy to prepare foods is growing. Yet, food production technologies are still relatively undeveloped at the medium and small scale levels. In order to take advantage of growth opportunities, efforts to improve the use of "best practices" in processing and production technology and to facilitate introduction of new products into the market are needed. For this to occur technologies and training to facilitate the introduction of new food products and the processes for their production are needed.

6.11 b. Informatics: India's growing consumer markets and expanding industrial sectors (from appliances to avionics) will demand increased numbers of installed computer bases and peripherals. The indigenous market is only beginning to develop and opportunities for vertically expanding the total value added product in India and for exporting are just beginning to be explored.

6.12 There are, however, significant gaps in infrastructure, from microprocessor design and fabrication to printed circuit boards to actual product development capacity. Public investments, as well as new joint ventures, can create the stimulus for more rapid development, if infrastructure requirements for design and production, as well as for skilled engineering and technical labor can be met.

6.13 c. Dry Land Agriculture: The environmental conditions in south India create special problems for the development of agriculture. Water shortages and soil problems make economic growth in farming areas difficult. Development of technology applications that can improve the range of crops that can be grown or that can improve cultivation processes will yield a substantial economic return for rural areas. Thus, an array of targeted agricultural technology activities, from sophisticated biotechnology applications to the more basic transfer and training of appropriate cultivation, conservation and irrigation technologies can have an important positive contribution to the country.

6.14 d. Industrial Machinery and Durable Equipment: India is a major producer of industrial machinery, such as machine tools, and certain categories of durable equipment, such as electrical machinery and power systems. While a major producer in these sectors, India faces the challenge of maintaining the level of competitiveness in these sectors if it is to increase exports and, more importantly, to apply current technologies in rapidly expanding domestic industrial sectors. For these reasons the sector needs to explore methods for incorporating current technologies into new product areas, such as plastics machinery and advanced machine tools. Doing so requires expanding the base of technical skills and tools, from the level of industrial design to the level of technician "hands-on" operation of equipment for manufacturing tools, dies and parts. As a result, TA, training, and upgrading of equipment used in these activities is essential for future development.

6.15 e. Chemical System Suppliers/Fabricators: India's chemical industry is only beginning to expand capacity in strategic fields related to its expanding consumer and industrial sectors. There are a number of traditional plastic resin producers, but they operate in narrow areas. The further requirements of industries, from computers to food processing and automotive supply, will necessitate expansion of chemical system production in advanced thermoplastic and thermoset resins, polymer composites and particularly in design, engineering and fabrication of plastic components. As a result, there is need, not so much for new chemical system development (as these are widely available under license from other producers overseas), but for development of applications and manufacturing capabilities that will support Indian industrial markets, whether for autos, aviation, or food packing.

6.16 E. Training: The project analysis of HRD was completed by a National Association of Schools of Public Affairs and Administration (NASPAA) consultant. This analysis identifies the Bangalore area's HRD needs in the near, medium, and long term and presents recommendations using the framework of inputs, human resource production techniques, outputs, and linkages. The heart of this report "Human Resource Development and the CTD" is presented as Annex J.

6.17 F. Institutional/Administrative: The institution created by this project, the Center for Technology Development, will be supported by and serve as, interface between several local, state, and national institutions. Over the last two years, these government, academic, and business organizations have been an integral part of the process of developing the CTD project.

6.18 1. The CTD Organization: The Governing Board's unique composition has two important implications. First, the national stature and influence of Board members will establish the identity of the CTD, not only as an organization in and of the state of Karnataka, but also as an entity with an explicitly all India dimension. Second, the quality and variety of its membership structure, especially the direct link with the ICICI, will ensure that the Board has the leadership ability to foster innovation in the financial, legal, and organizational environment of Karnataka.

6.19 The formation of the two nationally oriented Steering Committees, on Industries and Commerce and on Venture Capital, will help maintain the CTD's all India identity and aid in application of this technology development model to other geographic areas. In the beginning, representatives from the four southern states (Andhra Pradesh, Kerala, Tamil Nadu, and Karnataka) are expected to attend the biannual committee discussions, which will focus on issues relevant to all states. As the CTD program gets underway, representatives from the other states will be encouraged to attend.

6.20 The CTD Secretariat is currently comprised of an Honorary Director, a member Secretary, and a Program Assistant. All three professionals are very experienced managers, each having more than twenty years of experience in high level project planning, administration and implementation in the GOI and the GOK.

6.21 USAID/I recognizes, however, that the CTD organization is new and is interested in remaining a small and efficient body. Thus, an important purpose of the project inputs is to help the CTD develop administrative expertise in the areas of contracting, financial accounting and control and program monitoring/data base management. In the early years, project funds will be used to set up financial and monitoring systems and USAID/I will be expected to directly contract for many of the initial organizational strengthening inputs that will be required by the CTD. Over the course of USAID/I's involvement with the project, contracting responsibilities will gradually be shifted to the Secretariat staff or their designated contracting agent.

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6.22 The Focus Group structure was developed at the USAID/I sponsored Bangalore workshop held in March of 1987 as a way of channelling the ideas and concerns of leaders interested in five basic industries. Two of the Groups, Informatics and Food Processing, have met bi-weekly for over a year. The other Groups are expected to become active early on in the life of the project.

6.23 Members of the existing Groups and potential leaders of the other Groups have been a driving force behind the development of the CTD project and will provide critical technical expertise throughout the life of the project. Focus Groups will use their knowledge of science, industry, and the Bangalore area to draft proposals for project funding. Because of the volunteer nature of these Groups, it is important that USAID/I's involvement with the CTD meet with some early successes. An idea of such a successful endeavor might be the sponsorship of National Technology Conferences or the organization of appropriate Orientation Tours.

6.24 There may be merit in convening a functionally oriented Focus Group to support the technology/industry-oriented Focus Groups. For example, Human Resources might be a worthwhile Focus Group because of the crosscutting nature of the concern and the complexity of both the public and private recipients and providers.

6.25 One of the goals of the project is for the CTD to become a fully operational organization, capable of handling all aspects of its program including all contracting, accounting, and monitoring requirements. To help ensure progress in this direction, the CTD is developing a detailed Management Plan that will outline, inter alia, how and by when these particular capabilities will be developed. The Plan must be reviewed and approved by USAID/I as a Condition Precedent to the first disbursement of project funds.

6.26 The Plan will include details about the establishment of a Contracting Cell within the CTD Secretariat. Cell personnel are expected to be approved by the Governing Board and hired by December of 1989. Staff are likely to include contracting specialists deputed from the GOK. By March, 1990, the staff of the Cell should be trained and fully operational.

6.27 At their first meeting the Governing Board will hire a Chartered Accountant who will help CTD establish a Financial Accounting and Control System. This system will be fully operational by March, 1990. The CTD will prepare quarterly financial reports, subject to audit by a local auditor.

6.28 The CTD, with the help of local consultants, will set up by March 1990, a data base Management Information System. This system will record and summarize information collected from

CTD activities, such as data on project beneficiaries. Also during this period, Focus Groups will prepare Baseline Studies against which the impact of CTD funded activities can be measured.

6.29 2. ICICI/TDICI: The ICICI is an all India development finance institution charged with special responsibility for fostering development in Karnataka and in several other selected states. The ICICI is 79% publicly owned, 14% of its shareholders are foreign, and the remaining 7% shares are owned by private Indian investors. Though the institution is operationally autonomous, it has strong relations with the GOI. Through close contacts with the business community, the ICICI serves as an important link between the private sector and the GOI. The progressive leadership of the ICICI has been supportive of other USAID/I funded innovations such at the PACT and PACER projects. These projects are being administered by the ICICI.

6.30 The ICICI will have three roles relative to the CTD:

a. The ICICI will serve as the financial conduit through which USAID/I's financial contribution to the project will flow to the CTD. Under GOI rules for foreign assistance utilization, the Rupee equivalent of foreign assistance must be budgeted by a central or state government entity. Because the CTD cannot by definition meet this requirement, USAID/I will grant its funds to the ICICI, which will transfer funds to the CTD for eligible project expenditures. USAID/I followed this precedent in the PACER project. As in the case of PACER, the relationship between ICICI and the CTD will be defined by a Memorandum of Understanding which must be reviewed and approved by USAID/I as a Condition Precedent to the disbursement of project funds.

6.31 b. The ICICI will provide the CTD with financial guidance as necessary. The Chairman of the ICICI will serve on the CTD Governing Board and thereby maintain a continual link with the development of the CTD organization.

6.32 c. It is anticipated that through its subsidiary, the TDICI, the ICICI will make available a Rs.200 million (U.S. $15.4 million) Venture Capital Fund to support CTD sponsored new and expanding business investment proposals which reach a "bankable" stage, and will support development of a Satellite Technology Information Exchange System for the CTD.

6.33 The TDICI was established in Bangalore in 1988 as a subsidiary of the ICICI. The subsidiary was formed to facilitate access to venture capital and technology information. In a phased manner, it will also administer the PACT and PACER projects.

6.34 The TDICI will be linked to the CTD through two activities: Venture Capital and Satellite Information Exchange. The TDICI will serve as a source of venture capital financing ($15.4 million initially with potential for $100 million more) for new or expanding businesses. The CTD will provide area entrepreneurs with financing information and with guidance in preparing business plans. It is anticipated that the impetus behind some of the new proposals will be the technology research done in CTD sponsored ATC's.

6.35 CTD sponsored proposals for Venture Capital funding will undergo technical evaluation by the appropriate industry Focus Group in its monthly meeting. The commercial viability of these proposals will then be evaluated TDICI.

6.36 The ICICI has identified several financing options under the Venture Capital Fund scheme, including equity participation, conditional loans (interest rates linked to sales level), and conventional loans. The financing mix for each proposal will be decided on the basis of several factors, such as the type of company (new or existing), the promoter's contribution, desirable debt/equity ratio, nature of the proposal, and the profit potential of the proposal. The dividends accruing on the equity portfolio, the sale proceeds of the equity holding, and the repayments of conditional and conventional loans will be ploughed back into the Venture Capital Fund to sustain and augment the resources available for other potential proposals.

6.37 The TDICI is also expected to establish a satellite link for the international exchange of information related to technology. Obtaining this capacity has been an interest of CTD leaders since the beginning of the project design process. Since it appears that TDICI funds will be used to establish and maintain the linkage, the CTD will assist in this endeavor only if special needs arise. For example, if income from small scale user fees are insufficient to pay for required satellite use due to the limited financial capabilities of small-scale users, the CTD may subsidize part of the costs involved in small-scale use of the satellite link.

6.38 3. Other Institutions: The CTD will interact with several other important state and national level institutions. These institutions, the IISc, the CEI, and the Karnataka State Industrial Investment Development Corporation (KSIIDC) were instrumental in planning the initial USAID/I funded workshop that launched cooperative planning of the CTD project.

6.39 The IISc, Bangalore is one of the leading academic and research institutions in India. As such, it has developed considerable depth and breadth in its basic research capabilities, especially in physics and materials science. The IISc has over 600 researchers and other than faculty, in five major science divisions: Physics and Mathematical, Chemical, Biological, Electrical, and Mechanical. The Institute is Karnataka's most important repository of long-term, basic scientific research capability. Though the IISc is exceptionally strong in materials science, it is less advanced in biotechnology, which is an area that hopefully will be strengthened as a result of collaborative work on technology development.

6.40 Professor C.N.R. Rao, Director of the IISc, is the Chairman of the Prime Minister's high level Science Council. Dr. Rao will serve as Chairman of the CTD. The CTD will draw on the talent, facilities and technical expertise of the IISc. In turn, the CTD will work with IISc faculty, researchers, and curriculum developers to develop a stronger link between basic research and industry needs, creating opportunity for commercially-viable technologies. The Applied Technology Center on Informatics may actually be an autonomous subsidiary of the IISc.

6.41 The CEI is a national organization for the engineering manufacturing industry, representing both the public and private sectors. The CEI provides information, advisory and consulting services; plays a significant role in promoting international cooperation; and acts as a catalyst for industry action to enhance quality, productivity and HRD. The organization has cosponsored several successful workshops and seminars with USAID/I.

6.42 The CEI will have a significant advisory role to the CTD. The National President of the CEI will sit on the Governing Board of the CTD. In addition, the CEI will arrange financial support for the CTD through its local industry associations.

6.43 The Karnataka State Industrial Investment and Development Corporation, along with the Karnataka State Financial Corporation (KSFC), provides medium-term loans to industry and performs a major role in the promotion and assistance of projects. The KSIIDC will provide the CTD with both advisory services and with initial secretariat services until the CTD has funds to support its own staff.

6.44 4. <u>USAID/I Support Capability</u>: USAID/I responsibility for implementation of the CTD project will rest with the Office of Technology Development and Enterprise (TD&E), which is under the full-time supervision of a U.S. Foreign Service Officer. The staff of TD&E includes four professional FSN officers. One professional FSN staffer will backstop the CTD project on a full-time basis. Though in the initial years of the project, most overseas contracting will need to be done directly by USAID/I, this work is expected to be transferred to the CTD as the organization matures.

6.45 G. Social: The SRI study describes how the CTD can help meet the needs of small scale businesses. For example, one proven method of stimulating and capturing the benefits of economic growth is through the development of local suppliers, subcontractors, ancillaries, subsidiaries, and other forms of smaller scale enterprise related to larger industrial sectors. In Karnataka, the need for suppliers with higher technical competency and capability is fast increasing, but the development of supplies with suitable capabilities has proven difficult. A buyer/supplier initiative under the guidance of the CTD may help improve the linkage between different buyers and suppliers in the areas of technology and production and thus strengthen the competitiveness of all parties.

6.46 The scopes of work for the evaluation/monitoring and human resource consultants that assisted in the project design process, required them to consider how the CTD project can and should impact women. Thus women's issues will be addressed throughout the implementation of the project and as an important part of monitoring and evaluation of the project. The data base maintained by the CTD on client participation will indicate the gender of the client. Case studies that will be developed during evaluation will try to assess the impact technological change in key industries has had on women. For example, a force behind innovation in food processing is often saving time for women. The consultant's report also recommends that there be a special study of the constraints (if any) to entry of women into particular industries, job categories or management positions within industries.

6.47 The HRD consultants' report (Annex J) suggests ways that the CTD could help expand the capacity of the technology training system to accommodate women. For example, CTD leadership is aware of World Bank assistance for training women in electronics manufacturing and a Ford Foundation project for training women entrepreneurs. The CTD will determine how its own programs can complement or reinforce these initiatives so that the maximum number of women can be trained. The consultant's report also recommends establishing a Focus Group for Women in Technology Development and its Commercialization. Such a Group might also establish a "fast track" for women interested in faculty careers and positions in the state agencies that are trying to carry out entrepreneur development programs.

VII. CONDITIONS PRECEDENT & COVENANTS

7.00 A. Conditions Precedent to Disbursement of Funds: In addition to the standard Conditions Precedent to the disbursement of project funds, it is anticipated that the Project Agreement will contain

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a number of special Conditions Precedent (CPs) to the initial disbursement. These include:

7.01 1. A requirement that the ICICI provide, for the approval of A.I.D., a copy of the "Memorandum of Understanding" between the ICICI and the CTD which describes the procedures and mechanisms that will be employed to reimburse the CTD for eligible expenditures under the project;

7.02 2. A requirement that the ICICI provide, for the approval of A.I.D., a written confirmation of the fact that the CTD has in place a staff of at least three persons, including the Honorary Director of the CTD, which is required to implement the initial stages of the project. The ICICI's written confirmations should also indicate that the CTD is prepared to hire a minimum of two additional professionals by the end of the second year of the project; and

7.03 3. A requirement that the ICICI provide, for the approval of A.I.D., a copy of the CTD's "Management Plan" for the initial eighteen months of the project. Such a Plan should include the estimated amounts and timings of the Host Country and/or Direct A.I.D. contracts anticipated during this eighteen month period and should specifically indicate the manner in which the CTD will insure that it establishes acceptable financial management and control mechanisms for the funding provided by A.I.D. under the project.

7.04 B. Covenants: In addition, it is anticipated that the Project Agreement will contains the following Special Covenants:

7.05 1. That the CTD will be responsible for securing and financing, in a timely manner, any and all import duties and/or other GOI levies and clearances required for the importation of any goods to be financed under the project; and

7.06 2. That the CTD agrees to either maintain or increase the existing level of representation of the Private Sector and/or Non-Government Organizations on the Governing Board of the CTD.

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VIII. LISTING OF ANNEXES:

Annex A	Logical Framework
Annex B	Project Identification Document Approval Cable
Annex C	Resource Needs by Order of Technology Challenge (SRI)
Annex D	Public/Private Initiatives for Technology Development - Lessons Learned (SRI)
Annex E	Definitions of Technology Fields (SRI)
Annex F	Sample questions for Applied Research Institute Mission and Scope Studies (SRI)
Annex G	Illustrative Technology Program Activities (SRI)
Annex H	Analysis of Policy Environment (PW)
Annex I	List of Consultant Reports/Consultant Team Scopes of Work
Annex J	Human Resource Development and CTD (NASPAA)
Annex K	Detailed Monitoring and Evaluation Plan
Annex L	GOI Letter of Request
Annex M	Reconnaissance Surveys of Pune, University of Pune, 1986
Annex N	Innovations in Industrial Development and Competitiveness in Karnataka, Dr. Rao Associates, January 1987
Annex O	Technology Developments on a State Level Focused on National Goals, A.D. Little, Inc., April 1987
Annex P	Karnataka in Transformation, SRI International, November 1987
Annex Q	Policy Environment for the CTD Project, Price Waterhouse, July 1988
Annex R	Technology Development & Information Company of India Ltd., P. Sudarsan, August 1988
Annex S	Statutory Checklist
Annex T	Telex from Mr. Nayak, August 8, 1988
Annex U	CHART 3: Proposal Approval Process & Narrative Description
Annex V	Guidelines for Implementing the Project

NOTE: All Annexes listed above are available in the Official USAID/I Project files for the the Center for Technology Development Project.

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ANNEX A

CENTER FOR TECHNOLOGY DEVELOPMENT (386-0507)

LOGICAL FRAMEWORK

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<u>Sector Goal</u>	<u>Measures of Goal Achievement</u>		
Acceleration in the pace and quality of technology application to product and production processes development in existing and newbusiness in industry, agriculture, health, energy and other areas important to Indian development.	- Improved/new technology applications to at least 30 products and production processes for domestic and export markets. - Cost savings in production i.e. upto 30% of original production cost. - 50% of cost savings passed on to consumers. - About 25% increase in the availability of food and other products promoted by CTD. - About 500 new jobs created, 50% of them for women.	- GOI economic statistics. - State Govt. statistics. - Reports from the concerned institutions. - Baseline Surveys. - Final evaluation.	- Continued liberalization of GOI economic policy environment - The benefit of cost savings in production is passed on to consumers through adequate competition. - Baseline data will be collected for each indicator category. - The CTD will receive proposals enough to result in improved/new technology applications for 30 products.
<u>Project Purpose</u>	Conditions that will indicate purpose has been achieved. End of project status		
To develop and improve technology infrastructure resources essential for economic growth in India initially focusing on the Bangalore area of Karnataka.	- CTD fully operational with an office, 4 or 6 staff and becomes self sustained, interacting with key institutions (govt./academic/Industry/Financial). - At least 20 new economically viable ventures involving improved technology applications, promoted by CTD. - CTD involving at least 6 important policy makers in this project. - 10 or 15 new and/or strengthened local institutions and their trained professionals engaged in R&D, consultancy, HRD.	- Site visits. - Annual reports of the CTD and ICICI, Govt. of Karnataka & academic institutions. - Proceedings of conferences. - Press reports. Final project evaluation.	- Govt. of Karnataka interest in establishing CTD will continue. - CTD performs catalytical, co-ordinating and sponsoring role as envisaged. - The collaborating institutions are responsive to project activities on timely basis.

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NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
	- 5 local educational institutions strengthened and 50 ex-students actively linked to new ventures.		
Outputs A. Establishing operationally effective CTD for identifying and supplying components missing from the technology infrastructure.	Magnitude of Outputs - A functional CTD with an office and 4 or 6 staff; $428,571 raised by CTD from local sources over 6 years LOP for its operational expenses. - Proposals emerging as per accepted time-frame.	- Annual Reports of the CTD and ICICI - Quarterly administrative reports. - Site visits - Monitoring Reports - Mid-term project evaluations	- Industry focus groups act in timely manner to promote proposals and mobilise the required resources/support.
B.1 Expanded and strengthened Research & Development (R&D) base for technological development	- At least 3 Applied Technology Centers (ATC) established. ATCs engaging in prototype and production process design.		
2. Enhanced buyer-supplier relationship by promoting sub-contractings between large and small-scale industries in various sectors.	- Facilitation by CTD of at least 10 sub-contractings based on high technology buyers' needs. - Improved efficiency, quality control and flexibility among at least 10 small/medium scale industries.	-do-	- U.S. technical assistance and training support is provided in a timely and effective manner.
3. Regular technical information update system for Karnataka industry and research groups.	- U.S./Indian computerized technical information data bases linked through satellite telecommunications and use of this system by at least 50 firms paying fees.	-do-	- Access to Texas Instrument downlink is granted by GOI telecom authorities.
4. Expanded and enhanced human resource base for technological innovation.	- 10-15 industry oriented courses added to Karnataka's polytechnics. - Computerized learning systems added to at least 10 technical and management institutes - Around 70 top and 700 middle level R&D professionals trained and engaged in R&D, training and consultancy.	-do-	- Continued support of GOK and local industry in developing new training programs. - Private sector provides personnel to be trained and training facilities, whenever possible and other support.
5. Strengthened entrepreneurship environment particularly at the small/medium scale level.	- At least 20 new viable joint ventures and/or start-up firms established and working in such fields as food processing, and informatics as a result of CTD.	-do-	- Interest by local & foreign firms. - ICICI venture funding is available as planned.

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
6. Effective network among key institutions supporting increasing technology development and application.	- Mobilization and use of about $ 100 million venture capital funding. - Annual/bi-annual meetings among academic institutions, industries, financial and public institutions. - Involvement of 6 policy makers actively in this project.	-do-	- The institutions involved in networking will be active and ensure effective coordination.
Inputs			
A. USAID (Grant - $10 million & staff time of at least 2 professionals)	Implementation targets (Grant Inputs) ($000) A. USAID		
Breakdown 1. $ 3.2 million. 2. $ 2.5 million. 3. $3.8 million. 4. $ 0.5 million.	1. 250 man-months (both US and local) for TA. 2. 250 man-months (in U.S. and also third country and local) for Training. 3. Equipment for ATCs and training. 4. Publicity materials etc.	- Site visits. - USAID reports. - CTD & ICICI reports. -do-	- USAID, GOI and other inputs arrive as planned. - Private entrepreneurs are ready to take risks.
B. GOI & Others - ICICI funds $15.4 million.	B. GOI & Others 1. For initiating ventures (at least 20 during LOP).	-do-	
- Local govt. & industry support including in-kind support-$0.45 million.	2. For CTD operational expenses such as office, staff salary etc.	-do-	

ANNEX "B"

UNCLASSIFIED STATE 050935

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E.O. 12356: N/A
TAGS:
SUBJECT: CENTER FOR TECHNOLOGY DEVELOPMENT (386-0507)
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1. THE PID FOR THE SUBJECT PROJECT WAS REVIEWED BY THE PRC ON FEBRUARY 8 AND BY THE ANPAC ON FEBRUARY 18, 1988. ROBERT BECKMAN VERY ABLY REPRESENTED THE MISSION. THERE WERE NO ISSUES IDENTIFIED WHICH THE PRC CONSIDERED MIGHT JEOPARDIZE MOVING TO FINAL PP STAGE. BUT THERE WERE FOUR PROGRAMATIC AREAS CONSIDERED OF SUFFICIENT IMPORTANCE TO BE BROUGHT TO THE ATTENTION OF THE ANPAC. THE ANPAC APPROVED THE PID AND CONCURRED THAT THE MISSION DIRECTOR SHOULD EXERCISE HIS AUTHORITY TO APPROVE THE PP AND AUTHORIZE THE PROJECT.

2. PROGRAMATIC AREAS OF CONCERN:

A. POLICY ENVIRONMENT AND DIALOGUE: THE PID PRESENTED A LIMITED DISCUSSION OF THE INDIAN POLICY ENVIRONMENT WHICH MAY AFFECT THIS PROJECT. THERE WAS ALSO A LIMITED PRESENTATION ON HOW THIS PROJECT CAN HELP TO IMPROVE THE GOI POLICIES IN KARNATAKA HAVING TO DO WITH BUSINESS DEVELOPMENT, TECHNOLOGY TRANSFER AND THE FOSTERING OF A MORE MARKET DRIVEN SERVICE SUPPORT CULTURE AMONG THE

ACADEMIC AND RESEARCH INSTITUTIONS OF KARNATAKA. COUNTRIES IN ASIA ARE EXPERIMENTING WITH DIFFERENT APPROACHES TO DEVELOPING S AND T INFRASTRUCTURE, E.G. SCIENCE PARKS, THAT MAKE EFFICIENT USE OF HUMAN AND FINANCIAL CAPITAL. WHAT PLANS OR POLICIES IS KARNATAKA PURSUING IN THIS RESPECT THAT MAY AFFECT THE DEVELOPMENT OF APPLIED RESEARCH CENTERS?

THE PP SHOULD CONTAIN AN ANALYSIS OF THE POLICY ENVIRONMENT IN WHICH THE PROJECT WILL OPERATE, AND ANY KEY POLICY CONSTRAINTS THAT WILL AFFECT PROJECT FEASIBILITY. CERTAIN SENSITIVE ASPECTS OF WHAT THE PROJECT COULD DO TO ADDRESS THESE POLICY CONSTRAINTS OR IMPROVE LIKELIHOOD OF POLICY REFORM MAY BE INCLUDED IN A SEPARATE DOCUMENT OR IN AN ADDENDUM TO THE PP.

B. PROJECT FOCUS AND SUSTAINABILITY: THE PID DESCRIBES

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THREE MAJOR LEVELS OF ACTIVITY ASSOCIATED WITH THE PROJECT.

(1) THE CREATION AND OPERATION OF THE CENTER FOR TECHNOLOGY DEVELOPMENT; (CTD).

(2) THE CREATION WITH ASSISTANCE BY THE CTD AND USAID OF THREE TO FOUR INDUSTRY SPECIFIC APPLIED RESEARCH CENTERS.

(3) THE CREATION WITH ASSISTANCE OF THE CTD AND THE APPLIED RESEARCH CENTERS OF AT LEAST 20 NEW JOINT VENTURES OR START-UP FIRMS.

THE PROJECT TITLE IMPLIES A USAID PRIMARY FOCUS OF SUPPORT AT THE FIRST LEVEL. THE PROJECT BUDGET IMPLIES A USAID PRIMARY FOCUS OF SUPPORT AT THE SECOND LEVEL. THE PID LANGUAGE OFTEN IMPLIES A PRIMARY FOCUS AT THE THIRD LEVEL. THE MISSION REPRESENTATIVE CLARIFIED THAT THE PRIMARY FOCUS OF SUPPORT BY USAID WILL BE AT THE SECOND LEVEL.

THE PP WILL NEED TO BE EXPLICIT IN DESCRIBING WHAT THE PROJECT WILL ACTUALLY DO AS WELL AS ITS SPECIFIC OBJECTIVES AND MEASURES OF SUCCESS. THE PP SHOULD ALSO DISCUSS HOW ALL THREE LEVELS OF ACTIVITY WILL GROW AND CONTINUE BEYOND THE PACD. THE MISSION REPRESENTATIVE MENTIONED AT THE PRC MEETING THAT CONSIDERATION WAS BEING GIVEN TO PROVIDING AN ENDOWMENT TO THE CTD BY THE GOI. THE ANPAC FOUND THIS TO BE AN ATTRACTIVE IDEA THAT SHOULD BE PURSUED DURING PP DEVELOPMENT.

C. COMPETITION WITH U.S. EXPORTS AND INTELLECTUAL PROPERTY RIGHTS: THE PRC DISCUSSED AT LENGTH THE POTENTIAL IMPACT OF THE GROWING NUMBER OF RESTRICTIONS PLACED UPON PROJECTS LIKE THIS BY THE U.S. CONGRESS WHICH IMPEDE AID ASSISTANCE TO NON-U.S. FIRMS WHICH COMPETE WITH U.S. EXPORTS (E.G. LAUTENBERG). THERE WAS ALSO A DISCUSSION OF THE INCREASED CONCERN FOR THE PROTECTION OF U.S. INTELLECTUAL PROPERTY RIGHTS. THE PRESIDENT'S COMPETITIVENESS INITIATIVE OF JANUARY 27, 1987 DIRECTS QUOTE FEDERAL AGENCIES TO TAKE INTO ACCOUNT WHEN NEGOTIATING INTERNATIONAL AGREEMENTS OR PROVIDING BILATERAL ECONOMIC ASSISTANCE WHETHER THOSE COUNTRIES ADEQUATELY PROTECT U.S. INTELLECTUAL PROPERTY RIGHTS UNQUOTE. SINCE INFORMATICS AND BIOTECHNOLOGY ARE TWO AREAS WHERE INTELLECTUAL PROPERTY AND PATENT PROTECTION ARE IMPORTANT AND CONTROVERSIAL TOPICS, THIS ISSUE MAY BE EXTREMELY RELEVANT TO WHETHER U.S. COMPANIES WOULD BE WILLING TO PARTICIPATE IN THE PROGRAM.

THE PP WILL HAVE TO DEAL WITH BOTH OF THESE ISSUES IN A

CONCRETE MANNER BY ESTABLISHING GENERAL CRITERIA FOR TECHNOLOGY TRANSFER DEVELOPMENT. BECKMAN INDICATED THAT THE BIOTECHNOLOGY SPHERE WOULD BE GIVEN PARTICULAR ATTENTION IN THIS ANALYSIS GIVEN MISSION EXPERTISE.

D. THE PROPOSED LEVEL OF TECHNICAL ASSISTANCE: THE PRC WHOLEHEARTEDLY ENDORSES THE LEVEL OF TA AND TRAINING PROPOSED. HOWEVER, IT WAS QUESTIONED WHETHER THE GOI WILL PERMIT THIS LEVEL OF ASSISTANCE. THERE WAS ALSO A CONCERN RAISED ABOUT IMPLEMENTATION DIFFICULTIES WHICH MAY BE ENCOUNTERED BY SUCH A LABOR INTENSIVE MODE OF ASSISTANCE, PARTICULARLY GIVEN THE LIKELIHOOD OF REDUCED STAFF LEVELS. THIS PROJECT PROPOSES DOLS 4.450 MILLION FOR U.S. CONSULTANTS AND DOLS 1.75 MILLION FOR TRAINING. THIS REPRESENTS 62 PERCENT OF USAID'S TOTAL CONTRIBUTION TO THE PROJECT.

THE PP SHOULD CONTAIN A FULL DISCUSSION OF THE MECHANISM FOR SELECTING AND OBTAINING APPROVAL OF THIS TA AND TRAINING. THE MISSION SHOULD ASSURE ITSELF THAT THIS LEVEL OF TA AND TRAINING IS ACCEPTABLE TO THE GOI PRIOR TO PROJECT AUTHORIZATION. WE SHOULD NOT RELY ON CP'S TO DISBURSEMENT WHICH REQUIRE A TA AND TRAINING PLAN, AS WAS USED IN THE PRIOR PROJECTS.

3. ADDITIONAL GUIDANCE FOR PP DEVELOPMENT:

A. FUNDING MECHANISM AND BUDGET: HOW WILL THE AID FUNDS BE PASSED FROM THE GOI TO THE FINANCIAL

INTERMEDIARY INSTITUTION INVOLVED, THE ICICI, AND IN TURN TO THE CTD AND TO THE APPLIED RESEARCH CENTERS? THE PP SHOULD DESCRIBE THE BASIS FOR ESTIMATING THE PROJECT BUDGET AND PROVIDE A FINANCIAL ANALYSIS WHICH DESCRIBES HOW THE BUDGETING/FINANCIAL PROCESS FOR THE PROJECT WILL WORK.

B. PRIVATE SECTOR PARTICIPATION: THE BOARD OF DIRECTORS FOR USAID'S ONGOING PACT PROJECT CONSISTS OF SIX - SEVEN U.S AND INDIAN PRIVATE SECTOR REPRESENTATIVES AND ONE EACH GOI AND USG REPRESENTATIVE. THE PROPOSED BOARD OF DIRECTORS FOR THE CTD IS COMPOSED PRIMARILY OF GOI REPRESENTATIVES. THE MISSION AND THE GOI SHOULD CONSIDER HAVING MORE PRIVATE SECTOR REPRESENTATIVES ON THE CTD BOARD OF DIRECTORS TO BETTER ASSURE A MARKET ORIENTATION.

THE PID ON PAGE 21 STATES AN ASSUMPTION THAT QUOTE ...SOME LEVEL OF CORPORATE FINANCIAL PARTICIPATION IN AND CONTROL OF THE APPLIED RESEARCH CENTERS WOULD BE REQUIRED BEFORE AID FUNDS COULD BE DRAWN FOR ASSOCIATED CONSULTANCIES AND/OR TRAINING UNQUOTE. AS A TARGET, WE SHOULD ATTEMPT TO INCLUDE IN THE PROJECT AGREEMENT THAT THESE CENTERS BE MORE THAN 50 PERCENT PRIVATE SECTOR OWNED AND CONTROLLED BEFORE AID GRANT FUNDS ARE USED FOR THEIR SUPPORT.

THE PID CONTAINS A REFERENCE TO THE INDO-AMERICAN

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CHAMBER OF COMMERCE. THE PP SHOULD EXPLAIN THE ROLE OF THE CHAMBER.

C. SMALL SCALE BUSINESS PARTICIPATION: THE PP SHOULD PROVIDE EVIDENCE OF DEMAND FOR THESE TYPES OF SERVICES BY SMALL SCALE BUSINESSES IN KARNATAKA. THERE SHOULD ALSO BE A DISCUSSION ABOUT ANY POSSIBLE CONFLICTS OF INTEREST BETWEEN LARGE SCALE INDUSTRIES WHICH MAY HAVE A FINANCIAL INVOLVEMENT IN ONE OF THE APPLIED RESEARCH CENTERS AND THE SMALLER COMPETING BUSINESS WHO MAY WANT TO USE THE SERVICES OF THE CENTER. THE PP SHOULD DESCRIBE HOW THE MANAGEMENT/ADMINISTRATIVE STRUCTURE OF CTD AND THE THREE-FOUR INDUSTRY SPECIFIC APPLIED RESEARCH CENTERS WILL IN FACT FOCUS ENERGIES ON THE PRIMARY SMALL AND MEDIUM SIZE CLIENTELE.

D. TRAINING: THE PP SHOULD SPECIFY THAT THE REFOCUSING OF SECONDARY AND TERTIARY EDUCATION TO BE MARKET RESPONSIVE AND SUPPORTIVE OF INDUSTRY NEEDS WILL CONCENTRATE ON WIDELY GENERALIZED SKILL AND EDUCATIONAL MANPOWER REQUIREMENTS. IF EMPLOYER-SPECIFIC TRAINING IS

PROVIDED, THOSE FIRMS SHOULD BE REQUIRED TO PAY FOR THAT TRAINING. IN SUCH CASES EMPLOYERS MAY BE EXPECTED TO CAPTURE THE ECONOMIC GAINS FROM SUCH HUMAN CAPITAL INVETMENTS, FOR SUCH TRAINEES CANNOT MARKET THEIR NEW SKILLS ELSEWHERE IN THE LABOR MARKET. ON THE OTHER HAND, SKILLS NEEDED IN A WIDE VARIETY OF JOBS AND ENTERPRISES, AND WHICH CONTRIBUTE TO THE OCCUPATIONAL MOBILITY AND ADAPTABILITY OF STUDENTS, E.G. ENGINEERING, SCIENTIFIC, LITERACY AND ARITHMATIC SKILLS, ARE A LEGITIMATE FOCUS FOR AN EDUCATIONAL SUBSIDY. FOR SUCH GENERALIZED SKILLS, EMPLOYERS' INCENTIVE TO INVEST IN SUCH TRAINING WE UNDERCUT, BECAUSE STUDENTS, ONCE HAVING BEEN TRAINED, MAY TAKE THESE SKILLS AND MARKET THEMSELVES AMONG A WIDE VARIETY OF EMPLOYERS.

E. MONITORING AND EVALUATION: THE PP WILL NEED A

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MONITORING AND EVALUATION PLAN TO TRACK BOTH GOAL LEVEL OBJECTIVES AND PROJECT INPUT/OUTPUTS. WALLIS
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Resource Needs at Each Order of Technology Challenge

First order technology infrastructure for "deployment" includes these types of needs and sources of supply:

- Technology Institution Resources--Need: Organization sources of information on "best practices" and "off-the-shelf" existing technology for initial production, expansion, or modernization. Sources: consultants, state sponsored modernization programs, engineering colleges, polytechnics.

- Human Resources--Need: Technical skills for production line operation and management, start-up, expansion and modernization. Sources: equipment vendor training staff, internal company training, polytechnics, private training businesses

- Physical Resources--Need: Production equipment including stand alone and integrated automated manufacturing equipment, testing and quality control equipment, packaging, and information management equipment. Sources: equipment vendors, distributors, internal engineering departments.

- Financial Capital--Need: Financing for business production equipment, working capital, plant expansion, and modernization. Sources: banks and merchant banks, venture financing, state sponsored business finance programs, buyer financing, equipment leasing and finance companies.

Second order technology infrasture for "application and adaptation" includes:

- Technology Institution Resources--Need: R&D using new technology tools to generate new licenseable technology based products and processes, product development and commercialization support, business incubation. Source: Corporate R&D labs, public and private applied R&D institutions, university technology centers, technology licensing and incubation programs.

- Human Resources--Need: Bachelors, masters, and advanced degrees, as well as specialized technical training in engineering and sciences, business and R&D management. Sources: Universities, colleges, continuing education and corporate training programs.

- Physical Resources--Need: R&D laboratory equipment and instruments, computational and simulation systems, prototype development and production scale-up and testing facilities. Sources: endowments, university equipment budgets, organizational overhead rates, retained earnings, joint-venture project funding, state industrial technology programs

- Financial Resources--Need: support of short- to medium-term R&D projects, commercialization/licensing studies, prototype development and production scale-up, and new enterprise incubation, as well as support for four-year and post-graduate education, continuing and specialized training programs. Sources: corporate retained earnings, joint ventures, acquisitions, contract research, state funded industrial technology research, also, traditional higher education programs, corporate training programs, self-funded continuing education

Third order technology infrastructure for "discovery" includes:

- Technology Institution Resources--Need: basic, longer-term, science and science application research intended to discover new principles that could lead to new technologies. Sources: investigator directed university research, interdisciplinary university research centers, precompetitive industry-university research programs, national laboratory system.

- Human Resources--Need: Advanced science degrees, including Ph.Ds in sciences and interdisciplinary fields (such as biotechnology, advanced materials, etc.). Sources: research universities, land grant universities, some colleges.

- Physical Resources-Need: major laboratory facilities, instruments and computational equipment, supporting analytical resources. Sources: Grant allocations, donations, endowments, shared facilities.

- Financial Resources--Need: longer-term funding of directed research and supporting staff. Sources: national science agencies, Defense Department, and national institute grant programs, research foundations, corporate foundations, corporate internal line items.

Actions to Enhance Technology Infrastructure: Lessons Learned

Public and Private Action

The private and public sector leadership in states and regions can enhance their technology infrastructure by undertaking individual and collaborative actions. They can:

Enhance Market Information--By helping the technology supplier marketplace of R&D sources and providers of training and equipment to more easily reach their markets, and by helping users better reach suppliers. This can be achieved through creating information and technical facilitators and by brokering relationships between suppliers and users.

Enhance Market Development--When market actions to supply technology resources are not taking place, or are undeveloped, the public and private sector can make feasible the organization of new technology providers by helping to redefine institutional roles and missions (e.g., help universities play new roles with industry through subsidiary R&D organizations, encourage new collaboration between corporations, charter new industry technology institutions.)

Provide Market Incentives--When market actions are feasible, but marginal costs are high, incentives to induce development of new providers can be attempted, from providing seed capital and matching funds, or indirect support for R&D organization overhead, equipment and training

Directly Subsidize Market Activities--Where the market will not supply technology directly or through existing public institutions, and the cost of not acting is high, direct subsidy of technology activities can be undertaken through use of new funding methods, including more funding by corporate sponsors and subscribers, multiclient funding, contract research, and obtaining direct funding by government.

Technology Infrastructure Lessons

Strategies can be developed to improve any or all levels of technology infrastructure, as well as each of the technical, human resource, finance or physical inputs to the infrastructure. The development of new technology infrastructure, at the first, second or third level, can be enhanced by taking into consideration the experience of other countries.

First order lessons--Lessons learned about effective first order technology infrastructure strategies include the following:

- Avoid "glamour" issues, focus on market relevance of technology skills and equipment for high quality, modern, production
- Correct market inefficiencies first, emphasize improved flow of information, improve buyer-supplier networks before creating new programs
- Increase capacity of best existing private and public technical assistance providers first, from industrial extension services to community colleges
- Create new capacity to fill any first-order gaps, but stress private sector delivery mechanisms
- Integrate technical, human resource, and financial capital assistance, since it is often the lack of familiarity with technology as well as time and money to procure it that are key obstacles to use.

Second order lessons--Lessons learned about second order technology strategies include:

- Four new multidisciplinary technology fields are important to applied technology development: information, automated manufacturing, advanced materials, biotechnology
- Technologies should be treated as tools. Select technology fields that will provide "technology capture" opportunities for industries in the state or region. Thus, rather than having a general biotechnology center, a center could be created that focuses biotechology on a specific sector of importance to the economy, such as agriculture or pharmacy, but not both within the same institution (unless major resources are available.)
- Hasten refinement of technology applications to products that are close to commercialization through targeted investments and incentives. Avoid ambigous R&D exercises that are not market oriented.
- Strengthen or create connections between technology producers and potential industry users through new R&D institutions, joint-ventures, and licensing agreements that build market responsibilities.

- Pay special attention to small and medium size firm R&D needs and accessibility problems, emphasize technology that provides indigenization/import substitution opportunities.

- Develop a supportive climate for new technology-based spin-offs, including financing mechanisms for product development, business formation, and production scale-up.

Third order lessons--Lessons learned about third order technology infrastructure strategies include:

- Build from science strength, target comparative S&T advantage, do not pick "exotic" fields where there is no base of capacity

- Avoid uncompetitive duplication of effort and diversion from realistic priorities for attaining scientific leadership

- Improve capacity and leverage collaboration of major R&D players, including multi-industry funded R&D at universities and tech centers

- Strengthen interdisciplinary research skills and centers to achieve new synergies in emerging research fields

- Create better mechanisms to capture economic spin-offs, and "down stream" major scientific breakthroughs through intellectual property policies and promotion policies for faculty, precompetitive arrangements with industry.

- Explore opportunities for regional and international advanced research cooperation that will gain access to leading edge science developments.

DEFINITIONS OF KEY TECHNOLOGY FIELDS

Electronic Information (Informatics) -

Microprocessor circuit design (MSI, LSI, VLSI) and fabrication (chip foundries), memory devices (static RAM, ROM, tape), computer main memory (bipolar MMOS), secondary memory (metal ozide semiconductors, conductive polymers), information storage technology (magnetic disk, optical disks, high density magnetic tapes, data compression), printed circuit board design and fabrication (surface mount technology), component and peripheral design (modems, printers), computer design (32k bit microprocessors architecture) for personal computers, workstations, supermini-computers and telecommunications systems. Also, the software and software tools essential to design and use of information systems.

Automated Manufacturing (Mechatronics) -

Computer aided design (CAD) and engineering (CAM), particularly three-dimensional drafting, modeling, finite-element and stress analysis, numeric control and computer numeric controlled tool program generation, parametric CAD coding, integration with other CAD systems; automated materials handling vehicles, and robots for storage and retrieval, palletizing, bin-picking, stacking, tool changing; flexible manufacturing cells with CNC machines (3-axis), advanced tools (laser cutting), tool changers, pick and place robots, vision and sensor inspection (3 dimensional, nonvision, force, torque, pressure, tactile, speech sensors), integrated vision and robotic systems, group technologies for production lines, advanced factory management automation software (manufacturing resource planning), real-time communications (manufacturing automation protocol).

Advanced Materials -

Polymers: composites, which are based on incorporation of high-performance fibers (carbon, aramid, silicon, alumina, boron), into thermoset materials and thermoplastic matrix materials; thermoplastics, such as expoxy, polyesters, polyamides, and liquid crystal polymers; liquid crystal thermoplastic (LCT) resins; high performance polymer blends; fabrication techniques, such as compression molding, injection molding, extrusion, blow molding, reinforced reaction injection modeling (R/RIM), lay-up of composites, filament winding, computer control of polymer design and fabrication.

Ceramics: Conventional electronic applications in packaging of integrated circuits, capacitors, resistors, sensors and magnetic components; products made of conventional aluminum oxide, spark plugs and insulation devices; newer uses of ceramics for heat-and-wear resistant parts, ball bearings, nozzles, pump parts, mechanical seals; non-corrosive parts; cutting tools; armor; heat exchangers; auto valves and valve lifters; advanced ceramic fibers and ceramic matrix composites, ceramic/metal joining, tribiological ceramic coatings, ceramic synthesis and processing; advanced applications in heat exchangers, turbine rotors, turbochargers, diesel engine components, turnine static parts and rotors, aircraft propulsion systems.

Biotechnology -

Health -- products from molecular biology techniques include use of recombinant DNA to produce albumin, antibiotics, blood factors, chorionic gonadotropin, firbrinolytic enzymes, growth hormone, human insulin, interferons, lymphokines, disease vaccines, beta endorphins, regulator of calcium levels, epidermal growth factor, blood clotting factor tissue plasminogen activators, interleukin 2, monoclonal antibodies for diagnostic and therapeutic use, DNA probes for diagnosis.

Agriculture -- Cell culture and protoplast fusion to produce plant clones for selected varieties; Recombinant DNA to enable single gene transfer to produce microbial pesticides and herbicides, selection of unique varients through in vitro mutagenisis for horticultural crops; engineering of drought and salt resistance; ability to produce fertilizer and increase yield.

Food Processing -- Recombinant DNA and protein engineering to produce thermostable enzymes for food processing, synthesis of natural antioxidents, industrial enzymes for cellulose conversion to higher-value added products.

Chemicals -- Bioconversion of fermentable raw carbohydrates to provide value-added organic acids, alcohols, polyols; fermentation and filtration processes for recovery and purification of chemicals and produce energy.

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Sample of Questions That Could be Addressed by Mission and Scope Studies for Applied Research Centers

TECHNOLOGY INSTITUTE INTERVIEW GUIDE
(Prepared by SRI)

A. FOUNDING ASSUMPTIONS

1. Mission/character--What is the fundamental reason for and responsibility of this technology center or institute?

2. Role--What role will this technology center play in the regional economy and technology supply system?

3. Primary objectives--What are the key technological accomplishments the center is expected to achieve as part of its mission and strategy?

4. Basic organization strategy--What basic approach will center leadership take in using center resources to respond to mission statement?

B. ADMINISTRATIVE STRUCTURE

5. Management--What will be the center's executive leadership, administrative management?

6. Overall staffing--What will be the size and skill characteristics of staff?

7. Support structure--What will be the sources and types of staff support?

8. Overall facilities/labs--What will be the center's laboratory and technical resources?

C. PROGRAM STRUCTURE (For Individual Institute R&D Programs)

Please describe the technology programs that are planned for each center. For each technology program answer the following:

9. Mission--What overall technology development is this program intended to achieve?

10. Role--How will this program fit into the center's overall strategy?

11. Primary objectives--What is the program specifically intended to do, and in what time frame, with what outcomes?

12. Workplan--Provide examples of specific program activities (in brief), key results and output expected, and levels of effort (staff, other resources).

13. Evaluation measures--Please give examples and measures of how the success of program activities can be evaluated in terms of the mission of the center, and the objectives of each program.

14. Management--How will the program be run, who will run it, and how will it be coordinated with other programs.

15. Staffing--The type, number, and structure of program staff.

16. Support structure--Day to day technical/administrative assistance.

17. Laboratories and facilities--What type of individual or shared laboratory facilities will this program have? What specific types of equipment should the center procure? What is the most cost-effective method of procurement? Who are the suggested vendors.

D. CENTER CLIENTS/MARKET DEMAND

Please describe the characteristics of your intended clients or the proposed market for your services.

18. Industrial Sector Client Types

a. Automobiles
b. Auto suppliers
c. Chemicals and materials (plastics, ceramics, metals)
d. Pharmaceuticals, biotech based animal, plant, clinicals
e. Paper and forestry
f. Furniture
g. Computers and electronics
h. Manufacturing automation (vision, robotics, gauging)
i. Materials handling and industrial machinery
j. Food and food processing
k. Aerospace and defense
l. Appliances

19. Client Characteristics

a. Major corporation
b. Midsize corporation
c. Small firm
d. Business associations or group
e. Supplier - independent
f. Supplier - ancillary

20. Client Company Stage of Life Cycle

a. Emerging--new type of industrial sector (e.g., biotech, software)
b. Expanding--growing industrial sector (e.g., computers, pharmaceuticals)
c. Transforming--mature industrial sector

21. Level of Client R&D Investment and Technology Management

a. No R&D, low level of innovation
b. Low R&D level, reactive adaptor
c. Moderate R&D, much informal, innovative adaptor
d. Moderate to high R&D, structured and informal, proactive innovation
e. High level of R&D, major R&D system, long-term planning and investment

22. Company Location

a. Headquarters located in or out of the region?
b. Plant(s) located in or out of the region?
c. Total business employment in the region?

E. INSTITUTIONAL SPONSORS OF TECHNOLOGY CENTER

Please identify organizations sponsoring and participating in technology center activities, in addition to target client groups. Describe the roles of sponsors in terms of their contribution to center operations.

23. What types of sponsors does/will this center have?

a. Corporate sponsors--Providing core funding, general grants, possibly specific grants, contracts, affiliate program, consulting, loans of equipment, personnel, joint business ventures.

b. Industry associations--Specific programs and projects on technology issues, involvement in industry research consortia or association research programs.

c. Universities--Support or participation of the office of the president or vice-president for research on board, or in joint programs, specific relationships through deans of schools, department heads, visiting faculty, joint use of facilities, joint grant applications, center of excellence programs.

d. National research programs--Major government R&D funders.

e. National laboratories--Labs that might work with the center.

f. State programs--Technology deployment and modernization programs, technology networking, research excellence, seed capital, etc.

24. What role will sponsors play in the technology center?

a. Financial sponsor core funding
b. Investor (i.e., R&DLP, joint venture)
c. Equipment sponsor
d. Contributor to R&D agenda
e. Board member or advisor
f. Technical advisor
g. Off-site research partner
h. Independent supplier of research/consultant
i. Direct on-site research participant (firm, university)

F. OVERVIEW OF ANNUAL BUDGET

25. Overall technology center budget

26. Budgets for specific programs

G. SOURCES OF REVENUE/INCOME

27. Public Sector

a. State government funding
b. National research grant programs
c. National laboratory support

28. Philanthropic Sector

a. Charitable foundation core grants
b. Charitable foundation project grants
c. Corporate foundation core grants
d. Corporate foundation project grants

29. Private Sector

a. Corporate core grants
b. Corporate general grants (annual)
c. Corporate contracts (fixed fee, CPFF, task order)
d. Corporate affiliates and multiclients
e. Service fees (for consultations, lab services)
f. Royalties from licenses
g. Revenues from equity participation agreements
h. Publication revenues
i. Training program contracts and fees
j. Conferences

EXHIBIT I

ILLUSTRATIVE TECHNOLOGY PROGRAM ACTIVITIES

The following are possible categories of technology center activity. These examples are for illustration.

1. Technology Development

   a. Basic research--Investigator directed research.

   b. Applications research--Development of better understanding of new technology uses.

   c. Product or process development--Development of specific new applications or processes using a base technology

   d. Prototype design--Development of techniques for design of technology applications and products

   e. Production scale-up--Development of techniques for production scale up from design stage.

   f. System integration--Study and development of techniques for integrating individual technologies into groups, and groups into entire plant systems.

2. Technical Assistance (On a firm or industry-wide basis)

   a. Technology scanning--Analysis of technological and economic trends.

   b. Technology assessment--Evaluation of firm or industry capacity and need for specific technologies.

   c. Technology planning--Analysis of feasibility and development of plans for acquiring and utilizing specific types of technology.

   d. Technology testing--Provision of laboratory and technical services for testing and evaluating technology products.

   e. Technology building--Assistance in product design and prototype construction.

   f. Technology evaluation--Analysis of the market for specific technologies.

EXHIBIT 1 (Continued)

g. Technology configuration--Assistance in systems integration of individual technologies.

h. Technology brokering--Establishing matches between technology users and suppliers.

i. Technology investment--Taking equity or licensing position in new starts, using center technology, working with firm "incubating" through early stage development.

3. Training

a. Undergradutate internships.

b. Graduate internships--Research associate positions on projects.

c. Post-doctoral research fellowships--Research positions on projects.

d. Industry-coop training--Programs designed in affiliation with university or other accredited program.

e. Industry technology training--Nonaccredited, fee based training, designed to meet firm or industry group needs for plant floor and supervisory personnel.

f. Technology planning and management training--Focusing on firm or industry capacity building or specific areas of technology.

g. Professional continuing education--In conjunction with accredited or nonaccredited programs.

h. Industry-focused technology seminars or conferences.

4. Dissemination

a. Academic publications--Based on grant supported research.

b. Journal articles--Based on center projects.

c. Books or chapters--Based on center projects and programs.

d. Reports on projects or programs--Documents for public use.

d. Specialized newletters--For industry or technology users.

EXHIBIT 1 (Concluded)

f. Conferences--Symposia for industry or technology user groups.

g. Networking programs--Electronically linked user groups.

h. Technology patent program--Patent processing.

i. Technology licensing program--To new and existing firms.

j. Industry and public policy--Advocacy on technoeconomic issues.

k. Press releases--Public affairs statements on technology.

POLICY ENVIRONMENT FOR THE CTD PROJECT

SCOPE:

Policy environment in Karnataka State for industrial development, introduction of new technology and foreign joint ventures. Potential for policy dialogue within CTD activities.

ABSTRACT:

The National Environment: Given the centrally planned nature of the Indian economy, national policies are a dominant factor in shaping the economic policy environment for industrial development and technological upgradation in any state. While till recently the Indian economy has been very closely regulated with a set of complex and overlapping controls, the situation is undergoing substantive change. A host of liberalisation measures are opening up the economy to competition, allowing greater freedom and flexibility to businesses, encouraging technological upgradation, economic scale production and export initiatives. The need for further change has been recognised by both independent analysts and within the Government (e.g. the Mid-Term Appraisal of the Seventh 5-Year Plan), but resource constraints and concern with easing the problems of transition necessitate a cautious approach. Recently, with the announcement of the Import-Export Policy 1988-91 (February 1988), the Prime Minister's statement regarding a change in attitude towards direct foreign investment (April 1988), extension of royalty period for foreign tie-ups (July 1988), substantial change in industrial licensing limits (June 1988) and the freeing of dominant undertakings from licensing curbs applicable to MRTP Companies in areas where they are not "dominant" (June 1988), the policy reforms process appears to have gathered renewed momentum.

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Much remains to be done (eligibility conditions and alternative controls or bureaucratic delays having limited the impact of policy reforms), but there is a substantial increase in competition (largely domestic, and in some cases from imports), industrial growth rate has accelerated (from an average of 6.4% p.a. in the period 1981-84 to an average of 8.8% p.a. in the period 1984-87), manufactured exports have grown after years of stagnation, and firms are responding to increased competition by upgrading technologies, improving product quality and reducing costs and prices.

Situation in Karnataka: Within this national environment, Karnataka State provides a particularly good environment for the electronics industry and other high-technology industries which are not power intensive. While general industrial growth has lagged behind in the State due to acute power scarcity, the growth rate in these thrust industries has been far ahead of the national average. The concentration of reputed scientific and research institutions, the success of the 'electronics city' complex close to Bangalore, the plans for expansion of this complex and the setting up of a similar facility near Mysore city, the special treatment accorded to electronics and other high technology industries in the State's industrial development plans and in the recently announced package of incentives (June 1988), the excellent banking infrastructure in the State, the performance record of the state financial development institutions (KSFC and KSIIDC) and most recently the basing of the national headquarters of the Technology Development & Information Company of India in Bangalore, contribute towards providing a positive environment encouraging the development of high technology industries.

Potential for policy dialogue: Specific policy initiatives of concern to the CTD will emerge out of its activities. The composition of its Governing Board, Steering Committees and Focus Groups will enable it to exercise this influence even without a formal mandate. The national character of the CTD will help in exercising this influence since many of the relevant policies are determined by the Centre.

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REPORT ON POLICY ENVIRONMENT FOR THE CTD PROJECT

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REPORT ON POLICY ENVIRONMENT FOR THE CTD PROJECT

A. INDUSTRIAL DEVELOPMENT

A1 The National Environment

1. India has a centrally planned industrial strategy in which the Government of India (Centre) has a dominant role in shaping the overall policy environment for industrial development. The pursuit of multiple objectives has resulted in the creation of a complex system of overlapping policy mechanisms and controls, including industrial licences required to set up a plant, expand it, move it or change the product mix; additional monopoly or dominant clearances for the same purposes for large firms or industrial houses; control over mergers or closures; reservations of products or preferential treatment for small firms and the public sector; control over access to capital; controls on direct foreign investment in India; controls over foreign exchange payments including royalties for technology transfer; controls over a large proportion of imports and exports (via licensing, canalization, actual user policy, phased manufacturing programs, conditions in technology agreements, domestic purchase preferences, tariff barriers, etc); and through the system of taxes and administered prices.

2. While substantial progress has been made towards the achievement of policy objectives, productivity, output and employment performance have not always been commensurate with the resources invested, technologies having lagged behind and the policy instruments resulting in various inefficiencies. This is largely attributed to the lack of competition (and incentive to upgrade technologies and improve efficiences) due to protection in the domestic market (from internal competition as well as imports) and the lack of export rivalry (due to a combination of limited inducement to export, because of high profitability on domestic sales, as well as poor ability to compete due to outmoded technologies, inefficient capacities, etc.). Also, the complex nature of controls and their significance for profitability and growth has resulted in diversion of entrepreneurial attention to influencing/satisfying these requirements rather than to cost-cutting, innovation and quality improvement.

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3. These problems have been recognized by the Government, and a process of industrial policy reforms was initiated, which picked up speed after 1984 and continues to progress though somewhat cautiously. In general, the shift is from discretionary quantitative controls to non-discretionary fiscal controls, backed with an attempt to improve cost efficiency through increased domestic competition. Major policy changes have been in the relaxation of licensing constraints on entry in priority sectors (delicensing), allowing of greater freedom in responding to changing demand conditions (broad banding of licensing), relaxation of growth constraints through more liberal capacity re-endorsement, and encouragement of cost efficiency through reviewing/prescribing minimum scales of production. The administration of the control system has also been streamlined,and has speeded up noticeably.

4. The recently announced Import- Export Policy for 1988-91 carries forward the trade liberalization, while the Finance Act 1988 reintroduces Investment Allowance and extends substantial tax benefits for exports. More recent changes (June 1988) have eased licensing further for non-MRTP and non-FERA companies, raising the investment limit for general delicensing from Rs.50 million to 150 million in case of non-backward areas, and to Rs.500 million in backward areas; the number of industries requiring compulsory licensing has also been reduced from 56 to 26 industries. Further, for development of backward areas the government has decided to move away from "administrative regulations through licensing" to setting up and developing growth centres in 430 odd districts with substantial investment in providing good infrastructural facilities to meet industry requirements. The initial emphasis would be on developing about a hundred of these growth centres through an investment of Rs.250 million to 300 million in each such centre on infrastructural facilities, particularly power, water, telecommunications and banking. Another significant change has been the freeing of dominant undertakings from licensing curbs applicable to MRTP Companies in areas where they are not "dominant".

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5. While the various reforms introduced have improved industry performance measurably (industrial growth accelerated to 8.8 per cent during 1984-85, 1985-86 and 1986-87, from an average growth rate of 6.4 per cent in the preceding three years[1]), a number of problems remain in the regulatory system. The process of liberalisation is slow. There are instances of backtracking (e.g. withdrawal of the delicensing of 82 bulk drugs and intermediates for MRTP and FERA Companies in 1987) and a slowness (or default) in acting on certain announced policy measures. Eligibility conditions and new controls have also limited the impact of recent changes. A large number of concessions do not extend to MRTP and FERA companies, while these are often the only ones who can muster the resources required to take advantage of the liberalisation (e.g. raising of delicensing limits in June 1988 to Rs.500 million in backward aras). Similarly, the easing of licenses for increases in capacity have been limited to forms outside standard urban limits. Broadbanding is often confined to products of a narrow product range and the procedure for obtaining permission to broadband is similar to obtaining a licence. An entrepreneur entering into a delicensed field is still required to approach the Government for approval of foreign collaboration agreement, import of capital goods, phased manufacturing programme and environmental clearances. Even the requirement of registration (meant for statistical purposes) in delicensed areas is a fairly cumbersome and time consuming process.

1.Economic Survey 1987-88. Government of India; page 35.

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6. Overall, there is a significant improvement in the policy environment for industrial development, and the Government appears committed to this course. The need for further change has been recognised by both independent analysts and within the Government (e.g. the Mid-Term Appraisal of the Seventh 5-Year Plan). While the pace and scope of change may have been faster, concern with easing of the transition have necessitated a more cautious approach.

A2 Situation in Karnataka

7. Karnataka state must necessarily function within the framework of the national policies. The Industrial Policy Resolution of the State (July 1983) and the State's revised package of incentives and concessions for industry (June 1988) bring out the State's priorities. These must, however, be viewed in the context of Karnataka's acute energy crisis, tight financial position and infrastructural problems due to heavy concentration of industry around Bangalore city.

8. Karnataka sees the role of the State as one of a catalyst in promoting industrial development in desired areas through provision of improved infrastructural facilities, rather than through direct investment or budgetary support. Major incentives under the revised package are sales tax exemption (for tiny and small scale industries) or deferment (for medium and large scale industries) for five to seven years, and a state investment subsidy of 15 to 20 per cent of the value of fixed assets, subject to monetary limits.

9. The State's industrial policy emphasises dispersal of industry and provides for development of industrial estates at various growth centres to provide the necessary infrastructure. The package of incentives and concessions is also linked to the location of the industry, no incentives being generally available in Zone I (developed areas), with differential rates and limits being applied to Zone II (developing areas) and Zone III (industrially backward areas).

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10. The Industrial Policy also emphasised the development of small and tiny industries[2] (1,000 additional units to be set up every month), other industries based on human and natural resources available, and industries which are not power intensive. The electronics industry (already drawn to the State due to climatic factors, availability of qualified technical personnel and location of similar units, scientific and research institutions, and other infrastructural facilities) is treated on a special footing and allowed full scope for development throughout the state, including the developed areas. The Karnataka State Electronics Development Corporation Limited (KEONICS) has developed India's first 'Electronics City' (a 345 acres integrated complex of small, medium and large scale electronic units, supported by requisite infrastructural facilities) about 10 miles out of Bangalore city. This is proposed to be expanded by 200 acres, while another similar complex is also planned to come up near Mysore city. The revised package of incentives (1988) treats telecommunications, food processing and biotechnology industries on par with the electronics industry, extending to them the package of incentives normally available to units in the industrially backward areas (Zone III) even when these are located in the developed areas. Twentynine specified industries have been excluded from the purview of the new package of incentives, including power intensive units, wood based industries, State and Central undertakings, and any industry with an investment in fixed assets of more than Rs.200 million. Local employment is sought to be encouraged through insistence on provision of at least 80 per cent of jobs in new units to local people for entitlement to State incentives.

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2. Tiny industries are defined as units with investment in plant and machinery not exceeding Rs.200,000; small industries are defined as units with investment in plant and machinery not exceeding Rs.3.5 million (Rs.4.5 million in case of ancillaries).

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11. Karnataka state is one of the first to have introduced the concept of single window agency for granting clearances required by industry at the state level as well as the district level. This agency meets once a fortnight and takes care of all aspects concerning an industrial venture, so that industrialists do not have to deal separately with a number of agencies to get all the sanctions and clearances required in the setting up of a unit.

12. A major constraint to industrial development within the State is the acute scarcity of power (the power deficit in Karnataka being estimated at around 30.6 per cent in 1987-88[3]). Relatively high State taxes (incidence of state sales tax in Karnataka is the third highest in the country[4] and the State has a 2 per cent entry tax on industrial inputs as well as a turnover tax) are also regarded as a impediment to the development of industry and trade.

13. In general, while in overall terms the Karnataka state has moved down in an inter-state comparison of industrialization[5], the rate of growth is very good in electronics and in other high technology industries which are not power intensive. The State provides an excellent environment for these industries largely due to its infrastructure of scientific and research organizations (Bangalore is known as the 'Science City'), and has recognized their strategic importance for the State by freeing them of locational constraints.

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3. CMIE, Monthly Review of the Indian Economy, April 1988.

4. As per Reserve Bank of India figures quoted by the Commissioner of Commercial Taxes, Karnataka State, in a personal interview.

5. From third place to sixth place as per a statement made by the Industry and Power Minister, J.H.Patel, in the State Legislative Assembly on June 3, 1988 (Source:Hindu, June 4, 1988_).

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B. THE INTRODUCTION OF NEW TECHNOLOGY

14. A critical factor in the Indian policy environment which had been holding back the introduction of new technology was the high degree of protection to industry. With the recent and ongoing opening up to competition, and a greater thrust to exports, a more favourable environment is being created for technology upgradation. While increased necessity due to market factors is the strongest motivational factor for introduction of new technology, specific policies influencing this development are the policies relating to foreign collaborations (financial and/or technical), import of capital goods and indigenous research and its commercialization.

15. To help in the acquisition of appropriate technology from abroad[6], the Government of India is operating a scheme called the "National Register of Foreign Collaborations" (NRFC). This covers the compilation of data on foreign collaborations and specific analytical studies on different aspects of technology acquisition such as choice and source of technology, alternative means of acquisition, analysis of imported technologies from various angles such as financial, economic, legal and technological, and a study of the unpackaging of technology components to avoid their repetitive imports. Another scheme, the "Technology Absorption and Adaptation Scheme" (TAAS) strives to improve the level of imported technology in use in the country by providing catalytic support for accelerated absorption and adaptation of technologies by the industrial units.

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6. A discussion on the foreign collaborations policy is contained in the next section.

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16. With regard to import of capital goods, the Import-Export Policy 1985-88 introduced some degree of liberalisation by placing on Open General Licence (OGL) selected items of machinery and equipment not domestically available but required to improve the quality of production and to upgrade technology. These items, however, related mainly to a few industries assessed to have significant export potential. Further, the Union Budget 1985-86 reduced protection by lowering duty on project imports to 55%, on fertiliser machinery to zero, and on power plants to 25%. Protests by indigenous manufacturers resulted in some backtracking in 1987 with project imports duty being raised to 85%, fertiliser machinery duty to 15%, and power plants (below 50 MW capacity) to 35%. Modernisation in capital goods industries has been encouraged through a notification of 120 items of capital equipment which could be imported at a concessional import duty of 35 per cent under IDBI's Technology Upgradation Scheme.

17. The recently announced (March 1988) Import-Export Policy (1988-91) carries forward the trade liberalisation, within the constraints of domestic and external resources. Permissible imports under OGL have been increased by 745 items, including 99 items of capital goods most of which relate to the electronics, tea and silk industries. Another bold step is the formulation of a scheme permitting, for the first time, import of selected capital goods without clearance from the angle of indigenous availability. This scheme is restricted to manufacturer exporters of a certain minimum size, and the Government hastened to contain the political fallout by clarifying that the permissions would be given only on a case by case basis. However, the scheme is a significant departure from the practice of restricting imports to particular items of machinery not available in the country. The Technical Development Fund Scheme, allowing import of technology and capital goods by existing industrial units, has been further liberalised in April 1988.

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18. The expenditure of recognized in-house R&D units in industry is estimated to have increased from Rs.2 billion in 1980-81 to Rs.6 billion in 1987-88[7]. To encourage R&D activities the Government allows liberalised import facility to all recognised R&D units for importing their full requirements of technical and professional equipment, raw materials, components and spare parts on OGL (subject to actual user condition). Import of know-how, design, consultancy etc. upto a value of Rs.10 million is also allowed to in-house R&D units meeting certain conditions. Public funded R&D units are further allowed customs duty exemption on their imports upto specified limits. Fiscal incentives for scientific research earlier provided through weighted tax deductions have been discontinued, but expenditure on in-house research and contributions to not-for-profit scientific research associations continue to be tax-deductible, while the income of the scientific research associations is exempt from tax (subject to certain conditions).

19. To encourage commercialisation of R&D efforts, and to assure businesses that they would be able to obtain an industrial licence to commercialise the results of their R&D effort, the Government allows preferential treatment in licensing for commercial exploitation of in-house R&D results to non-MRTP and non-FERA companies. There is also a provision for delicensing of industries set up on the basis of knowhow developed by the applicant's in-house R&D unit, or obtained from a National Laboratory or an approved R&D unit (though this does not also extend to MRTP and FERA companies or for items reserved for the public sector or the small scale). A higher than normal depreciation allowance is also allowed in tax computation on plant and machinery installed for manufacture of goods based on indigenous technology.

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7. Annual Report 1987-88, Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India, page 42.

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20. The financial institutions have a number of schemes to provide finances for technology upgradation and modernisation. Notable among these are concessional loans from the Technical Development Fund (TDF), Modernisation Assistance Scheme, Technology Upgradation Scheme (TUS) and Textile Modernisation Fund Scheme. There is a Technical Assistance Fund (TAF) to finance a wide range of promotional activities like preparation of techno-economic surveys, entrepreneurialship development programmes, research projects and research institutions in the field of industrial economics, support to Technical Consultancy Organizations and for upgradation of the skills of State-level institutions concerned with industrial development. There is also an interest subsidy scheme for encouraging the adoption of indigenous technology as well as a concessional loan scheme for assisting in development of technology through in-house R&D efforts.

21. While funds for commercialisation of laboratory research are scarce, recently a number of schemes have been set up by institutions to tackle this problem. These include assistance provided by the National Research Development Corporation (tasked with transfer of technology from public funded laboratories and research institutions), the Risk Capital and Technology Finance Corporation, the Technology Development and Information Company of India, and the IDBI's Venture Capital Fund.

22. For improved information flow the National Information System for Science and Technology (NISSAT) programme envisages promotion and support to the development of a compatible set of information systems on science and technology and interlinking of these into a network.

23. In order to provide a stimulated environment for converting basic research findings into commercially viable products and for creating a facility nucleated around academic or research institutions, Science and Technology Entrepreneurs Parks (STEPs) are being set up on the lines of Science Parks in USA and UK. Six such parks are coming up in Ranchi (Bihar), Tarapur (Maharashtra), Tiruchirapalli (Tamil Nadu), Kanpur (Uttar Pradesh), Mysore (Karnataka) and Calcutta (West Bengal), while 5 other institutions are getting support for promotional and pre-operative expenses for the establishment of STEPs.

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24. A significant factor in shaping the policy environment for introduction of new technology is the law relating to proprietory rights protection. India is not a signatory to the Paris Convention and the salient features of the patent laws in India are:

- Term of Patent, which is 15 to 20 years in most countries, is 14 years from date of patent in India (Except for "food, medicine or drug substance" where it is 7 years from date of patent or 5 years from date of sealing, whichever is shorter); there is no provision in Indian law enabling extension of term.

- In India, only process patents are allowed in case of "food, medicine or drug" substance, and "other substance prepared or produced by chemical process"; also, burden of proof of infringement is on the patentee though this is difficult to prove in case of process patents. This makes patent protection substantively weaker in these cases.

- What is patentable under Indian law may also be more restrictive as Indian patent authorities and courts continue to apply the 'vendable product' test which has undergone much change in the technologically more advanced countries.

- Wide provisions exist in Indian law for compulsory licensing, granting of licence of right, deemed endorsement with licences of right and right to use by Government. In practice, however, these provisions are very rarely invoked.

- Granting of patents normally takes around 3 years from the date of filing to the date of sealing (still fairly long but a considerable improvement over the 4 to 5 years period till a few years back). Confidentiality of information with patent office before acceptance of complete specifications is very high.

- Remedy for infringement is through court process which is fair and reasonable to the patentee, but time consuming.

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While statutory protection is less than in developed countries, the degree of practical protection is widely perceived to be considerably more than provided in law, as the general state of technology does not permit firms to set up production facilities for medium or high-technology products without having full details of drawings/designs and technical assistance in putting up the project.

25 There are very few specific measures within the State's ambit with the potential for directly influencing the policy environment for introduction of new technology. The large number of leading research and educational institutions in Karnataka State, and the encouragement being given to electronics and other high technology industries, are the main ways in which this effort is supported in Karnataka. The technology transfer/industry interface departments of the Indian Institute of Sciences, the Central Food Technology Research Institute, Indian Space Research Organisation, National Aeronautical Laboratory etc. provide the potential for extending research findings to industry and using research institutions to meet industry needs. The setting up of the Technology Development and Information Company of India with national headquarters in Bangalore should aid the effort by facilitating availability of funds as well as technical information. An earlier State scheme for subsidising procurement of knowhow by industry has been discontinued in the newly announced package of incentives, but is unlikely to be missed as it had reportedly not been used much.

C. FOREIGN COLLABORATIONS

26. The policy relating to foreign collaborations (investment and technical knowhow) is determined entirely by the Centre. Foreign investment is allowed on a selective basis, in a wide range of sectors, and equity participation is normally restricted to less than 40 per cent. Higher equity is however permitted in areas of high technology or where there is a special contribution to exports. Companies with foreign equity participation below 40 per cent are generally treated on par with wholly Indian companies; companies with foreign equity in exces of 40 per cent (commonly known as FERA companies) are only permitted to grow in specified sectors.

27. Royalty payment rates depend on the nature of technology, but are normally not allowed to exceed 5 per cent of production value (net of excise duty, standard bought outs and imports). Lumpsum payments are permitted to be made for import of knowhow, technical designs and drawings, the amount together with royalty payments normally not being allowed to exceed 8 per cent of the value of production over the period of the agreement. The high Indian income tax rates to which royalty income and technical knowhow fee is subjected (30 per cent of gross amount except where lower rates are specifically provided in double taxation avoidance agreements), and the 5 per cent R&D cess imposed on these payments from December 1987, increase the cost of foreign technology to the Indian party while reducing the amount flowing to the collaborator.

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28. While there is little change in the basic policy, recent years have seen a more liberal attitude on the part of the Government towards foreign collaborations in terms of permitting imports of technology and simplification in procedures. The number of foreign collaboration approvals have gone up sharply from around 300 per year till 1980, to 590 in 1982 and 1024 in 1985. There has been a marginal decline to 957 in 1986 and 853 in 1987. While the time consuming process for taking on record of foreign collaboration agreements have been dispensed with, and other administrative simplifications have been introduced, the Prime Minister has promised that further simplification in processes, and speeding up of procedures, would be effected.

29. Recently (July 1988), the Government decided to extend the period of royalty payments from the existing five years to seven years. A higher period of royalty payments could also be considered where the foreign collaboration proposals pertain to high technology areas and in cases where the technology adoption would invariably take a longer time. Also, the Government has decided not to insist on strict compliance with the phased manufacturing programme (PMP) where import content has already been reduced to 30 per cent (as against the earlier requirement of reduction to 10 per cent). Another significant change is the Government decision to encourage foreign equity partcipation as part of the foreign collaboration proposal, rather than to opt for outright purchase of technology or components for executing projects on PMP basis. This is being done to facilitate a rapid transfer of technology and to ensure continued flow of technology upgradations carried out by foreign collaborators.

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D. POTENTIAL FOR POLICY DIALOGUE/POLICY CHANGE

30. The role of the CTD project in policy dialogue/policy change is strategic but must necessarily be subtle. The activities sponsored by USAID during the project development phase seem to have influenced Karnataka State's policy formulation, with the recently announced package of industrial incentives/concessions according special treatment to the high technology industries identified as having special potential in the State's developmental context.

31. On a continuing basis, the specific areas in which the CTD would seek to influence policy dialogue/policy changes have not been pre-identified. These are expected to emerge out of the activities of the CTD, such as the national seminars proposed to be organized annually in each focus area. The CTD is also expected to influence policy through the members of its Governing Board, Steering Committees and Focus Groups. The position of these members in Government and in industry would enable CTD to exercise this influence without a formal mandate to cover this activity.

32. While the Government's insistence on the CTD assuming a national character may possibly dilute the regional focus of the project, it does place it in an advantageous position for taking policy initiatives at the Centre which, as the preceding analysis shows, may be required due to the federal structure and centrally planned nature of the Indian economy.

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Scope of Work

Background

The context of the contractor's action is the design of a technology development project located in Bangalore, Karnataka State, South India. The objectives and structure of this project are set forth in the Project Identification Document dated January 29, 1988.

The contractor is expected to thoroughly familiarize him/herself with the basic materials on the project such as the PID and its supporting documentation.

In order to meet the requirements of this consultancy the contractor will engage in discussions with USAID/India, Government of India, Government of Karnataka, the Industrial Credit and Investment Corporation of India Ltd. (ICICI), Bangalore-area academic institutions and industrialists as directed by the Office of Technology Development and Enterprise, USAID/India, but will be expected to exercise a considerable degree of autonomy and initiative in establishing and executing an in-country work program.

Work Requirement

The contractor will prepare a report that will cover the following activities:

i) Criteria and procedure governing AID funded technical assistance and training; and
ii) AID funded procurement.

The specific work relating to the above activities will be as follows:

Criteria and Procedures Governing AID-funded Technical Assistance and Training

The contractor will:

a) While working with AID and the Indian project counterpart(s), develop and provide a set of appropriate criteria to help determine the selection and allocation of funds for U.S. consultants and U.S. based as well as India based training program under the CTD project. These criteria shall be oriented to the subject areas, i.e., scientific disciplines/ industrial processes, as well as new institutions, e.g.

applied research centers and buyer/supplier programs, to be addressed under the project. In this regard, the work of the contractor will include, but not be limited to, the fields of food processing, informatics, and biotechnology. The criteria will also suggest the types of planning assistance and associated training appropriate to the CTD effort, i.e. of US expertise in the planning for state-level action for technology development, planning for university-industry centers of excellence, industry "incubators", science and technology parks, etc.

The criteria shall include recommendations concerning the apropriate role for Indian private industry in the establishment, management, ownership, and financial support for the organizations and instituitons to be developed pursuant to the implementation of the CTD project. In this regard, the contractor will address the role of small and medium industry and local business organizations as sponsors, suppliers, and beneficiaries of the activities to be carried out under CTD sponsorship.

b) Suggest a broad 'positive' list of subjects, areas, and disciplines against which AID funding may be applied, as well as a narrrow 'negative list' of activities which would be excluded (e.g. defense, aerospace, nuclear, weather modifications). The illustrative list of project funded activities shall indicate (i) fit with criteria, (ii) nature of activity and (iii) estimated budget.

c) Incorporate a set of recommendations concerning cost-effective means for accessing pertinent U.S. expertise and training as well as the organization of training in India where appropriate.

d) Provide a set of recommendations concerning cost-effective approaches to the establishment of satellite-based technical information linkages between the US and India, with emphasis on accessing of computerized data bases in the US.

e) Provide a discussion of pertinent issues concerned with potential direct transfer of technology which may occur in connection with the technology development activities to be undertaken under CTD sponsorship, and in particular shall review any pertinent issues concerning protection of intellectual property rights and regulatory considerations.

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AID-funded Procurement

The Contractor will:

a) provide an illustrative list of the types of special equipment, e.g. scientific measuring and testing equipment, CNC machine tools, and process control instrumentation, which would be pertinent to the establishment of one or more of the anticipated sub-activities under the project. Inasmuch as lack of foreign exchange per se is not likely to be a constraint to project implementation, the recommendations of the contractor in this regard shall address the advantages, if any, of the flexibility afforded the project sponsors from AID-funded procurement; the possible benefits of acquiring a specialized purchasing agent; and the possibility of more rapid customs clearance in India for AID-financed procurement.

The Contractor will submit the report to the Assistant Director, Technology Development and Enterprise, USAID/New Delhi before leaving New Delhi.

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SCOPE OF WORK

A. **Background:**

The context of the contractor's effort is the design of a technology development project located in Bangalore, Karnataka State, South India. The objectives and structure of this project are setforth in the Project Identification Document dated January 29, 1988.

Work Requirement:

The contractor will prepare a report that will address the issues relating to Human Resources Development in the CTD project paper.

B. **Statement of Work:**

The Contractor will:

1. Have indepth discussions with the staff of selected Indian institutions of Management/Business in Karnataka so as to assess their capacity in commercializing technology and identify institutional factors that are thought to have an impact on technology development.

2. Recommend particular capacity-building efforts that need support (and can be supported in early phases of CTD's development) to produce resources needed in latter phases e.g. technical training, faculties development program.

3. Identify HRD components including processes that need to be institutionalized over the longer term (whereas others may be temporary or periodic e.g. specific training courses).

4. Recommend priorities and routes for decision makers to consider in developing a strategy to foster a dynamic human resource base, responsive to a market-driven commercial technology development process.

5. Recommend a systematic monitoring effort to trace the progress of HRD in the project and guide mid-project corrections.

6. Suggest a menu of short-term consultancies and/or training programs which will support the achievements of HRD objectives.

7. Suggest cost-effective means of reaching TA and training resources in the U.S. for HRD.

8. Recommend how best to incorporate Women in Development (WID) concerns in the design of HRD in the CTD project.

9. The contractor will submit a draft report to the Assistant Director, Directorate of Technology Development and Enterprise, USAID/New Delhi at least two days before leaving New Delhi. A final report will be sent to USAID within 30 days thereafter.

C. Implementation:

The contractor will (1) thoroughly familiarize him/herself with the basic materials on the project such as the PID and its supporting documentation; (2) engage in discussions with USAID/India, Government of India, Government of Karnataka, the Industrial Credit and Investment Corporation of India Ltd. (ICICI), Bangalore-area academic institutions and industrialists as directed by the Directorate of Technology Development and Enterprise, USAID/India; and (3) exercise a considerable degree of autonomy and initiative in establishing and executing an in-country work program.

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Scope of Work

(A) Background

The context of the contractor's effort is the design of a technology development project located in Bangalore, Karnataka State, South India. The objectives and structure of this project are set forth in the Project Identification Document dated January 29, 1988.

(B) Statement of Work

1. The contractor will prepare a detailed monitoring and evaluation plan for the Center for Technology Development project. The plan will be designed to accomplish, inter alia, two main purposes:

(1) tracking and assessment of the contribution of AID-funded inputs, e.g. consultancies, training and equipment; and

(2) assessment of the broader success of the CTD project in achieving an accelerated process of technology development in Karnataka. The Plan will also include an assessment of how Women in Development (WID) issues can be addressed in the monitoring and evaluation process.

The contractor will also suggest an appropriate methodology for constructing a set of base-line data for the project, and for the design and scheduling of subsequent evaluation activities. The contractor will also assess the feasibility of installing a management information system for the CTD project.

The contractor will provide recommendations concerning the use of local resources for evaluations, based on discussions with Indian organizations such as the Indian Institute of Sciences (ISC), Indian Institute of Management (IIM), Operations Research Group (ORG), etc.

(C) Implementation

The contractor will

(1) thoroughly familiarize him/herself with the basic materials on the project such as the PID and its supporting documentation, and to the extent available, with detailed design materials prepared by other contractors (see below).

(2) Engage in discussions with USAID/India, Government of India, Government of Karnataka, the Industrial Credit and Investment Corporation of India Ltd. (ICICI), Bangalore-area academic institutions and industrialists as directed by USAID Project Officer Robert W. Beckman. Within USAID/India, the Contractor will also

coordinate with the project office and the Evaluation Division of the Program office.

(3) Exercise a considerable degree of autonomy and initiative in establishing and executing an in-country work program.

The contractor will submit a draft report to the Assistant Director, Directorate of Technology Development and Enterprise, USAID at least two days before leaving New Delhi. A final report will be submitted ot USAID within 30 days thereafter.

III. HUMAN RESOURCE DEVELOPMENT AND CTD: TECHNICAL ANALYSIS

A. Framework for Analysis and Recommendations

Analysis of human resource development needs in the CTD Project is based on the framework presented in SRI's Karnataka in Transition: Blueprint for Action. Accordingly, the capacity of institutions to generate appropriate human resources in small and medium firms in emerging and expanding industries in the near, medium and long term is discussed in this section. (It should be noted that since no transforming industries have been included in the first phase of the CTD Project, analysis of human resource development with regard to this sector is not included in this report.)

Within the SRI framework, a systems approach is used to gauge capacity and response of human resource producing institutions (institutes, universities, polytechnics, training centers). This approach analyzes institutions in terms of:

> their inputs (faculty, financial resources, facilities, students, and demand linkages to their environment),
>
> their production technology (curriculum, learning methods, production capacity),
>
> their outputs (quality and quantity of graduates, of the knowledge generated by the faculty, of the research and consulting capacity, and importantly, and
>
> the linkage of these outputs to the rest of the infrastructure for technology development in Karnataka, within the SRI framework.

By the last is meant the relationship of the outputs of the human resource institutions to the needs of the finance mechanisms, the ~~research and development~~ and production facilities, and the organizational networks of buyers and suppliers, all of which constitue the technology development infrastructure in Karnataka, or any economic system.

B. Near Term Human Resource Development Needs of Emerging and Expanding Industries

Project support will address near, medium and long term human resource development needs, each of which has two dimensions: the level of the human resource producing institution, and the kind of technology challenge shown in Figure

II-1. In this section near term needs will be discussed.

In the emerging industries of informatics and biotechnology, the "first order" challenge is to deploy "off-the-shelf" technology which will keep pace with domestic and international competitors. This requires a combination of entrepreneurial, technical and management skills which will allow the emerging industries in Karnataka to take the necessary risks and to tailor their research to market needs.

In expanding industries the near term needs are similar to those in emerging industries. There is concern with preserving market share, expanding product lines and introducing new products. In the CTD Project, food-processing has been identified as an expanding industry which will receive project attention and support. There is considerable potential for this industry to expand domestic markets, and to move into international markets in some product lines if new technologies and marketing strategies are developed.

Near term needs relate to helping the market work better. Consequently, a high priority near term need is strengthening the capacity of emerging and expanding industries to respond to frequent technology and market changes. Flexibility is a key to success, and derives from confidence in ability to make changes at technical and managerial levels. Such confidence stems from knowledge about the conditions which lead to changes, and in the process of making changes. Management skills in forecasting, R&D management, modern manufacturing management, global competitive analysis are needed, as well as improved skills in production.

Findings and recommendations regarding near term human resource development needs of both industries are presented below.

1. Findings.

The present capacity of educational/training institutions in Karnataka to assist R&D organizations and production units in commercializing new technology in small and medium scale organizations in the emerging industries of informatics and biotechnology and the expanding industry of food processing is extremely limited. This assessment is shared by those in the educational and training institutions and the client organizations, and applies across the full range of institutions from IISc, IIM/B, regional universities and polytechnics, to public and private training institutes. It also includes the special units within financial institutions such as KSIIDC and KSFC, and the Research and Training sections of the District Industrial Centres which have this function. In the remainder of this section an analysis will be made of the institutions generally concerned with the near term human resources. These include vocational training and the regional polytechnic, as well as the continuing education programs of universities and institutes such as IISc, IIT and IIM/Bangalore.

There are many factors which limit present capacity. The primary ones are:

(a) Inputs: The faculty who are available for teaching/training, research and consulting do not have a firm knowledge base of what constitutes successful patterns of off-the- shelf technology development in biotechnology, informatics and food-processing. This is not to suggest that there have not been success cases; there have been, just as there have been failures. However, the patterns of success and failure have not been adequately researched, or if they have been, findings are not felt to be readily available through cases and other training materials. Few of the institutions have a clear strategy to develop ~~this~~ knowledge base. For example, IIM/B, an obvious resource for near term research and consulting related to managerial and financial needs, has only recently begun to develop the consulting and training linkages which would provide the insight and experiences necessary for systematic analysis of technology commercialization strategies. These emerging linkages need substantially more conceptualization and resources if they are to provide the needed knowledge base.

In the research and consulting wings of the financial institutions, there is a shortage of trained staff who would carry out training and consulting functions, and it is felt that the current advice and guidance provided to entrepreneurs is based on a knowledge base limited to traditional industries serving domestic markets.

The facilities available for teaching/training and research purposes are insuffucient in quantity and, in many of the ITIs and polytechnics, are lacking in state-of-the-art equipment needed for near term results.

There is general consensus that the quality of students available for near term training is adequate, though in the ITIs there are occasional problems of language and initial adaptation to rigorous learning discipline.

A major limitation to the enhancement of these input resources is lack of financial resources. For example, in the ITIs there does not appear to be adequate incentives for faculty to upgrade their skills. Trainers are encouraged to use the summer break in the training calendar to pursue their own professional development. However, few respond to the calls from industry sponsored training programs, since their pay stays the same regardless of whether they attend such programs.

There is hope that recent policy changes will give some institutions more autonomy, and thus more latitude to increase resources through self-financing and other alternatives.

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(b) HR Production Technology: At the technical/vocational level there are excellent examples of curriculum development oriented to near term human resource needs. For example, the Government Tool Room and Training Centre and the NTTF Electronics Training Program both have excellent curricula. On the other hand, the ITIs and the polytechnics need considerable assistance in bringing their curricula up to a standard that will produce human resources capable of having an immediate impact in the areas of informatics, biotechnology and food-processing.

Those responsible for developing and implementing training programs through the Directorate of Vocational Training and Employment and training units of state government do not have the same opportunities to travel abroad to gain new ideas and techniques to improve training in their organizations as do their counterparts in the industry sponsored training units. This contributes to a lag in techniques as well as a feeling of inferiority about program capability.

In the area of entrepreneurial development, including managment and finance, the curricula and training content of the institutions attempting to serve these needs require considerable strengthening. Most lack skill development that is directly related to flexible and proactive marketing of "off-the-shelf" technology.

The learning methods used at the Government Tool Room and Training Centre and the NTTF Electronics Training Program both achieve a desirable balance of knowledge, skills and values. At other education and training institutions this balance has yet to be achieved. In the ITIs more emphasis is needed in conceptual skills and in developing a value base that is appropriate for working in or managing a small scale organization. In the polytechnics there is insufficient emphasis given to technical and managerial skill development, perhaps reflecting the lack of training facilities needed for these learning tasks, and the lack of faculty training in these areas.

Through a special project IIM/B faculty will provide two weeks of training to faculty of regional polytechnics on entrepreneurship. This effort does not have curriculum development goals at the polytechnics, nor is there an explicit plan for providing training materials. The general purpose is to share information, which presumably will then be echoed in an ad hoc fashion to students at the polytechnics sometime during their studies. In sum, there is not an appropriate mechanism to transfer this information effectively, and it can be expected that the effort will have little lasting effect.

All of the training units, from top academic institutions to ITIs are drastically short of appropriate learning tools, especially computers. A key reason for this is that most faculty members, trainers, and decision-makers (deans and directors) do not know how to use these tools themselves, and therefore underestimate and undervalue their need. Until this group of people becomes competent in the use of these tools this problem will persist. A secondary reason for these shortages is cost. Budget resources are dedicated primarily to staff salaries, with little funding available for equipment purchases.

The production capacity of the educational and training institutions is seriously limited. For example, there are entrepreneur development programs being conducted by financial institutions and other government agencies. KSFC has conducted two such programs in the last year, reaching a total of 150 persons. Similarly, the Women's Cell of TECSOK/GOK has an Entrepreneur Development Program supported by the Ford Foundation. The Single Window Agency of KSIIDC also attempts to provide assistance to entrepreneurs, as do the District Industries Centres. In all cases, the numbers of entrepreneurs reached is a small fraction of those who need assistance. Often the effort is not targeted to specific industry areas (and thus the information is too general), and the format for providing the information does not provide opportunity for follow-up.

In short, the number of persons trained in near term production and entrepreneurial requirements is felt to be far less than the numbers needing such training. The production capacity is limited by the resources available for faculty/trainers, for learning facilities, and for learning approaches and tools.

(c) Outputs: As indicated in the statement above, limited human resource production capacity means that not enough appropriately educated and trained personnel, with skills needed for near term requirements, are going to be available in the next 1-3 years. This will limit CTD's ability to achieve early successes, unless options are used to address this situation.

Furthermore, the quality of persons trained, and the quality of the research and consulting assistance provided by the whole range of institutions needs to be focused more clearly on near term requirements. The intention of the Single Window Agency at both the state and district level is not being met, in terms of outputs, or in terms of serving real demand for these services, largely because of deficiencies in the level of funding for adequate input and production capabilities.

In addition, special attention needs to be given to strengthening the capability of training institutions and other organizations, such as the technical assistance wings of the financial institutions, in providing consulting services as a follow-up to the training activities. None of the small and medium scale organizations are likely to have the resources to develop their own in-house planning and evaluation capabilities regarding any aspect of management (including marketing, production, and new product or process research and development. This capability needs to be developed within a range of supporting institutions, such as those identified above.

(d) Linkages: More needs to be done to strengthen the linkages among the institutions which provide the human resources and the rest of the technology development infrastructure in Karnataka, especially with regard to near term needs. For example, there is a feeling among industry leaders that educational institutions lack a strong commitment to responding to the needs of industry. Evidence offered to support this view includes: training courses aren't offered in specific areas of need, and in formats that are conducive to problem solving, nor at times most convenient to busy entrepreneurs.

The linkages to the financial institutions need to be strengthened considerably so that they are better able to fulfill their functions. Better training of their staff with regard to the new technologies in the fields of informatics, biotechnology and food-processing is needed so that venture capital requests can be processed more efficiently and effectively.

Better information sharing mechanisms are needed to assist industry users and trainers/consultants in knowing about market changes and technology developments. There is a need to strengthen the information transfer linkages between institutions in Karnataka and sources of new information, such as institutions of higher education and R&D in the US and other countries. At present the flow of information needed for research, consulting, and other critical aspects of management related to the commercialization of technology in limited. Limiting factors include: lack of knowledge about sources of information; financial resources to subscribe; hardware and software to acquire, update and disseminate information in a timely and usable manner to users.

2. Recommendations.

(a) Inputs: Strengthening of the faculty/trainer inputs in near term institutions and with regard to near term technology challenges should be pursued through the following recommended activities:

* a training of trainers program in consultancy skills in the areas of marketing, project planning and implementation, and supervision for staff of KSIIDC, KSFC, and DIC. This could be done in collaboration with IIM/B as a follow-up to the research recently completed by IIM/B in DICs.

* a training/consultancy program for faculty

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and trainers/supervisors from industry on planning, implementing and monitoring formal experiential learning programs (such as cooperative education and structured internship programs which provide concrete skills and help shape appropriate values) for students in near term institutions, such as the polytechnics;

- a consultancy/training program with IIM/B to help develop its entrepreneurship program with the faculty of regional universities and polytechnics;

- a training/consultancy program to develop, use and monitor the effects of video and computer based learning resources in entrepreneur development programs. This activity would develop capacity to adapt imported resources and create indigenous resources, and more importantly, would help increase training production and improve its effectiveness.

With regard to student inputs, special consideration should be given to expanding the capacity of the system to accomodate women. Significant efforts are under way through projects of other donors which are relevant to this project. For example, approximately 45% of the World Bank grant for improving the ITIs is allocated to training for women. The Ford Foundation has a project in Karnataka in assisting women entrepreneurs.

CTD should determine how it can best relate to these activities in order to further USAID's WID goals.

Consideration should be given to establishing a focus group for Women in Technology Development and Its Commercialization. If a group is established, it should follow the same developmental process as the other focus groups, including a study tour to establish linkage with appropriate resources for its special needs.

Consideration should be given to establishing a "fast track" group of women for faculty careers and for staff and management positions in the state agencies which are attempting to carry out entrepreneur development programs. A particular intent with this latter group might be to develop women trainers and consultants to work with women entrepreneurs.

Facilities need to be expanded and upgraded, especially in the polytechnics. The Government of India and other donors have plans to improve facilities and expand their capabilities, and the CTD Project should carefully coordinate its plans regarding support for facilities with these efforts.

(b) HR Production Techniques: Along with better facilities, deans, directors, faculty members, trainers and other key staff need hands-on training in the use of modern tools of learning. More up-to-date learning tools need to be acquired. Considerable savings can be realized by making it easier and cheaper for industry to give its surplus equipment to training programs.

Regarding curriculum development, CTD should facilitate the development of a strategy to conduct research creating the knowledge base for commercializing technology in the targeted areas, and disseminating this information in an effective manner. This strategy should include the division of labor among the interested institutions for implementing research, developing materials, training trainers and appropriate staff at educational and financial institutions, and monitoring the dissemination of this information through entrepreneur development programs and other educational/training activities carried out by involved agencies.

To initiate the planning of this activity, a small (3-4) team of researchers/trainers from the key educational and financial institutions and a representative of industry should carry out a study tour in the US and appropriate Asian countries (e.g. Korea and Taiwan) in order to gather insight into designing a research and dissemination strategy.

(c) Outputs: If the recommendations indicated above are carried out, there will be an impact on HRD outputs. More and better prepared individuals will leave the near term training institutions.

Faculty/trainers will be prepared to carry out more effective research and consultancies concerning "first order" technological challenges, keeping firms in the informatics, biotechnology and food-processing industries more attuned to market demands. They will also be better prepared to design and implement more effective continuing education programs for mid-level and senior executives on entrepreneurship and R&D management.

The development of consulting capabilities needs to be integrated and coordinated with the activities to develop the knowledge base discussed above. Consequently, CTD should facilitate a process towards this end, working closely with the key institutions currently engaged in efforts to provide consulting services to entrepreneurs in target areas. A strategy of training programs should be developed and implemented to upgrade consulting skills related to the specific needs of the target areas. In order to lever limited resources for this need, a small team of skilled consultants should carry out a study tour similar to that recommended for the research needs. At the conclusion of this tour, this team should then engage in a systematic process of training other trainers in the key institutions likely to be called upon by entrepreneurs in the target areas for consulting services.

Training programs run be industry and government should be given substantial incentives for expanding their programs and for running them on a cost-recovery basis. Substantial increases in training capacity can be achieved without increasing capital

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equipment costs by making more effective use of facilities through more use of training shifts. Revenue generating shifts, (that is where the full, real costs of training are paid for by the trainees, or a specific firm or industry) should be scheduled during times that promote maximum revenue generation, and traditionally subsidized training should be scheduled during non-peak hours of revenue generation.

(d) Linkages: A general recommendation is that a Human Resources Focus Group be established to assure coordination of HRD activities through CTD with those of other focus groups. This focus group should also coordinate with HRD planning bodies of other entities, such as the Entrepreneur Development Program of the State of Karnataka, and the curriculum review mechanisms used to plan the courses of the ITIs, the Foreman Training Institute, and the polytechnics. The HRD focus group should address near, medium and long term needs in emerging and expanding industries.

In order to assure maintenance of a market-driven, applied orientation character of this project, all focus groups, including HRD, should be chaired by individuals with a demonstrated commitment to achieving practical, timely results.

It is recommended that Focus Groups regularly consider the linkages among the elements and organizations who share near term technology development concerns, and assure that CTD planning and activities are addressing these needs adequately.

In order to assure maximum use of resources for the acquisition of technology information, a Technology Information Coordination Committee should be estaplished which would regularly and systematically survey the information needs of organizations associated with the efforts of CTD, and assess the uses made of information and data being acquired. This committee should be responsible for the line-item in the CTD budget for technology information acquisition.

C. Medium Term Human Resource Development Needs of Emerging and Expanding Industries

Medium term needs generally are concerned with "second order" technology challenges. These challenges involve "technology capture" in investment processes and emphasize applied technology development and refinements which hasten commercialization. For example, in the food-processing industry there are a variety of new packaging materials and technologies which have great potential in India., However they have not been introduced and/or adapted by Karnataka's food-processing industry as yet. Such introduction will require human resource development in the financial institutions which provide the venture capital to make these changes, and in the education/training and research institutions which provide the medium term human resources for industry. These generally include the regional universities and other institutions with 3-5 year degree programs.

Analysis of the needs for the development of the medium term human resources follow.

1. Findings.

Karnataka has, relative to other Indian states, a more highly developed medium term technology infrastructure. However, in order to support the kind of growth envisioned through the CTD Project and State economic development plans, the institutions that perform medium term human resource development for the needs of industry need to increase the quality and quantity of their activities.

(a) Inputs: In the academic institutions engaged in medium term human resource development, which includes university graduates and some advanced degrees at the masters level, the analysis of inputs is much the same as it is regarding near term needs, though perhaps to a lesser degree. Faculty members need opportunites through short term training assignments to acquire better skills and knowledge concerning technology capture and R&D management focusing on applied technology in order to incorporate this information in the curricula of their degree progams, in the continuing education programs for mid- and senior level managers from industry, and in the content of their research and consulting practices.

In the key research organizations serving the informatics, biotechnology and food-processing industries, similar needs exist, though to a lesser degree. What is needed more, as an input, is a commitment to doing "second -order" applied research. There appear to be historical and structural reasons that inhibit the use of these organizations by small and medium firms for applied technology R&D needs, as pointed out in the SRI report and confirmed through more recent interviews. This commitment may need to take the form of new organization arrangements, such as subsidiaries to existing units with more flexible research policies, or new units created specifically to serve the medium term needs of the industries.

The facilities of both academic and research organization need some updating changes in order to accomodate market driven research needs. This is especially true in the academic institutions, where lab facilities are inadequate to the needs of state-of-the-art industry. In research organizations the facilities are generally better than in the academic institutions, though in some cases updating is needed, as for example, in CFTRI in certain areas (such as baking), and in the organizations serving the informatics industry where the rate of change is substantially higher than in others.

There is an incipient concern that the numbers of students in advanced degree programs concerned with informatics may not be as great as it should be to supply downstream demands. The problem is that high salaries available to those holding diplomas or undergraduate degrees attract these individuals, depleting the number and quality of those who go on to graduate degrees.

(b) HR Production Technology: A major need in the academic institutions is in curricular reform. Much more emphasis needs to be given to the development of problem solving skills, in both the engineering schools and the management schools. A constraint to curricular reform has been the bureaucratic process such reform entails. However, the autonomy recently granted to many universities may make curricular changes easier, which will allow these institutions to be much more responsive to the needs of industry.

To the extent that the research organizations such as CFTRI have a human resource development mission, their "curricula" might be thought of as the training provided directly or indirectly for industry on R&D matters. Staff who are involved with such training need to have training in curriculum design specific to "second-order" technology challenges.

The learning tools available in the regional universities are generally in dire need of updating or having more available. For example, introducing courses in CAD/CAM and CNC is ineffective unless all students have ample access to these tools, which is not the present case. These needs are particularly acute in education for the informatics and biotechnology industries.

The capacity of education programs preparing individuals for technical and management positions in the informatics industry needs to be greatly expanded. Current demand exceeds supply, and as economic growth occurs the demand will increase. In this regard, serious attention needs to be given to the continuing overproduction of engineers in traditional fields of civil and mechanical engineering. This waste of human development resources cannot be afforded by India. Furthermore, academic institutions such as the regional universities should give greater priority to the development of continuing education programs to retool the many underemployed engineers in career lines serving the emerging and expanding industries, since the cost of retooling an engineer is less than the cost of educating a new one.

(c) Outputs: The needed improvements in the outputs from the academic institutions have been implied in the above analysis: more graduates for career lines in the emerging and expanding industries, with greater preparation in problem solving in both technical and management areas, and with more applied skills gained through use of state-of-the-art learning tools. In the research organizations, greater effort needs to be given to making their research operations more responsive to the rapidly changing needs of industry.

(d) Linkages: Although there are a few "incubator" progams such as the one run by ISRO, the general situation in Karnataka is that the linkages among the academic and research organizationa and the rest of the technology infrastructure needs considerable strenthening in order to promote and sustain medium term human resource development goals. This would appear to be especially true for small firms where the management resources and experience are likely to be limited, and the benefits of linkages will be much more important than in larger firms.

The financial institutions which support venture capital projects and attempt to provide research and consulting services to the smaller firms need to be strengthened to carry out this linking function more effectively. As indicated in the Near Term Analysis above, their staff need to be included in training activities aimed at strengthening the technology infrastructure.

2. Recommendations.

(a) Inputs: In the Near Term Analysis section above there were a series of recommendations regarding the strengthening of faculty and trainers in terms of training, research, consultancy and curriculum development/learning tools. These same recommendations apply regarding Medium Term human resource development institutions.

With regard to students, it is recommended that assistance be given to selected educational institutions to develop model programs for the recruitment and retention of top quality students, with a special emphasis on women. This should include assistance to develop a model retooling program for underutilized engineers in traditional fields. The emphasis on developing a few well developed model programs regarding medium term human resources is that this component of technology development has an important long term impact. Since the CTD/Karnataka Project will serve as a model for other all India efforts, and since these same needs will exist elsewhere, probably in greater degrees than in Karnataka, it seems prudent to invest in this effort here and now.

(b) HR Production Technology:

Combining recommendations regarding several factors, including facilities, curriculum, learning tools, and linkages, it is recommended that one or two model programs be established through a regional university or a branch of IIT/Madras, with consideration given to developing a multi-donor effort to create a "research and training park" within an emerging industrial park. This would be a way of modeling effective, efficient linkage among the components and processes of a comprehensive research and development effort closely tied to industrial growth. Integrated into the structure of such an

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industry-cum-research and training-park should be the Single Window Agency services of the State. If funding is adequate, the integrated park concept might be attempted on an industry-specific basis; for example, a park for electronics (which is currently being developed), a park for food processing, and a park for biotechnology.

In these model programs, priority would be given to the development of a curriculum that achieves an appropriate balance of knowledge, skills and values, including an emphasis on problem solving in both managerial and technical areas. Experimentation with approaches to cooperative education is recommenoed as a way of finding mechanaism for achieving curricilar balance. Experimentation with programs to bring faculty members to industry, and industry leaders/managers to academic/research institutions should also be pursued.

(c) Outputs: Successful implementation of the recommendations made above, especially with regard to the retooling of underemployed engineers from traditional fields, will have a desirable impact on the output of human resources, in terms of numbers and quality of preparation.

In order to improve the quality of consulting provided to industry, CTD should facilitate a process that provides a pool of consultants with training in consulting skills particular to the "second-order technology development needs of informatics, biotechnology and food-processing industries. This pool of consultants should then provide training to other trainers/ consultants to multiply the effect and availability of such resources.

(d) Linkages: It is recommended that the Technology Information Coordination Committee (whose formation was recommended in the Near Term Analysis above) should also include information users serving medium term needs. Of particular interest is information regarding patent information, technological forecasting and feasibility studies.

It is recommended that Focus Groups regularly consider the linkages among the elements and organizations who share medium term technology development concerns, and assure that CTD planning and activities are addressing these needs adequately.

C. Long Term Human Resource Development Needs of Emerging and Expanding Industries

Long term needs are those associated with "third-order" technology challenges. These involve pursuing scientific breakthroughs which have a potential for commercialization. An emphasis is on precompetitive research, carried out by industry, or funded by industry but carried out in academic or R&D centers. Karnataka has a base of R&D organizations with the potential of engaging in long term research, though most are now engaged in research not closely related to the interests of the target industries. Publications by Indians in the field of biotechnology are strong, but are not keeping up with the field. In the field of physics and material sciences, several Indians associated with IISc in Karnataka are regarded as seminal contributers. This suggests potential in some subfields of informatics.

Academic institutions which develop long term human resources are those which have advanced degrees leading to the doctorate. In Karnataka there is the world famous Indian Institute of Science, as well as the Indian Institute of Management/Bangalore.

More specific analysis and recommendations within the systems model context follow.

1. Findings.

(a) Inputs: The faculty resources in the academic and research institutions are generally well prepared for their roles. They include some of the best scholars in the world. To the extent that there are shortcomings in faculty preparation, they are in having access to most current techniques and technical information. Also, there is a shortage of individuals with adequate training in R&D management, an essential skill in the context of this project in the near, medium and long term. Industry and the academic institutions can help to alleviate some of these shortcomings by making it easier for personnel from their respective organizations to collaborate on special projects through liberal leave or exchange policies.

Student inputs are among the best available anywhere in India in the science fields. As noted above in the medium term needs section, there is a growing awareness of and concern about the numbers and quality of students matriculating in advanced degree programs. The high salaries paid by industry to individuals with undergraduate degrees, combined with the relatively low salaries of faculty members even at the best academic institutions, is keeping people out of doctoral programs. This may present a very serious long term problem for India, with very costly impacts.

Facilities in the academic and research organizations are generally closer to the standards needed for the type of human resource development they perform than institutions carrying out medium and near term development. However, given the high capital investment generally associated with these facilities, there is a need to systematically assess future needs, and develop the bases of support in government and industry to keep these facilities at the cutting edge of technology.

An input which needs considerably more attention is the commitment of the leaders of academic and research organizations to work more collaboratively with industry in order to develop and implement th long term research and development needed in the fields of informatics, biotechnology and food-processing which

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will result in commercially viable products and processes. Several studies done in preparation of the the CTD Project have indicated the need for such commitment.

Seed capital for basic research is an essential resource always in short supply. While foreign investors may take up some of the slack in the informatics industry, local industry will have to play a more supportive role than it has in the past in the food-processing and biotechnology fields.

(b) HR Production Technology: Industry inputs, from India and abroad, are needed to keep the curricula and research and consulting activities of the academic and R&D organizations in closer harmony. Mechanisms to facilitate this input need to be strengthened. Recently approved autonomy measures should make it easier for regional universities to make curricular changes, and the CTD Project should assist through focus group support.

Learning tools, especially computers, are needed to provide all students and faculty with opportunities to develop the highest level of research skills. Even in the better equipped organizations there is still a scarcity of access time to research equipment.

(c) Outputs: As seen earlier, the number and quality of individuals graduating from advanced degree programs and staying in India, either in academic institutions or government funded research organizations, is not likely to meet future staffing needs in these organizations. Raids by foreign and domestic industries cut into current staffing levels and limit the output production of basic research, as reported earlier in the field of biotechnology.

(d) Linkages: More than any other sector, linkages among the long term elements of the technology infrastructure need to be strengthened, due to the long time lines required for basic research. The potential exists, but the climate and interest has not been very strong for this to occur on a regular, systematic basis.

At the heart of this process is the need to have faster and more complete access to information regarding basic research throughout the world, and to have this information shared and discussed regularly in Karnataka by industry and academic leaders.

2. Recommendations.

(a) Inputs: The CTD Project should assure that R&D management training is available and utilized in order to help develop long term planning and implementation of basic research activities in the targeted industries.

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It is recommended that the Human Resource Focus Group facilitate the development of policies which encourage collaboration and exchanges of researchers from academia and industry in order to promote and guide basic research in a direction that has early potential for commercialization.

It is recommended that model programs be developed to recruit and retain top graduates in Karnataka's academic and industrial research organizations. This is an essential step in assuring that there will be an adequate supply of tomorrow's innovators, and that they will be working for Karnataka's industries, instead of foreign competitors.

It is recommended that CTD exercise leadership in establishing a basic research endownment fund for each of the targeted industries, with a broad base of support from international donors, national and local industries, and state and national governments, and in designing a mechanism which assures the effective use of these funds.

(b) HR Production Technology: It is recommended that through the Human Resource Focus Group mechanisms be strengthened, or created where necessary, to assure industry-government-academia interaction regarding curricular content, research agendas and the appropriate learning facilities to carry out long term human resource development.

Toward this end it is recommended that a small group of academic and industry leaders carry out a study tour in the United States and appropriate other countries such as Japan, Korea and Taiwan to study how long term human resource development in the informatics, biotechnology and food-processing industries can be designed and sustained with industry and government support.

(c) Outputs and linkages: Long term human resource needs of the emerging and expanding industries need to be appraised on a regular and systematic basis by the Human Resource Focus Group, in conjunction with the other focus groups. It is recommended that the Human Resource Focus Group be charged with this task, as with near and medium needs, and that it have the necessary resources to carry out these tasks.

It is recommended that the Technology Information Coordination Committee (whose formation was recommended in the Near Term Analysis above) should also include information users serving long term needs. Of particular interest are journals and professional association proceedings regarding current research. It is recommended that means be explored to find information transfer processes that provide real time direct access to such sources of information in the US and Europe.

ANNEX "K"

WCG
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August 11, 1988

Mr. Ram Berry
Office of Technology Development and Enterprise
U.S. Agency for International Development
New Delhi, India

Dear Ram:

Enclosed please find the final version of the Monitoring and Evaluation Plan for the Center for Technology Development Project. Bob Beckman suggested that I send it to you in his absence from the Mission.

This version of the plan reflects a number of changes, most of which are stylistic in nature. In addition, I have made a few substantive changes which I believe improve upon the version I submitted in New Delhi. For example, I have refined the "Key Management Questions" and included in that section the indicators corresponding to each set of questions. The previous version had noted the indicators only in discussing the data collection plan; I think the linkage between the reporting plan and its rationale is clarified by this change. I have also amplified the recommendations regarding the project baseline survey.

Time permitting, I hope you can include this version in the project paper after reviewing it. As discussed with Bob, the Washington Consulting Group will send another copy of the monitoring plan to accompany its voucher.

I'd like to thank you all again for the opportunity to work with you on a fascinating project. I will be following the CTD's progress with great interest, and hope you will let me know if I can be of any service in the future.

Sincerely,

Karen

Karen Anderson

CENTER FOR TECHNOLOGY DEVELOPMENT PROJECT
MONITORING AND EVALUATION PLAN

Prepared for USAID/India
Office of Technology Development and Enterprise

by Karen Anderson
The Washington Consulting Group, Inc.

August 1988

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PURPOSE OF THE MONITORING AND EVALUATION PLAN

The monitoring and evaluation plan for USAID/India's Center for Technology Development Project has three principal purposes: (1) to outline a plan for supplying A.I.D. and CTD managers with the information regarding project inputs, outputs, and progress toward achievement of the project purpose and goal which they need for decisionmaking; (2) to describe the data collection necessary to permit assessment of the project's effectiveness, impact, efficiency and sustainability in future evaluations; and (3) to provide a vehicle for capturing lessons learned in the project which will aid in efforts to replicate its activities elsewhere in India.

This paper outlines the key questions and issues which should be monitored during project implementation and serve as a basis for interim and final evaluations. It then suggests a methodology for collecting the data necessary to address those questions.

KEY MANAGEMENT QUESTIONS

The CTD's monitoring and evaluation system should provide for a steady flow of information to CTD and A.I.D managers regarding the status of project implementation. These information flows should be designed to answer managers' probable questions relating to levels of project inputs, outputs, purpose and goal. Summarized below is a preliminary set of questions which may be used as a basis for data collection, along with a few key indicators corresponding to each project level.

The goal of the CTD project is to accelerate the pace and quality of technology innovation for products and production processes in industries important for economic development in India. Thus, at the goal level, monitoring and evaluation will seek to provide information to answer the following questions: Has the rate of commercialization of new products by businesses in target sectors increased? Has the application of state-of-the-art technical tools by these businesses expanded? Key indicators to address goal-related questions will be the numbers of products commercialized and sold by beneficiary businesses, and the number of firms assisted by the CTD which have succeeded in commercializing products.

The purpose of the project is to develop and improve the technology resources needed for economic growth in India, taking Bangalore as an initial model. To determine the project's progress in achieving its purpose, the monitoring system should provide information to answer questions such as the following: Has the CTD established itself as an operationally effective agency for identifying and supplying components missing from the technology infrastructure? Has CTD assistance provided industry, including

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small- and medium-scale enterprises, increased access to needed technology? Has the assistance contributed to businesses' ability to produce and commercialize new products? Has the training provided through CTD programs increased the trainees' capacity to contribute to the application of technology in their businesses and industries? How many joint ventures and start-up firms have been established with assistance from the CTD's brokering activities? Has the CTD succeeded in increasing productive interaction among industry, academic institutions and government regarding technology development and application? Key indicators to measure in addressing purpose-level questions will include the numbers of joint ventures and start-up firms established with CTD assistance; the number of contacts established among key groups (committees, meetings, etc.); the number of facilities available to assist businesses in their production processes; the number of industry-oriented courses available in target fields; the numbers of businesses and individuals reporting benefits from CTD assistance; and the percentage of CTD activity costs paid by industry.

Project outputs will include a range of activities intended to enhance industry's access to technology: establishment of applied technology centers; training programs; assistance in production testing, scale-up and market analysis; curriculum development; and other activities. A.I.D. will provide technical assistance to the project through inputs to include funding for consultancies, training, and equipment. Questions regarding project inputs and outputs will include the following: Are applied technology centers being established in the time frames anticipated? Are industry-oriented training programs and curriculum development activities being established? Is equipment needed for technology application being procured? How many individuals are being trained? How many individuals have participated in study tours? How many businesses are being assisted, and through what types of activities? What are project expenditures for A.I.D.-supplied inputs, and how do they compare to planned expenditures? Key indicators will include the numbers of businesses and individuals assisted, the number of courses and curriculum development activities established, and records of procurement and usage of equipment.

During the project's initial stages, managers should be provided feedback documenting the progress of the CTD's start-up process and identifying any problem areas which arise. Questions to be answered will include the following: Are proposals for activities being submitted to the CTD according to expected time frames? Is the quality of these proposals proving sufficient for their acceptance? In cases where technical assistance is provided for proposal preparation, has that assistance proven adequate? Key indicators will include the numbers of focus group meetings, numbers of proposals reviewed and accepted, and percentage of favorable reports from focus groups regarding technical assistance.

Monitoring and evaluation should also provide information regarding project impacts on significant socioeconomic indicators, although these are not specified as explicit project objectives. Related questions may include the following: How have CTD activities impacted on employment in participating businesses, including employment of women? How have project activities contributed to agricultural production through research applications in areas such as dry-land farming? Has the project contributed to decreasing food wastage and to labor-saving for women as a result of the application of food processing technologies?

DATA COLLECTION PLAN

Oversight of the CTD's monitoring system within A.I.D. will be the responsibility of the designated CTD project officer in the Office of Technology Development and Enterprise. Within the CTD, the Secretariat will be responsible for coordinating data collection and reporting through the focus groups, and transmitting the products of these efforts to A.I.D. The focus groups will act as channels for data from the individual activities carried out under their sponsorship, delegating responsibility for provision of data to managers of each activity as appropriate. The A.I.D. project officer will work with the CTD Secretariat and focus group representatives to develop the monitoring system and its component mechanisms, and to adapt them as necessary to fit changing activities and information needs during the life of the project. The A.I.D. project officer will perform periodic site visits to review and identify any problem areas in the data collection process. It is also recommended that the project officer periodically verify project achievements and reassess needs of target industries through informal surveys of beneficiary businesses.

The data collection plan for the project is outlined below.

Baseline Survey

As noted in the project implementation plan, proposals submitted to the CTD will include analyses of the existing sources of supply of the services to be provided. These surveys can be supplemented and corroborated by independent assessments commissioned from local research institutions. Activity-specific baselines can then be established to cover the key conditions which each CTD initiative is intended to affect.

Before attempting to establish a project-wide baseline, A.I.D. and CTD project managers should consider a number of factors. The potential costs, in time and resources required for gathering baseline data, should be weighed against the estimated benefits of

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providing a resource for measuring project impacts. A crucial factor to be considered is the degree to which a causal relationship can be reasonably traced between CTD activities and changes in the conditions to be measured.

One possible set of project-wide baselines could be created through measurement of selected data regarding status of target industries in Karnataka: (1) the number of foreign collaborations (joint ventures) approved in target fields, such as food processing and informatics; (2) the number of industrial licenses issued for products and processes in target fields; (3) product sales levels in target fields. Statistics for product and process sales may not be available at the degree of specificity required to relate them to CTD activities. In that case, the baseline survey will need to identify and investigate sources of raw data. Such an effort may be considerably time-consuming, and the feasibility of drawing causal relationships between CTD activities and changes in the data will be limited. Another methodology would involve survey of randomly selected businesses in the target sectors, to be followed up with repeat interviews during the project's interim and final evaluations. This sample would serve as a control group against which the performance of A.I.D.-assisted businesses might be compared. An important caveat to consider is that government policy changes constitute the principal determinant of change in numbers of foreign collaborations and industrial licenses. This increases the difficulty of isolating and attributing impacts to CTD assistance.

An alternative set of indicators can be studied for a baseline survey which may entail less expenditure of time and effort. These indicators are listed below, with principal data sources suggested for each indicator. Project managers will wish to define the data to be sought in greater detail.

Indicator	Suggested Data Source
Number of industry-related courses offered in target fields	Survey of polytechnic/institute/ university syllabi; interviews with staff and faculty
Number of existing facilities for assistance with production testing, scale-up, market testing	Interviews with industry associations
Number of existing mechanisms (meetings, committees, etc.) for interaction among industry, scientific organizations, and government to coordinate technology development	Interviews with representatives of key agencies in industry, academia, and government

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Follow-up data collection incorporated in interim and final project evaluations, including interviews with key informants, should seek to identify and describe the role of project activities in effecting changes in these conditions.

Reporting Plan

The CTD Secretariat will coordinate a system of ongoing reporting using data provided by each focus group. The focus group will report on its own activities, and summarize activities of each project carried out under its sponsorship. The Secretariat will submit reports to A.I.D. on a quarterly basis, according to a schedule and format to be agreed upon between the CTD and A.I.D. at project inception. These reports should contain concise and timely records of the status of project achievements in terms of the key indicators, which may include the following:

-- number of focus group meetings
-- number of proposals reviewed/accepted
-- number of businesses assisted (break down by activity: number assisted in product testing, market analysis, etc.)
-- number of individuals trained (disaggregate by gender)
-- number of study tour participants (disaggregate by gender)
-- number of person/days of consultant services provided
-- number of courses offered
-- number of curriculum development activities
-- numbers of conferences, seminars, and other activities to promote industry/academia/government interaction
-- number of joint ventures/start-up firms formed
-- number of new products commercialized with CTD assistance
-- record of equipment procured
-- record of equipment usage
-- summary of post-activity questionnaire responses
-- expenditures for each activity (budget and actual)
-- total expenditures in quarter (budget and actual)
-- cumulative disbursements
-- percentage of activity costs paid by industry

In addition to quarterly reporting of disbursement levels, the CTD Secretariat has planned to employ independent auditing and accounting concerns to oversee and report on the Center's accounts. Data submitted quarterly on costs of each project activity may be measured against outputs to provide a basis for assessing cost-effectiveness and efficiency, including comparisons across project activities. Quarterly reports will also contain a brief narrative describing planned activities, any problem areas which have arisen, and follow-up on corrective action taken regarding previously reported problem areas. Changes in membership of focus groups, the CTD Secretariat and Governing Board should also be noted.

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It is suggested that the CTD produce a descriptive annual report suitable for wide distribution after its activities have reached the implementation stage. As well as serving as a feedback mechanism for the various donor agencies, such a report would assist in disseminating "lessons learned" for use in replication of the CTD's activities.

Beneficiary Databases

The CTD will establish standardized databases to provide a record of businesses and individuals assisted through its programs. These databases will be supplied with information collected by the managers of each activity prior to or at the outset of assistance. The databases will serve as a basis for measuring project impacts over time, and have the potential to serve additional purposes for the CTD and for industries participating in the project. For example, they can eventually be used as a means of identifying individuals trained in specific fields, or businesses capable of supplying a specific component. The databases will contain a set of a few key data on each individual and business assisted, which may include the following:

For individuals: name; address; gender; place of employment; position; salary, if possible; type and duration of training or other assistance provided; cost of assistance to individual or employer.

For businesses: name; location; type of business; types of products produced; production levels; some measure of income (sales, net income/profit, value added); number of employees, disaggregated by gender; nature and source of assistance; cost of assistance to business.

Post-Activity Questionnaires

Where feasible, managers of CTD programs and activities should administer brief questionnaires to individuals and businesses assisted, following completion of the training program or other activity. This feedback will assist the CTD in modifying its programs in response to participant reactions and needs. Questionnaires may include the following types of questions:

-- How would you assess the quality of the course or technical assistance (excellent, good, fair, or poor)?
-- Did the course/assistance meet your needs and expectations?
-- How will the training/assistance received help you in your work/business? What changes do you expect?
-- (For trainee) Was the material presented new to you, or did it repeat something you already knew?

-- (For business) Is the assistance you received through the CTD available to you from any other sources? If so, what are they? How would you compare the quality and cost of alternate sources' assistance to that of CTD services?
-- Do you have any suggestions for improvement of the course or assistance?

For cases in which technical assistance is provided to the CTD itself or to one of the focus groups, the individuals assisted should complete a similar questionnaire.

Responses to these questionnaires should be summarized in the CTD's quarterly reports, e.g., 70% of trainees rated the course as good to excellent, etc.

<u>Evaluations</u>

Independent evaluations of the CTD's operations and individual project activities will be scheduled at two interim points during the project, and following its completion. Timing of the first evaluation will depend upon the progress of project implementation, but it should be conducted approximately two years after the project's inception. The second interim evaluation should take place between the third and fourth years of the project. A final evaluation will be performed following project completion. To the extent feasible, these evaluations will be collaborative, involving participation by the CTD's management, members of focus groups, and managers of representative project activities, along with A.I.D. representatives and consultants.

Evaluations will seek to answer the key questions regarding the project's achievement of its goal and purpose, and its effectiveness in delivery of inputs and outputs. Information drawn from the administrative records outlined above will provide the basic empirical foundation for these assessments. Project databases can be used to identify a sample of beneficiaries for case study. The sample should provide representative selection from the full range of CTD activities, including: (1) different categories of activities, e.g., training programs and centers for applied technology; (2) activities employing various technological "tools", such as biotechnology and informatics; and (3) key industries signalled for CTD activity, such as food processing and computer hardware and software. The sample should also be selected to illustrate impacts on small- and medium-scale industry and on women.

Providing answers to goal- and purpose- level questions should constitute a special focus of these evaluations. For example, assessment of training programs should examine the effectiveness of the training provided in increasing trainees' capacity to contribute to application of technology in their businesses. This

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assessment will utilize interviews with trainees' employers as well as the trainees themselves, and examine responses to post-training questionnaires. Evaluation of assistance to businesses (e.g., through applied technology centers) will use information provided by project databases, with follow-up case studies to track changes in business sales, profits, product lines, etc. Case studies will seek to determine if and how businesses' access to the technology needed for their production processes has increased following the CTD's assistance. Tracing levels of industry support for CTD activities will aid in assessment of the project's sustainability.

Evaluations will also provide follow-up study of conditions measured for project-wide and activity-specific baselines. For example, interviews with representatives of target groups in industry, academia, government, and financial institutions will seek to gauge the CTD's impact on levels of productive interaction among those groups.

Special Studies

Special studies may be scheduled when needed to provide in-depth information on issues of particular interest, or as a means of spot-checking problem areas. Some possible topics might include the following:

-- studies of constraints (if any) to entry of women in particular industries, job categories, or management positions within industries;

-- case studies to examine the impact of project activities on socioeconomic conditions, e.g., effects of biotechnology research applications for dry-land agriculture on food production and employment;

-- study of project impacts on buyer-supplier linkages and other problems of small- and medium-scale enterprises in target sectors.

Coordination of the CTD Monitoring System

It is suggested that the CTD consider hiring one person, either full- or part-time, to coordinate the flows of information described above. The CTD will suggest, subject to A.I.D. approval, the most effective means of producing quarterly reports and databases. A low-cost computerized system utilizing simple computerized spreadsheet and database and/or word processing programs will most likely be sufficient for project needs. Technical assistance in carrying out monitoring activities may be accessed through the A.I.D. project officer and Evaluation Office.

Evaluation Budget

The estimated budget for monitoring and evaluation activities is $300,000, representing 3 percent of the project budget of $10 million. This amount will cover three evaluations, monitoring assistance to the CTD as needed, and procurement of basic computer hardware and software for the computerized management information system.

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ANNEX "L"

P. Vishwanathan
Under Secretary (AC)
Tele.No. 3012423

भारत सरकार
वित्त मंत्रालय
आर्थिक कार्य विभाग
Government of India (Bharat Sarkar)
Ministry of Finance (Vitta Mantralaya)
Department of Economic Affairs (Arthik Karya Vibhag)

नई दिल्ली/New Delhi July 28, 1989

Dear Mr. Steven,

Please refer to your letter dated 15th February, 1989 regarding Project Grant Agreement for the Centre for Technology Development.

2. I am pleased to inform you that Govt. of India has no objection to the provisions contained in the Project Grant Agreement between ICICI and USA for Centre for Technology Development. I shall be grateful if an amount of $ 3.00 million is made available for this project and also take further necessary action in regard to the finalisation of the agreement providing for total assistance of $ 10 million over the life of the project. Govt. of India has no objection to your signing this agreement with I.C.I.C.I.

With regards,

Yours sincerely,

(P. VISHWANATHAN)

Mr. Steven J. Freundlich,
Chief (Acting),
Office of Projects, USAID,
American Embassy,
New Delhi.

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SCIENCE & TECHNOLOGY PARK

UNIVERSITY OF POONA
Ganeshkhind, PUNE - 411007.

19 DEC

FROM

REF NO 03/10

UNIVERSITY OF POONA
DIRECTOR
SCIENCE & TECHNOLOGY PARK

DATA BOOK ON POONA & AROUND

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SCIENCE & TECHNOLOGY PARK

UNIVERSITY OF POONA

Ganeshkhind

PREFACE

ACCORDING TO THE THEORY OF ECONOMICS, THE CRITICAL FACTORS OF PRODUCTION ARE LABOUR, RAW MATERIALS AND CAPITAL. THERE IS NOW A FOURTH FACTOR THAT IS OVERRIDING THE OTHER THREE. IT IS TECHNOLOGY AND IT HAS BECOME THE MOST CRITICAL FACTOR. ALL NATIONS NOW SEE TECHNOLOGY AS THE ENGINE THAT DRIVES THEIR ECONOMICS. NO COUNTRY CAN SURVIVE IN A GLOBAL ECONOMY WITH ABSOLESCENT FACILITIES. THE WORLD, AT PRESENT IS WITNESSING TREMENDOUS FORCES OF THE TECHNOLOGICAL CHANGES. THESE FORCES WOULD CONTINUOUSLY RESTRUCTURE WORLD ECONOMICS. THE MANAGEMENT WOULD BE THE MANAGEMENT OF CONTINUOUS CHANGE, CONTINUOUS MODIFICATIONS IN SKILLS OF WORKS FORCES, AND THEREBY RE-EDUCATING & RE-TRAINING OURSELVES.

OVER THE YEARS, INDIA HAS ALSO BUILT A VAST POOL OF SCIENTIC AND TECHNOLOGICAL TALENT AND WITH THE APPLICATION OF TECHNOLOGY TO THE MULTITUDE OF OPPORTUNITIES, NEW BUSINESS & JOBS WOULD BE CREATED IN THE INDUSTRIAL CITIES IN INDIA IN THE NEAR FUTURE. POONA IS A VITAL PART OF THE COUNTRY'S GROWING INDUSTRY. IT IS OBSERVED THAT NO CITY OTHER THAN POONA, HAS A UNIQUE CONCENTRATION OF ELECTRONICS MANUFACTURERS AS ON TODAY. IN ADDITION, THERE ARE LARGE NUMBER OF RESEARCH LABORATORIES & GOVERNMENT ESTABLISHMENTS IN POONA, WHEREIN CONTINUOUS RESEARCH & DEVELOPMENT ACTIVITIES IN THE FIELD BY ELECTRONICS TAKE PLACE. THE GOVERNMENT HAS ALSO ESTABLISHED A DEVELOPMENT CENTRE IN ELECTRONICS AT POONA.

FOR SMALL SCALE INDUSTRIES, THERE IS AN EXTENSION CENTRE OF SMALL INDUSTRIES SERVICE INSTITUTE WHICH OFFERS MANY COMMON

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TECHNOLOGY
PARK
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19 DEC 1986

SERVICE FACILITIES. ALL THESE THINGS CREATED A DYNAMISM IN THE GROWTH OF POONA AS AN INDUSTRIAL CITY. THIS CITY HAS NOW BEEN SURROUNDED FROM ALL SIDES BY DEVELOPING INDUSTRIAL AREAS. THIS ALSO SIGNIFIES AN ALL ROUND DEVELOPMENT IN TERMS OF JOB OPPORTUNITIES, SCOPE FOR STARTING ANCILLARIES AND AN INCREASE IN THE STANDARD OF LIVING. THEREBY, THERE IS A RAPID SOCIAL TRANSFORMATION OF POONA DUE TO INDUSTAIALISED CITY.

THE DATA AND INFORMATION WHICH WE HAVE COMPITED FOR THIS DATA BOOK WILL REFLECT THE ABOVE FACTS. WE HAVE PUT IN A SPECIAL EFFORTS TO COLLECT THE AUTHENTIC & LATEST INFORMATION AS FAR AS POSSIBLE FROM THE VARIOUS SOURCES AVAILABLE. WE TAKE THIS OPPORTUNITY TO THANK THE FOLLOWING AGENCIES FROM WHERE THE INFORMATION HAS BEEN COLLECTED EITHER THROUGH PUBLISHED BOOKS/ DOCUMENTS OR THROUGH DIALOGUES WITH THE CONCERNED PERSONS -

1. MAHRATTA CHAMBER OF COMMERCE & INDUSTRIES
2. DIRECTORATE OF INDUSTRIES, GOVT OF MAHARASHTRA
3. MITCON
4. M S F C/I F C/W M D C
5. GOVT. DEPARTMENTS, THE EMPLOYMENT EXCHANGE, LABOUR OFFICE ETC.

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1.0 PRELIMINERIES

1.1 INDUSTRIAL SCENE OF MAHARASHTRA

MAHARASHTRA CONTINUES TO HOLD ITS PREMIER POSITION ON THE INDUSTRIAL SCENE IN THE COUNTRY WITH A SHARE OF 24.7% IN THE NATIONAL INDUSTRIAL OUTPUT DURING 1985. THE POLICIES TOWARDS INDUSTRIAL DIVERSIFICATION PURSUED BY THE STATE GOVERNMENT, HAVE LARGELY CONTRIBUTED TO MAHARASHTRA'S NO 1 RANK IN THE NATIONAL OUTPUT OF 13 OUT OF 16 MAJOR INDUSTRIES. THE STATE ACCOUNTS FOR A SIGNIFICANT SHARE IN SOME OF THE MODERN INDUSTRY GROUP LIKE CHEMICALS, METAL PRODUCTS, ELECTRICAL MACHINERY AND PETROLIUM PRODUCTS.

THE SOUND INDUSTRIAL BASE DEVELOPED IN THE STATE CONTINUES TO STIMULATE FURTHER GROWTH OF INDUSTRIAL ACTIVITIES. OF THE TOTAL NUMBER OF 11587 NON-GOVT. COMPANIES NEWLY REGISTERED WITH THE REGISTRAR OF COMPANIES DURING 1983-84, 2796 I.E. OVER 24%, WERE IN THE STATE OF MAHARASHTRA. IN REGARD TO THE LETTERS OF INTENT AND THE INDUSTRIAL LICENCES ISSUED DURING THE FINANCIAL YEAR 1984-85, MAHARASHTRA LEADS THE REST, HAVING SECURED 230 OUT OF THE TOTAL 1266 LETTERS OF INTENT AND 143 OUT OF

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955 INDUSTRIAL LICENCES GRANTED.

ONE FAVOURABLE ASPECT OF THE INDUSTRIAL ENVIRON -MENT IN THE STATE IS THE OVERALL SATISFACTORY POWER POSITION. THE DYNAMISM IN THE INDUSTRIAL SCENE OF MAHARASHTRA HAS BEEN FURTHER ACTIVISED BY SOME OF THE RECENT DEVELOPMENTS. THREE INDUSTRIAL ESTATES EXCLUSIVELY FOR SETTING UP ELECTRONICS INDUSTRY ARE BEING DEVELOPED NEAR NAGPUR, NAGAR & AURANGABAD. THEREBY, MAHARASHTRA STATE WILL TAKE RAPID PACE FOR ENHANCING ITS SHARE IN THE GROWTH OF ELECTRONICS INDUSTRY IN THE FORTHCOMING YEARS.

1.2 WHERE POONA STANDS

POONA IS KNOWN FROM TIMES, IMMEMORIAL FOR ITS MULTIVAROUS ACTIVITIES AND TYPICAL CHARACTER NOT ONLY IN THE STATE BUT ALSO THROUGH THE COUNTRY.

IT HAS BEEN THE CENTRE OF EDUCATIONAL AND THE CULTURAL ACTIVITIES, HOME OF POLITICIANS, SOCIAL WORKERS AND A SOURCE OF INSPIRATION FOR PROFGRESS AND DEVELOPMENT IN ALL SPHERES OF LIFE. TRUE TO ITS RICH HERITAGE OF BEING A CENTRE OF EDUCATIONAL, CULTURAL AND SOCIAL FIELDS OF ACTIVITIES, IT HAS KEPT PACE WITH THE CHANGING TIMES AND HAS COME UP AS SECOND LARGEST INDUSTRIAL TOWN IN THE STATE.

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EARLIER THE CITY HAD NO LOCAL TRADITION OF LARGE SCALE TRADE OR COMMERCE. IT HAS BEEN A TYPICAL MIDDLE CLASS COMMUNITY. NONE OF ITS LEADING ENTREPRENEURS TODAY CLAIMS A TEXTILE

BACKGROUND WHICH WAS THE MAJOR DETERMINENT IN THE SUCCESS OF MANY PROMINENT BUSINESS HOUSE

IN OTHER PARTS OF INDIA. ON THE OTHER HAND, ANOTHER UNIQUE FEATURE OF THE INDUSTRIAL INFRASTRUCTURE IN AND AROUND POONA IS THAT MAJOR PART OF THE SMALL SCALE SECTOR IS TECHNO -LOGICALLY ORIENTED.

IN 1960, THE MAHARASHTRA INDUSTRIAL DEVELOPMENT CORPORATION (MIDC) UNDERTOOK DEVELOPMENT OF A LARGE INDUSTRIAL AREA OF 4000 ACRES IN THE PIMPRI-CHINCHWAD & BHOSARI INDUSTRIAL COMPLEX. A LARGE NUMBER OF INDUSTRIES, BOTH LARGE SCALE & SMALL SCALE, HAVE ALREADY BEEN ESTABLISHED IN THIS AREA BUT THE DEVELOPMENT OF THIS AREA BY MIDC, HAS FURTHER HELPED THE PROCESS OF INDUSTRIALISATION IN POONA. THE RESULT IS THAT THERE ARE MORE THAN 5000 UNITS IN TOTO IN AND AROUND POONA CITY, AS ON TODAY.

THE FACTS & FIGURES MENTIONED IN THE FOLLOWING PAGES RELATE TO THE POONA METROPOLITAN REGION COVERING THE AREAS UNDER PUNE MUNICIPAL CORPORA -TION, PUNE & KIRKEE CANTONMENT BOARDS AND PIMPRI-CHINCHWAD MUNICIPAL CORPORATION, SPREAD

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OVER THE LARGE AREA OF AROUND 1500 SQ KMS. THE FORMER AREA CAN BE CALLED AS ZONE 1 & LATTER AS ZONE-2. THE DISTRIBUTION OF INDUSTRIES IN ZONE-2 IS MUCH MORE COMPACT & CONCENTRATED ON THE OTHER HAND THE DISTRIBUTION OF INDUS -TRIES IN ZONE-1 IS MORE OR LESS SCATTERED AROUND POONA CITY, NAGAR ROAD, HADAPSAR, GULTEKDI, SATARA ROAD AND KOTHRUD. THE LARGE NUMBER OF SMALL SCALE INDUSTRIES ARE IN ZONE-1 (62%) AND LARGE PORTION OF LARGE & MEDIUM AREA ARE IN ZONE-2 (65%). A DETAILED LIST OF 44 LARGE UNITS IS DEPICTED IN SECTION 3.11 WHILE A LIST OF 88 MEDIUM SCALE INDUSTRIES IS SHOWN UNDER SECTION 3.12.

THE IMPORTANCE OF THE SMALL SCALE SECTOR IN THE INDUSTRIAL PROFILE IS ILLUSTRATED BY THE FACT THAT THEY ACCOUNT FOR NEARLY HALF OF THE TOTAL EMPLOYMENT GENERATED AND MORE THAN ONE-THIRD OF THE TOTAL TURNOVER IS FROM THE SMALL SCALE SECTOR. MORE THAN ONE THIRD OF THE TOTAL INVESTMENT IS ALSO DONE IN THE SMALL SCALE SECTOR AND ABOUT 14% OF THE TOTAL EXPORTS COME FROM THIS SECTOR. THE PRODUCTS MANUFACTURED BY THE SMALL, SCALE INDUSTRIES COULD BE BROADLY CLASSIFIED AS

A. CONSUMABLES.

B. EQUIPMENTS & COMPONENTS IN INDUSTRIAL APPLICATIONS.

ON THE OTHER HAND, PRODUCTS MANUFACTURED BY

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THE LARGE & MEDIUM INDUSTRIES REQUIRE SPECIALISED TECHNOLOGY WITH HIGH PRECISION AND ACCURACY. THIS TECHNOLOGY WAS IMPORTED IN MOST OF THE CASES BY COLLABORATION AGREEMENTS WITH FOREIGN DEVELOPED COUNTRIES LIKE JAPAN, U.S.A, WEST GERMANY U.K & FRANCE.

1.3 NEW DEVELOPMENTS & TECHNOLOGY PARK

THIS, HOWEVER DOES NOT MEAN THE PMR HAS REACHED THE SATURATION LEVEL, BUT THE PROCESS HAS BEEN SET IN MOTION AND NEEDS MUCH LESS MOTIVATIONAL EFFORTS. THE DEVELOPED PART AND THE DEVELOPING PARTS OF THE ZONES HAVE DIVERSE PROBLEMS. IT IS, THEREFORE, FELT THAT BY AND LARGE THE PROMOTION OF NEW UNITS IN THE DEVELOPED PARTS SHOULD BE OF THE NATURE OF ANCILLARY UNITS TO LARGE SCALE UNITS, THE NURSING OF SICK UNITS AND TO ASSIT THE EXIST -ING ONES IN SOLVING THEIR MARKETING PROBLEMS. THEREFORE, DIRECTORATE OF INDUSTRIES OF GOVT OF MAHARASHTRA HAS PREPARED THE ACTION PLAN FOR 1983-88. THE DIALOGUES WITH THE LOCAL PEOPLE AND IDENTIFICATION OF LOCAL TALENT AND SKILLS IS THE BASIS OF THE ACTION PLAN IN THE DEVELOPING AREAS. A GENERAL SURVEY HAS BEEN MADE FOR THIS PURPOSE.

SECONDLY, THE STATE GOVT. HAS ANNOUNCED A PLAN TO SET UP A SPECIAL ELECTRONIC INDUSTRIAL ZONE AT BHOSARI. THESE AND THE OTHER NEW DEVELOPMENTS

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WILL GIVE A FURTHER PUSH TO THE TECHNOLOGY YIELDING SOPHISTICATED PRODUCTS. THIS WILL BE FURTHER ENHANCED WITH THE ESTABLISHMENT OF TECHNOLOGY PARK IN POONA UNIVERSITY, SOME SORT OF INDUSTRY/UNIVERSITY CO-OPERATIVE RESEARCH CENTRE AND SETTING UP SUPER COMPUTER CENTRE AT UDYOG BHAVAN

0 STATE PROFILE

1 POPULATION

	1981 CENSUS	1985 (APP)
RURAL	4.08 CRORES	4.68 CRORES
URBAN	2.20 CRORES	2.80 CRORES
TOTAL	6.28 CRORES	7.48 CRORES

DENSITY OF POPULATION 204 PER SQ KM (on the basis of 1981 data)

2 LAND AREA

AREA SOWN	(000 HECTORS)	18248 (NET)	19915 (GROSS)
FORESTS	(000 HECTORS)	5326	
UNCULTIVATED	(000 HECTORS)	2766	

.3 IRRIGATION

POTENTIAL	(000 HECTORS)	2306
UTILISATION	(000 HECTORS)	1896

.4 MAJOR CROPS :RICE, WHEAT, JOWAR, BAJARI, SUGARCANE, MAIZE, TUR DAL, VARAI, CEREALS, ONIONS, GROUND NUTS, POTATO.

.4 OUTTURN OF PRINCIPAL CROPS (1981 DATA)

CROPS	MAHARASHTRA	INDIA	% OF M.S.
RICE	2130	49912	4.3
WHEAT	963	34550	2.8
JOWAR	4924	11172	44.1
BAJRI	639	4953	12.3
ALL CEREALS	9069	113183	8.0
ALL PULSES	968	10640	9.1
ALL FOODGRAINS	10037	123823	8.1
SUGAR CANE	2389	14742	16.2
COTTON	243	1282	19.0
GROUNDNUT	488	5363	9.1

THE PERCENTAGE FIGURES WILL SPEAK FOR THE COMPARATIVE PICTURE OF MAHARASHTRA STATE AND INDIA. EVEN THOUGH THEY RELATES TO THE YEAR 1981. IT IS HOPED THAT COMPARATIVE PICTURE WOULD NOT HAVE CHANGED MUCH FOR THE YEAR 1985 ALSO.

.5 PER CAPITA INCOME RS.2625 AS COMPARED TO INDIA'S RS 1868
(BASED ON 1983 DATA)

.6 NO OF DISTRICTS 30

7 NO OF TOWNS 289
NO OF VILLAGES 38661

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POWER

INSTALLED CAPACITY	1983-84	4686 MW.
	1984-85	5816 MW.
MAXIMUM DEMAND	1983-84	3650 MW.
	1984-85	3919 MW.
GENERATION	1980-81	18689 MILLION KWH
	1981-82	19768 ,,
	1982-83	20938 ,,
	1983-84	22923 ,,
	1984-85	24174 ,,

DETAILS OF GENERATION FOR 1984-85

1 HYDRO	4452	MILLION KWH
2 THERMAL	17984	,,
3 GAS TURBINE	1738	,,
TOTAL	24174	MILLION KWH

UTILISATION (FOR 1984-85)

INDUSTRIAL	- L.T.	943	MILLION KWH
	H.T.	5519	,,
	TOTAL	6462	,,
~~NON~~ DOMESTIC		1291	,,
COMMERCIAL		405	,,
RAILWAY		325	,,
PUBLIC ~~WORKS~~ LIGHTING		415	,,
CULTIVATION/AGRL.		3215	,,
OTHER UTILISATION (DISTN. LICENCES		9432	,,
TOTAL		21552	,,

SHORTFALL 3456 MILLION KWH

NO OF VILLAGES ELECTRIFIED	1983-84	32914
	1984-85	33402

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.9 AREAS OF LOCATION OF INDUSTRIES IN MAHARASHTRA

THE INDUSTRIES IN MAHARASHTRA ARE MAINLY CONCENTRATED IN THREE DISTRICTS, NAMELY, GREATER BOMBAY, THANA AND POONA. THESE THREE DISTRICTS COVER 25% OF THE POPULATION & 8.5% OF AREA BUT CONTRIBUTES TO 82% OF PRODUCTION, 71% OF EMPLOYMENT AND 70% OF INVESTMENT. THE PER CAPITAL ADDED VALUE OF THE WHOLE MAHARASHTRA STATE IS RS 728 BUT FOR THESE DISTRICTS COMBINED, IT IS RS 1634.

UPTO 1960, MAINLY, CONSUMABLE PRODUCTS WERE BEING MANUFACTURED BY THE INDUSTRIES IN MAHARASHTRA, BUT SINCE LAST 25 YEARS THE PICTURE IS CHANGED. NOW MAINLY CAPITAL GOODS ARE PRODUCED SUCH AS MACHINERIES COMPONENTS, SPARE PARTS, PETROLIUM PRODUCTS, ELECTRICAL & ELECTRONICS ITEMS, CHEMICAL ETC. TATAS, BIRLAS, MAFATALALS, KIRLOSKARS, SARABHAI, GARWARES, WALCHAND ARE THE MAIN BUSINESSS HOUSES IN MAHARASHTRA MANAGING THE INDUSTRIAL SCENE.

ANOTHER CHANGE DURING LAST FEW YEARS IS THAT, NEW DISTRICTS ARE DEVELOPING WITH VARIOUS INDUSTRIAL ESTALISHMENTS. THEY ARE NASIK, AURANGABAD, KOLHAPUR, NAGPUR, JALNA ETC. THUS AS ON TODYA, MEDIUM & SMALL INDUSTRIES ARE LOCATED IN THE ABOVE MENTIONED DISTRICTS.

IT IS OBSERVED THAT MAHARASHTRA CAN BE SAID TO BE THE BASTION OF INDIAN INDUSTRY, WHICH, IF GEARED UP HAS THE POTENETIAL TO SHOW THE WAY FOR INDIA TO BECOME INTER-

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NATIONALLY COMPETITIVE.

THE PRESENT SITUATION CALLS FOR BALANCED APPROACH TO SECTORAL DEVELOPMENT OF INDUSTRIES VIZ. LARGE, MEDIUM & SMALL SCALE

INDUSTRIES. TOWARDS THAT END, GRADED INCENTIVES ARE OFFERED TO INDUSTRIES OF VARIOUS SECTORS SO AS TO ACHIEVE MAXIMUM DECENTRALISATION, WITH EMPHASIS ON GROWTH OF ANCILLARY AND SMALL SCALE UNITS AROUND THE BIG UNITS IN ALL THE UNDER-DEVELOPED DISTRICTS OF THE STATE. THE HIGH INCREASE IN THE NUMBER OF REGISTERED SMALL SCALE UNITS IN THE STATE FROM 4860 IN 1961 TO 80675 IN 1982, REFLECTS STATE GOVT'S POLICY FOR PROMOTION OF SMALL SCALE INDUSTRIES. AS AGAINST THIS, THE NUMBER OF LARGE & MEDIUM INDUSTRIES IN THE STATE IS 1900.

THE DISTINGUISHING FEATURES OF SMALL SCALE SECTOR IN MAHARASHTRA ARE ITS COMPARATIVELY HIGHER TECHNOLOGY ORIENTATION, AND SLIGHTLY MORE CAPITAL INTENSENESS WITH HIGHER OUTPUT PER UNIT AND OUTPUT PER WORKER THAN THOSE OF ITS COUNTERPARTS IN THE REST OF INDIA.

KEEPING THE OBJECTIVE OF BALANCED INDUSTRIALISATION OF THE STATE IN MIND, 62 INDUSTRIAL AREAS HAVE BEEN FORMED AS FOLLOWS, THE MAJOR EMPHASIS BEING ON DEVELOPING PARTS.

SR NO	DIVISION	NO OF INDUSTRIAL AREAS	LAND IN POSESSION HECTORS
1	KONKAN	12	3493
2	WESTERN MAHARASHTRA, PUNE	8	1675
3	WESTERN MAHARASHTRA NASIK	6	1865
4	MARATHWADA	11	2098
5	VIDARBHA AMARAVATI	4	879
6	VIDARBHA, NAGPUR	8	1845
	TOTAL	49	11855

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IN THE DEVELOPED PARTS OF THE STATE

1	BOMBAY METRPOLITAN REGION	11	4790
2	PUNE METROPOLITAN REGION	2	6228
	TOTAL	13	6018
	GRAND TOTAL	62	17873

THE MAJOR & THE MEDIUM SCALE INDUSTRIES ARE MAINLY CONCENTRATED IN WESTERN MAHARASHTRA, PUNE NASIK AND THE METROPOLITAN REGIONS. AND IN THE REST PART OF THE STATE MAINLY SMALL SCALE UNITS ARE SITUATED. FURTHER, AS THE SUGARCANE IS THE MAIN CROP IN THE STATE, THERE ARE APPROXIMATELY 79 SUGAR FACTORIES IN MAHARASHTRA ENGAGED IN CO-OPERATIVE SECTOR.

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CITY PROFILE

1 POPULATION

	1981 CENSUS	1985 (APP)
P.M.C.	12.03 LAKHS	16 LAKHS
REST PUNE	4.83 LAKHS	8 LAKHS
GREATER PUNE	16.86 LAKHS	24 LAKHS

2 LAND AREA 266.68 SQ. KM. APP.OF POONA METROPOLITON REGION

3 DENSITY 6322 PER SQ.KM. (ON THE BASIS OF 1981 DATA)

4 CLIMATE

RANGE OF TEMPERATURE		MAXIMUM	MINIMUM
	SUMMER	40 CENT.	26 CENT.
	WINTER	29 CENT.	19 CENT.
	SPRING	32 CENT.	21 CENT.

5 RAINFALL 673 MMS (500 MMS JULY-OCT)

EDUCATIONAL FACILITIES (1984-85 DATA)

NAME OF THE INSTITUTE	NO OF STUDENTS CAPACITY GRADUATE	POSTGRADUATE	TOTAL	NO OF TEACHER
A. ENGINEERING				
1. COLLEGE OF ENGG, POONA-5	2015	128	2143	140
2. COLLEGE OF ENGG, POONA-2	83	-	83	5
3. COLLEGE OF ENGG, BHARATI VIDYAPEETH	320	-	320	11
4. COLLEGE OF ENGG, MAHARASHTRA ACADEMY	304	-	304	8
5. COLLGE OF ARCHITECHTURE , POONA-30	204	-	204	5
TOTAL	2926	128	3054	169
B. LAW				
1. ILS LAW COLLEGE, POONA-4	1209	167	1376	8
2. ABMVPS LAW COLLEGE, POONA-9	295	97	392	3
3. SYMBIOSIS LAW COLLEGE, POONA-4	1243	150	1393	7
4. BHARATI VIDYAPEETH'S NEW LAW COLLEGE	413	76	489	4
TOTAL	3160	490	3650	22

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NAME OF THE INSTITUTE	NO OF STUDENTS CAPACITY			NO OF
	GRADUATE	POSTGRADUATE	TOTAL	TEACHERS
C. MEDICINE				
1. B J MEDICAL COLLEGE	1190	231	1421	271
2. ARMED FORCES MEDICAL COLLEGE	136	781	917	83
3. D M SATHE HOMEOPATHEC MEDICAL COLLEGE	150	-	150	22
4. COLLEGE OF PHARMACY BHARATI VIDYAPEET	219	-	219	13
TOTAL	1695	1012	2707	389
D. AYURVED				
1. TILAK AYURVED COLLEGE	552	24	576	32
2. ASHTANG AYURVED COLLEGE	101	2	103	16
TOTAL	653	26	679	48
E. EDUCATION				
1. TILAK COLLEGE OF EDUCATION	213	118	331	20
2. ADARSH COLLEGE OF EDUCATION	270	47	317	23
3. ADHYAPAK MAHAVIDYALAYA	100	-	100	11
TOTAL	583	165	748	54
F. COMMERCE				
1. BRIHAN MAHARASHTRA COLLEGE OF COMM.	1534	249	1783	26
2. GARWARE COLLEGE OF COMMERCE	1479	124	1603	25
3. NESS WADIA COLLEGE OF COMMERCE	1792	344	2136	29
4. ST VINCENT COLLEGE OF COMMERCE	319	81	400	3
5. TIKARAM JAGANNATH COLLEGE OF COMMERCE	279	-	279	9
7. COLLEGE OF COMMERCE POONA-18	167	-	167	8
TOTAL	5570	798	6368	100
G. ARTS & SCIENCE				
1. FERGUSON COLLEGE	1610	190	1800	114
2. N WADIA COLLEGE ARTS & SCIENCE	1615	76	91	94
3. ABASAHEB GARAWARE COLLEGE OF A & S	1287	101	1388	93
TOTAL	4512	367	4879	301

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NAME OF THE INSTITUTE	NO OF STUDENTS CAPACITY			NO OF
H. ARTS & COMMERCE	GRADUATE	POSTGRADUATE	TOTAL	TEACHER
1. ST. MIRA COLLEGE OF ARTS & COMMERCE	905	22	927	26
2. SHAHU MANDIR COLLEGE OF ARTS & COMM.	1048	110	1158	22
3. ARTS & COMMERCE COLLEGE, HADAPSAR	687	93	780	15
4. ARTS & COMMERCE COLLEGE PANDAVNAGAR	248	-	248	5
5. SYMBIOSIS SOCIETY'S ARTS & COMM.COL.	276	-	276	9
6.S.K. COLLEGE OF ARTS & COMM.CHINCHWAD	992	83	1075	19
TOTAL	4156	308	4464	96

I. ARTS,SCIENCE & COMMERCE COLLEGE

1. S P COLLEGE	2223	130	2353	130
2. POONA COLLEGE OF ARTS SCI. & COMM	1572	179	1751	56
3. Y MOHITE COLLEGE OF ARTS SCI. & COM.	770	133	903	24
4. SANGHAVI KESARI COLLEGE	992	83	1075	19
5. MORDEN COLLEGE OF A/S/C	1790	125	1915	68
TOTAL	7347	650	7997	297

J.FACUTIWISE REGISTERED STUDENTS FOR DOCTORATE WITH POONA UNIVERSITY

(DATA AS ON AUG 1986)

FACULTY	REGISTERED STUDENTS
ARTS(LANGUAGES)	200
SCIENCE	344
LAW	-
MEDICINE	24
ENGINEERING	-
COMMERCE	135
EDUCATION	51
AYURVED	58
[illegible]	[illegible]

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BUSINESS / PROFESSIONAL TRAINING COURSES

	NAME & ADDRESS OF THE INSTITUTE	HEAD OF THE INSTITUTE	TELEPHONE NO
	INSTITUTE OF MANAGEMENT DEVELOPMENT AND RESEARCH FERGUSON COLLEGE CAMPUS, DECCAN GYMKHANA, POONA-411004	DR P C SHEJWALKAR	53186
	SYMBIOSIS INSTITUTE OF MANAGEMENT GANESH KHIND ROAD POONA-411004	DR S B MUZUMADAR GEORGE JUDAH	57626
	AUDYOGIC TANTRA SHIKSHAN SANSTHA MIDC, C2, CHINCHWAD POONA-411019	SHRI M D JAMBHEKAR	82079
	NESS WADIA COLLEGE OF MANAGEMENT AND COMUTER SCIENCE POONA-411001	PROF NULKAR	
	M M CHANDRASHEKHAR AGASHE COLLEGE OF PHYSICAL EDUCATION GULTEKADI POONA-411037		470872
	M A E E R MAHARASHTRA INSTITUTE OF TECHNOLOGY POONA-411002		
	C.T & R SOCIETY'S PUNE INSTITUTE OF COMPUTER TECHNOLOGY 774, BHAWANI PETH POONA-2		21446
	VISHWAKARMA INSTITUTE OF TECHNOLOGY		
	JNANA PRABODHINI'S INSTITUTE OF COMPUTER MANAGEMENT & LEADERSHIP DEVELOPMENT 510 SADASHIV PETH POONA-411030	DR V C TAMHANKAR ~~POONA - 411030~~	32691
0.	DNYANESHWAR VIDYAPEETH'S ABHINAV YANTRIKI MAHAVIDYALAYA ILS LAW COLLEGE CAMPUS POONA - 411004	DR M D APTE	52237
	VAIKUNTH MEHTA NATIONAL INSTITUTE OF CO-OPERATIVE MANAGEMENT POONA UNIVERSITY ROAD POONA - 411007	DR N H R HYNNIEWAT	56008
2.	FILM & TELEVISION INSTITUTE OF INDIA LAW COLLEGE ROAD	P V PARULEKAR	470025

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POONA - 411004

POONA CHAPTER OF COST ACCOUNTANTS 1195/4-B F C ROAD POONA - 411004	DR ASHOK JOSHI	59727
ST JOSEPH'S TECHNICAL INSTITUTE 39 SHANKARSHET ROAD POONA - 411009	FR IVO MEYER S J	66492
SPICER MEMORIAL COLLEGE GANESH KHIND ROAD POONA - 411007	DR M E CHERIAN	56675

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7 UNEMPLOYED WORKERS (REGISTERED)

	1982	1983	1984	1985
SKILLED	4312	5028	5376	6122
SEMI SKILLED	10513	11637	11396	13754
NON SKILLED	16158	18666	19124	22792

8 RESEARCH AND/OR TRAINING INSTITUTIONS

INSTITUTE

A.GOVERNMENT	NAME OF DIRECTOR	NATURE OF RESEARCH
1.CENTRAL WATER & POWER RESEARCH STATION (TELEPHONE-445550-51-52) ADDRESS-P.O.KHADAKWASLA RESEARCH STATION POONA-411024	SHRI P.C.SAXENA	TESTING & RESEARCH AND DEVELOPMENT FOR 1.RIVER & CANAL HYDRAULIES 2.COASTER & HARBOUR ENGINEERING 3.SHIP MODEL TESTING 4.STRUCTURAL ENGG 5.EARTH SCIENCE 6.APPLIED SCIENCES
2.CONTROLLERATE OF INSPECTION (ENGG.EQUIPEMENT) (TELEPHONE-51316/58/07) ADDRESS-AUNDH CAMP POONA-411027	BRIG.B.R.GULATI	1.IT IS AN APPROVED LABORATORY FOR ISI CERTIFICATION SCHEME FOR STEEL WIRE ROPE LINK CHAINS,FIBRE ROPES ETC. 2.IT RENDERS VALUABLE SERVERCES IN TESTING JOBS.
3.ELECTRONICS TESTING & DEVELOPEMENT CENTRE PUNE (TELEPHONE-59787) ADDRESS-AGRICULTURE COLLEGE COMPOUND SHIVAGINAGAR POONA-411005	SHRI P.H.BHAVE	THE OBJECTIVES ARE TO PROVIDE- 1.ELECTRICAL,ENVIRONMENTAL TESTING FACILITY AS PER ISI,JSS & MANUFACTURER'S SPECIFICATIONS 2.CALIBRATION FACILITIES TO ECHELON III LEVEL 3.DEVELOPEMENT FACILITIES TO ENTERPRENEURS 4.LIBRARY/DATA BANK FACILITY

INSTITUTE	NAME OF DIRECTOR	NATURE OF RESEARCH
4.INSTITUTE OF ARMAMENT TECHNOLOGY (TELEPHONE-440050) ADDRESS-GIRINAGAR POONA-411025	MAJ.GENERAL N.SUBBA RAO	1.THE SERVICES RENDERED ARE MOSTLY IN RESEARCH & DEVELOPEMENT. 2.APPLIED RESEARCH IS UNDERTAKEN IN -PHYSICS,CHEMISTRY -TELECOMMUNICATIONS -METALLURGY
5.NATIONAL INSTITUTE OF VIROLOGY (TELEPHONE-67301-4) ADDRESS-20-A DR.AMBEDKAR ROAD P.O. BOX NO 11 POONA-411001	DR.KHORSHED M PAVRI	FACILITIES EXIST WITH SPECIAL REFERENCE TO ARBOVIRUSES RESPIRATORY & HEPATITIS VIRUSES IN THE FIELD OF 1.EPIDEMILOGY 2.IMMUNOLOGY 3.TISSUE CULTURE & CELL BIOLOGY 4.MEDICAL ENTOMOLOGY & ZOOLOGY 5.RICKETTSIOLOGY 6.PATHOLOGY & CLINICAL VIROLOGY 7.LABORATORY ANIMALS 8.DEVELOPMENT OF VIRAL VACCINE ETC.
6.RESEARCH & DEVELOPMENT ESTABLISHMENTS (ENGINEERS) (TELEPHONE-67881,67875) ADDRESS-DIGHI,POONA-411015	BRIG.RVN KADAMMBI	1.TYPE TESTING OF IC ENGINE 2.ENVIRONMENTAL TESTS 3.METALLURGICAL TESTS 4.FABRIC TESTS 5.SOILS & CIVIL ENGG.TESTS
7.SMALL INDUSTRIES SERVICE INSTITUTE (TELEPHONE-440594) ADDRESS-SHANKARSHET ROAD SWARGATE POONA-411037	CAPT.T.D SRINIVASAN	1.CO-ORDINATING THE POLICIES & PROGRAMS FOR THE DEVELOPMENT SMALL SCALE INDUSTRIES IN THE COUNTRY 2.MAINTAINING CLOSE LIAISON WITH THE CENTRAL MINISTRY,PLANNING COMMISION,STATE GOVTS. FINANCIAL INSTITUTIONS 3.IT PROVIDES CONSULTANCY IN TECHNOMANAGERIAL ASPECTS,TRAINING, ASSISTANCE IN MARKETING

INSTITUTE	NAME OF DIRECTOR	NATURE OF RESEARCH
8. MAHARASHTRA INDUSTRIAL & TECHNICAL CONSULTANCY ORGANISATION LTD (MITCON) (TELEPHONE -) ADDRESS - UDHYOG BHAVAN P.U.ROAD POONA-411007	SHRI S.P RANADE	1.TRAINING & INFORMATION 2.ADVICE & CONSELLING 3.ASSISTANCE & LIAISON 4.ACTION & IMPLEMENTTATION
9. THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA (TELEPHONE - 56546/52671) ADDRESS - SURVEY NO 102 VETAL HILL KOTHRUD POONA -411004	SHRI K RAMCHANDRAN	AN EXTENSIVE RANGE OF FAC-LITIES FOR EVALUATION & DEVELOPMENT OF AUTOMOTIVE COMPONENTS HAVE BEEN SET UP IN ARAI,E.G 1.VEHICLE LAB. 2.POWER PLA-NT LAB. 3.COMPONENTS LA 4.MATERIALS LAB. 5.METHROL-OGY LAB. 5.INSTRUMENTAT ON LAB.
10. CENTRAL INSTITUTE OF ROAD TRANSPORT (TELEPHONE - 83671-72) ADDRESS - PUNE-NASIK ROAD BHOSARI POONA - 41026	SHRI P G PATANKAR	1.TESTING AS PER ASRTU/ISI STANDARDS 2.MANAGEMENT RESEARCH STUD-IES RELATING TO ROAD TR-NSPORT ECONOMICS, ENGG AND TRANSPORT PROBLEMS. 3.TRAINING PROGRAMMES IN TRAFFIC MANAGEMENT,STORE MANAGEMENT ETC.
11. COLLEGE OF ENGINEERING (TELEPHONE - 59535/55466) ADDRESS - SHIVAJINAGAR POONA - 411005	PROF H.M. GANESHRAO	RESEARCH DEVELOPMENT & TESTING IN 1.CIVIL ENGG 2.MECH. ENGG. 3.COASTAL & HARBOUR ENGG. 4.ELECTRONICS & TELECOMMU-NICATION. 5.METALLURGY 6.ENVIRONMEN-TAL ENGG.
12. GOVT. POLYTECHNIC (TELEPHONE - 57907)	PROF M R DESHPANDE	1.TESTING OF MATERIALS FOR STRENGTH.

ADDRESS - GANESHKHIND ROAD POONA - 411007		2.TESTING OF TAXI/AUTORIKSHAW METERS. 3.TESTING OF I.C. ENGINES UPTO 10 H.P. 4.METALLURGICAL TESTING.
. INSECTICIDES TESTING LABORATORY (TELEPHONE - 58413) ADDRESS - AGRI COLLEGE CAMPUS SHIVAJINAGAR POONA - 411005	SHRI U D THAKARE	TESTING OF INSECTICIDES & PESTICIDES.

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INSTITUTE	NAME OF DIRECTOR	NATURE OF RESEARCH
B. SEMI GOVERNMENT		
1. CENTRAL BEE RESEARCH INSTITUTE (TELEPHONE-51819) ADDRESS - 1153 GANESHKHIND RD POONA - 411007	DR R P PHADKE	1.PHYSICO-CHEMICAL STUDIES OF MAJOR BEE PLANTS 2.FIEHE'S TEST ON HONEY 3.FINER ANALYSIS OF DIFFER-RENT INGREDIENTS OF HON 4.STUDIES ON INDIAN HONEY-BEES 5.BEE MANAGEMENT
2. HANDMADE PAPER INSTITUTE (TELEPHONE - 56383) ADDRESS - K B JOSHI ROAD AGRI COLLEGE CAMPUS POONA - 411005	SHRI D C NADAPH	1.PHYSICAL-CHEMICAL TESTS ON PAPER 2.R & D ON ALL HANDMADE PAPER 3.CONSULTANCY & TRAINING IN PRODUCTION OF HANDM-ADE PAPER ADE PA
C. PRIVETE/PUBLIC TRUST		
1. ABASAHEB GARWARE COLLEGE DEPARTMENT OF MICROBIOLOGY (TELEPHONE - 30311) ADDRESS - KARVE ROAD POONA - 411004	MRS.P.V.SARDESAI	1. ANALYTICAL FACILITIES ARE AVAILABLE FOR MICR-OBIOLOGICAL EXAMINATION OF FOOD SUCH AS MASALA, PICKLES MEAT AND MILK PRODUCTS 2. MICROBIOLOGICAL STANDA-RDS ARE AVAILABLE FOR FOOD PRODUCTS. 3. TECHNICAL ADVICE ON FOOD PRODUCTS
2. THE BHARATIYA AGRO INDUSTRIES FOUNDATION (TELEPHONE - 52621) ADDRESS -'KAMDHENU' SENAPATI BAPAT MARG POONA - 411016	DR MANUBHAI DESAI	1. RESEARCH IN CATTLE GENE-TICS & BEEDING 2. RESEARCH IN AGROFORESTR
3. INDIAN DRUG RESEARCH ASSO-CIATION DRUG RESEARCH LABORATORY	DR G S PENDSE	1. TESTING DRUGS,PHARMA-CEUTICALS,COSMETICS, FATS ,OILS ETC.

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ADDRESS - 561-B SHIVAJINAGAR
POONA - 411005

2. TRAINING FACILITIES FOR ANALYTS & COMMERCIAL APPRENTICES
3. R & D PROGRAM ON BEHALF OF INDUSTRIES.

INSTITUTE	NAME OF DIRECTOR	NATURE OF RESEARCH
. PRIVATE		
. BEHRAM WADIA & ASSOCIATES (TELEPHONE - 23134) ADDRESS - 77, KOREGAON PARK POONA - 411001	DR B H WADIA	TESTING COMPONENT & CIRCUITS
. BHASKARACHARYA PRATISTHANA (TELEPHONE - 58910) ADDRESS - 106/6 ERANDWANE POONA - 411004	SHRI W N KOLHATKAR	1. RESEARCH PROGRAMME AT POST DOCTORAL LEVEL 2. PROMOTION OF MATHEMAT--IES BY RESEARCH FACILITIES
. DECCAN SUGAR INSTITUTE (TELEPHONE - 70650) ADDRESS - MANJARI POONA - 412307	DR N A RAMAIAH	1. TESTING OF PRODUCTS OF SUGAR INDUSTRIES & PRODUCTS ALLIED TO SUGAR & SUGAR CANE. 2. RESEARCH ON UTILISATION OF BY-PRODUCTS OF THE SUGAR.
INDUSTRIAL TECHNICAL INSTITUTE (TELEPHONE - 55848/54685) ADDRESS - 3 B, LAJWANTI 9/62 ERANDWANA POONA - 4110004	SHRI S D MAHULIKAR	1. TESTING OF EQUIPMENT AS PER FACTORY ACT. 2. TESTING OF OIL TANKER 3. INSPECTION & TESTING OF PRESSURE VESSELS.
. KIRLOSKAR CONSULTANTS LTD (TELEPHONE - 56495/54211) ADDRESS - 917/19A SHIVAJINAGAR POONA - 4110004	SHRI D V TIKEKAR	1. CHEMICAL ANALYSIS OF METALS & ITS ALLOYS, ORES,SOILS & FERTILISERS, OIL SEEDS & CAKES, WASTE WATER & EFLUENTS
NATIONAL CHEMICALS LABORATORY	DR L K DORAISWAMY	1. RESEARCH CONCERENED

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(TELEPHONE - 56451/2/3)
ADDRESS - PASHAN
POONA - 411008

WITH BASIC NEEDS SUCH FOOD, HEALTH & ENERGY BY INNOVATIVE UTILISATI-ON OF AVAILABLE NATUR-RAL RESOURCES.

2. APPLIED RESEARCH WHICH COULD MEET SHORT TERM & LONG TERM NEEDS OF INDIAN CHEMICAL INDUS-RIES.

3. ANALYTICAL SERVICES WITH MODERN SOPHISTICAT-ED INSTRUMENTS FOR STRUCTURAL ELUCIDATION.

4. SPONSORED RESEARCH

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1. WHAT PORTION OF RESEARCH IN GOVT & SEMI-GOVT INSTITUTIONS IS USED FOR PRAC-TICAL APPLICATION IN PRIVATE INDUSTRIES ?

1. ARAI IS ONE OF TWO APPROVED AGENCIES BY THE MINISTRY OF INDUSTRY, FOR THE EVALUATION OF 2,3 & 4 WHEELERS INCLUDING ELECTRIC VEHICLE & TRACTOR TRAILER COMBINATIONS.

2. CWPRS HAS 450 RESEARCH PROJECTS & 200 MODELS ON HAND. IT IS RECOGNISED AS A REGIONAL LAB BY THE UNITED NATIONS ECONOMICS & SOCIAL COMMISSION FOR ASIA & PACIFIC.

3. MITCON IS AN ACTIVATOR OF TRAINING & DEVELOPMENT PROGRAMMES FOR ENTERPREN-EURS. IT GIVES ATTENTION ON TECHNOL-OGICAL TRANSFER OF KNOWHOW & SKILLS FROM THE ADVANCED INDUSTRIAL CENTRES TO THE NEWLY DEVELOPING CENTRES.

4. SISI, ATTACHED TO THE MINISTRY OF IND-USTRY, IS THE MODEL AAGENCY FOR COOR-DINATION THE POLICIES & PROGRAMMES FOR THE DEVELOPMENT OF SMALL INDUSTR-IES IN THE COUNTRY.

2. WHETHER SPONSORED OR CONTRACT RESEARCH UNDERTAKEN ?

1. ARAI UNDER TAKES SPONSORED PROJECTS OF SPECIFIC NATURE FROM INDUSTRY & GOVT. E. G.
   1. CONVERSION OF A PRE-COMBUSTON CHAMBER ENGINE TO A DIRECT INJECTION ENGINE.
   2. DESIGN OF TRANSMISSION SYSTEM FOR A LIGHT COMMERCIAL VEHICLE.

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2. PROJECTS WHICH ARE OF IMMEDIATE INTE--REST TO THE INDUSTRY ARE UNDERTAKEN AT NCL ON BEHALF OF PUBLIC & PRIVATE SECTOR ON SPONSORSHIP BASIS. SPONSORED WORK ON DEVELOPMENT OF KNOW-HOW ON THE CHEMICALS WHICH ARE IMPO-RTED AND WHICH HAS A SIZEABLE ECONO-MIC IMPACT AND FOR THE MANUFACTURE OF WHICH TECHNOLOGY IS NOT ALREADY ESTA--BLISED IN THE COUNTRY CAN BE UNDERTAKEN AT NCL.

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3.9 HEALTH FACILITIES

	NO OF INSTITUTIONS	NO.OF BEDS
GOVERNMENT HOSPITALS	13	7128
MUNICIPAL HOSPITALS	11	754
TRUST HOSPITALS	13	1234
PRIVATE HOSPITALS	76	597
PRIVATE PRACTITIONERS	10	53
TOTAL	123	9766

3.10 RECREATIONAL FACILITIES

	NUMBER
PARKS	10
PICNIC SPOTS	15
CINEMAS	30
THEATRES	5
CLUBS	14
PUBLIC HALLS	16

3.11 INDUSTRIES (PUBLIC AS WELL AS PRIVATE)
(DATA IS BASED ON YEAR 1984-85)

MAJOR INDUSTRIES (TURNOVER EXCEEDING RS 10 CRORES)

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML. PRODN.	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
1.ADVANI OERLIKON LTD (TELE-242525)	A.PARSURAM (G.M.)	1951	WELDING CONSUMABLES & EQUIPMENTS H.T EQUIP-MENTS, ELECTRONIC MUSICAL EQUIPMENTS, CARBONS ETC	70.46	YES	U.S.A.
2.ASSOCIATED BEARING COMPANY(SKF) (TELE-82791)	AKBAR HYDARI	1965	BALL BEAR-INGS,TEX-TILES COM-PONENTS, PULLEY, SPINDLE INSERTS ETC.	40.60	YES	SWEDEN

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IE OF THE IPANY	NAME OF THE CHAIRMAN/MD	YEAR OF COMML. PRODN.	PRODUCT	TURNOVER IN CRORES OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
3.ATLAS COPCO (INDIA) LTD. (TELE-315623)	AKBAR HYDARI	1960	AIR COM-PRESSORS, DRILLING EQUIPMENTS AQUA RIGS	26.21	YES	SWEDEN
4.BAJAJ AUTO LIMITED (TELE-82851)	RAHULKUMAR BAJAJ	1945	SCOOTERS AUTO-RIKSHAS PICK-UP VANS, AUTO-TRAILERS DELIVERY VANS	191.02	YES	JAPAN
5.BAJAJ TEMPO LIMITED (TELE-86380)	H.K.FIRODIA	1958	LIGHT COMM ERCIAL VEHICALS 3&4 WHEELERS AND DIESEL ENGINE	78.60	YES	W.GERMANY
6.BHARAT FORGE COMPANY LTD. (TELE-70451)	N.A.KALYANI	1966	QUALITY STEEL FORGINGS, CRANKSHAFTS, FRONT AXLE WHEELS, STUB AXLE, SHAFTS	46.47	NO	–
7.BACKAU WOLF INDIA LTD. (TELE-84461)	D.N.DAMANI (M.D.)	1947	SUGER MILL MACHINARY, CENTRIFUGAL MACHINES, BOILERS FOR SUGER PLANT, CONVEYING, EQUIPMENT.	40.00	YES	W.GERMANY
3.THE CENTRAL PULP MILLS (TELE-55090)	M.S.PARKHE (M.D)	1960	PAPER GRADE MARKET PULP, M.F.GRADE WRITING & PRINTING	21.00	NO	–

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO RATION YES/NO	COUNTRY OF COLLABO RATION
15.FINOLEX CABLES LTD (TELE-85963)	CHHABRIA	1967	TELEPHONE CABLES,POWER CABLES,AUTO & BATTERY CABLES,AND FLEXIBLE WIRES ETC.	18.52	YES	U.S.A.
16.FINOLEX PIPES(P)LTD. (TELE-82621)	CHHABRIA	1981	REGID PVC PIPES,PVC FITTING.	17.84	NO	_
17.GARWARE NYLONS LTD (TELE-83804)	B.D.GARWARE	1962	NYLON YARN, TWINE,CORD & POLYESTER FILAMENT YARN	99.21	YES	U.S.A & W.GERMANY
18.HINDUSTAN ANTIBIOTICS LTD. (PUBLIC SECT (TELE-86511)	D.B.TELANG	1954	PENICILLIN, STREPTOMYCIN, AMPICILLIN, FORMULATIONS, DIAGNOSTIC KIT-NANCY-KIT	34.60	NO	_
19.THE INDIAN CABLE CO:LTD (TELE-70011)	K.TAPURIAH	1920	ELECTRICAL CABLES & WIRES	66.78	NO	_
20.INDUSTRIAL OXYGEN CO. PVT LTD. (TELE-65616)	L.K.JAIN	1964	OXYGEN, ACETELYNE, NITROGEN, HYDROGEN AND AIR SEPERATION PLANTS	10.76	NO	_

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AME OF THE OMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
21.INTERNATIONAL COMPUTERS(IND) MANUFACTURE LTD. (TELE-65285)	V.D.KHER (ASST M.D.)	1963	MAIN FRAME COMPUTERS, MINI/MICRO COMPUTERS, LINE PRINTERS, MAG TAPES ETC.	26.34	YES	U.K.
22.K.K.NAG PVT.LTD. (TELE-66456)	K.K. NAG	1965	LEAD COILS, LEAD VALVES PVC & FRP DUCTINGS, EXHAUST SYSTEM,TANKS, ETC.	10.29	NO	_
23.KSB PUMPS LIMITED (TELE-82006)	V.C.SETALVAD	1962	SUBMERISIBLE PUMPS,HIGH PRESSURE PUMPS, CHEMICAL PROCESS PUMPS ETC.	19.81	YES	W.GERMANY
24.KIRLOSKAR BROTHERS LIMITED (TELE-31056)	S.L.KIRLOSKAR	1920	INDUSTRIAL PUMPS AND VALVES,AGRL. PUMPS, SEALED COMPRESSORS.	68.17	NO	_
25.KIRLOSKAR CUMMINES LIMITED (TELE-30240)	C.S.KIRLOSKAR	1962	INTERNAL CUMBUSTION ENGINES IN THE RANGE OF 60-1600H.P.	115.02	YES	U.S.A.
26.KIRLOSKAR	S.L.KIRLOSKAR	1949	DIESEL ENGINES	80.42	NO	_

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OIL ENGINES LIMITED (TELE-55341)			& SPARES, BIMETAL BEARING & STRIP, CRUSHER D.P. SETS.			

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
27.KIRLOSKAR PNEUMATIC COMPANY LTD. (TELE-70133)	A.KIRLOSKAR	1970	COMPRESSED AIR & GAS EQUIPMENTS, AIRCONDITIONING & REFRIGERATION EQUIPMENT, TRACTORS ETC.	62.35	YES	U.K.
28.MAHARASHTRA SCOOTERS LIMITED (TELE-83396)	RAHULKUMAR BAJAJ	1975	PRIYA SCOOTERS	28.40	NO	_
29.NAV MAHARASHTRA CHAKAN OIL MILLS (TELE-66406)	S.LUNKAD	1961	EDIBLE OILS, DE-OILED CAKES PULES & BASIN CATTLE FEED, SOAPS.	24.12	NO	_
30.PAPER & PULP CONVERSIONS LIMITED (TELE-55301)	M.S.PARKHE (M.D.)	1942	PAPER & PAPER BOARDS, PAPER MAKING MACHINES, COATED PAPER AND BOARDS	17.85	NO	_
31.PEICO ELECTRONICS & ELECTRICALS LIMITED (TELE-83547)	W.MACLAINE PONT	1930	TAPE RECORDERS LOUD SPEAKERS, RADIOS, TRANSISTORS, ELECTRONIC & SCIENTIFIC INSTRUMENTS, PAS ETC.	176.89	YES (NOW TERMNATED SINCE 1977)	HOLLAND

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32.PADUMJEE PULP & PAPER MILLS LTD (TELE-82032)	S.L.KIRLOSKAR	1964	PULP AND DIFFERENT VARIENTIES OF SPECIALITY PAPERS	18.43	YES	ITALI

IE OF THE IPANY	NAME OF THE CHAIRMAN/M.D.	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
33.THE RAJA BAHADUR MOTILAL MILLS LTD (TELE-66331)	NANDLAL M. PITTIE	1926	CLOTH PRINTED & DYED DRESS MATERIAL, BED COVERS, LONG CLOTH ETC YARNS, POPLIN, CAMBRICS	16.06	NO	
34.RECONDO LIMITED (TELE-25296)		1947	CONSTRUCTION, COOLING TOWERS & FAN BLADES	16.62	NO	-
35.SANDVIC ASIA LTD (TELE-86491)	NAWAL S. PHATARPHEKAR	1960	TUNGSTON CARBIDE PRODUCTS, TOOLS,TC TIPPED COROMANT TOOLS,SPE-CIALISIED TOOLS, HYDROGEN GAS.	19.63	YES	SWEDEN
36.SUDERSHAN CHEMICAL INDUSTRIES (TELE-67334)	R.J. RATHI	1951	PIGMENTS, INTERMEDIATES, PESTICIDES.	24.76	YES	U.S.A.

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37.TATA ENGG. & LOCOMOTIVE COMPANY LTD. (TELE-84261)	SUMANT MOOLGAOKAR	1966	TRUCK & BUS CHASIS, MARINE ENGINES, GENERAL AND SPECIAL PURPOSE MACHINES ETC.	294.45	YES	JAPAN

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D.	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
38.THERMAX PVT.LTD. (TELE-85903)	R.D.AGA	1980	STEAM BOILERS PROCESS HEAT EQUIPMENT, WATER TREATMENT PLANTS, AIR POLUTION CONTROL EQUIPMENT ETC.	59.70	NO	-
39.VANAZ ENGINEERS PVT LTD. (TELE-31344)	S.K.KHANDEKAR	1949	LPG CYLINDER VALVES,LPG PRESSURE REGULATORS, PRESSURE DIE CASTINGS, ETC.	12.84	NO	-
40.VULCAN LAVAL LIMITED (TELE-86321)	V.A.DATAR (M.D.)	1961	DAIRY MACHINERY,BREWERY MACHINERY, MATCH MAKING MACHINES, MILK TANKERS ETC.	33.04	YES	SWEDEN
41.WALCHANDNAGAR INDUSTRIES LIMITED (TELE-85161)	V.L.DOSHI	1960	CNC MACHINE TOOL,SUGER MACHINERY, SHAPING PLANNING &	116.94	YES	W.GERMANY

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SLOTTING
MACHINES,
LATHES ETC.

42. YASHWANT SAHAKARI SAKHAR KARKHANA (TELE-79281)	KANCHAN	1969	SUGER, MOLLASSES, BAGASSE	12.50	NO	-

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
43.KINETIC ENGINEERING LIMITED. (TELE-84301)	H.K.FIRODIYA	1970	MPOEDS & AUTOMOBILE PARTS.	19.44	YES	JAPAN
44.RUSTON & HORNSBY (INDIA) LIMITED (TELE-83564)	C.MATHRANI	1939	DIESEL ENGINE 5 TO 150 H.P. FOR VARIOUS APPLICATIONS LIKE MARINE, INDUSTRIAL, AGRICULTURE & GENERATING SET.	29.65	YES	U.K.

NOTE-HINDUSTAN ANTIBIOTICS LTD.IS THE ONLY PUBLIC SECTOR INDUSTRY IN POONA.REST ALL ARE IN PRIVATE SECTOR.

INHOUSE RESEARCH & DEVELOPMENT.

IN MOST OF THE ABOVE COMPANIES THE TECHNOLOGY WAS IMPORTED. OVER THE YEARS THE IMPORTED TECHNOLOGY HAS BEEN ABSORBED BY INTERNAL RESEARCH & DEVELOPMENT, AND THE CHANGES WERE MADE ACCORDINGLY TO SUIT THE RESOURCES AVAILABLE LOCALLY AND J OPERATION CONDITIONS.

THUS IN BIG COMPANIES INHOUSE RESEARCH & DEVELOPMENT FACILITIES ARE AVAILABLE AND THEY ARE WELL ORGANISED AND MANAGED. BUT ITS NATURE AND ANNUAL BUDGETS, COMPANY BY COMPANY CANNOT BE GIVEN, BECAUSE SUCH DATA IS NOT PUBLISHED SEPARATELY.

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12 MEDIUM INDUSTRIES (DATA IS BASED ON YEAR 1984-85)
(TURNOVER BETWEEN RS 1 CRORE & RS 10 CRORES)

1E OF THE 1PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
AGARWAL NTAINERS T LTD. ELE-83741)	M.S.AGARWAL	1974	200 LITERS CAPACITY M.S.BARRELS, 10TO160 LITERS DRUM,FUEL TANKS	4.00	NO	-
AJAY META-EM PVT. 1ITED. ELE-54943)	P.G.PAWAR	1968	FOUNDRY CHEMICALS AND FUELS	3.50	NO	-
IT SOAP CTORY ELE-26382)		1955	WASHING SOAP, DETERGENTS, CLEANING POWDER.	7.00	NO	-
AMERICAN RIGERATOR 1PANY LTD. CO-WHITNEY DRAULIC VISION) ELE-85127)	A.R.KAMAT	1960	HYDRAULIC EQUIPMENTS, AIR-CONDITIONERS WATER COOLERS, INDUSTRIAL BLOWERS.	5.47	YES	U.S.A.
AMPHETRONIX 1ITED LE-83363)	PAUL VARGHES (CHIEF EXCT)	1972	ELECTRONIC CONNECTORS	3.00	YES	U.S.A.

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
6.ARBOR ACRES FARM INDIA LIMITED (TELE-65987)	R.K.HANDA	1962	ONE DAY OLD BROILER AND LAYER CHICKS.	1.00	NO	-
7.ATLAS AUTOMOTIVE COMPONENTS (TELE-83856)	D.K.NANDY	1969	ALUMINIUM ALLOY DIE CASTINGS AND SAND CASTINGS	3.00	NO	-
8.B.G.SHIRKE AND COMPANY (TELE-70151)	B.G.SHIRKE	1944	FABRICATED STRUCTRUAL STEEL,PREFABRICATED HOUSES OF STEEL WOOD PANEL PRODUCTS BUILDING COMPONENTS, CONSTRUCTION MACHINERY, TRANSMISSION LINE TOWERS.	4.84	NO	-
9.B.K.BENZYL (TELE-62889)			CHLOROQUIN PHOSPHATE, AMODIAQUIN DIHYDROCHLORIDE.	2.40	NO	-
10.THE BRIHAN MAHARASHTRA SUGER SYNDICATE LTD. (TELE-444491)	D.C.AGHSHE (JT.M.D.)	1934	WHISKY RUM BRANDY,GIN, VODKA, DENATURED SPIRIT	4.00	NO	-

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IE OF THE IPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
.C.T.R.MFG. IUSTRIES IITED (LE-66317)	A.P.KUMAR	1964	MILLING CUTTER PRESSED STEEL RADIATORS,LT OIL CIRCUIT BRAKERS,ON-LOAD TAP CHARGES FOR TRANSFORMERS	2.20	NO	_
CAMBRIDGE TRUMENTS DIA) PVT. ITED LE-83495)	DARIVS FORBE	1962	TEMPERATURE INDICATORS & RECORDERS,PH METERS,THERM-OMETERS,ELECTRO CARDIOGRAPH	1.13	YES	U.K.
CONSOLIDATED STS PVT. ITED LE-442019)	M.NEVREKAR	1966	CRANES & HOISTS	1.28	NO	_
DAI-ICHI KARIA LTD. LE-83427)	D.M.NETRAWALA	1960	SURFACE ACTIVE AGENTS,PROCESS AIDS,SPECIALITY CHEMICALS	5.61	NO	_
DECCAN EMB. .COMPANY LTD. LE-67741)	S.P.SHROFF	1960	SEWING THREAD INDUSTRIAL YARNS	2.00	NO	_
DECCAN HANICAL HEMICAL USTRIES LTD	K.R.NATU	1969	CONVEYORS, BUCKET ELE-VATORS,COAL & ASH HANDLING SYSTEMS,	2.84	NO	-

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(TELE-82994)

GENERAL FAB
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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML. PRODN.	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO RATION
17.DEMECH OVERSEAS CONSTRUCTION PVT LTD (TELE-50934)		1979	TECHNICAL SERVICES	1.36	NO	_
18.DIVGI METAL WARE PVT. LIMITED (TELE-30375)	A.N.DIVGI	1964	AUTOMOBILE GEARS	5.00	NO	_
19.EAGLE FLASK PVT LIMITED (TELE-24-25)	A.C.PADAMSEE	1956	GLASS SHELLS FOR VACCUM FLASKS,VACCUM FLASKS,INSULA-TED WARE LEAD CRYSTAL GRASS WARE	2.40	YES	
20.ELECTRONICA SALES AND SERVICE (TELE-443532)	S.R.POPHALE	1978	ELECTRIC DIS-CHARGE MACHINE, NC WIRECUT EDM, NC RETROFIT PACKAGES FOR LATHES,MILLING	2.24	NO	_
21.ELLORA ENGINEERING COMPANY LTD (TELE-61380)	KHENY DHARMRAJ	1979	STEEL FORGINGS	2.30	NO	-
22.F.PUDOMJEE COMPANY LTD		1965	DIFFERENT VARIETIES OF PAPER	2.57	NO	_

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_E-82032)			SUCH AS KRAFT,TISSUE ETC.			

E OF THE PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
.FORMICA IA ISION _E-82121)	R.RAM (CHIEF EXECT	1965	DECORATIVE LAMINATES, INDUSTRIAL LAMINATES COPPER CLAD & GLASS EPOXY LAMINATES	6.90	YES	U.S.A.
GARWARE AMENT PORATION LTD _E-82241)	B.D.GARWARE	1961	SYNTHETIC TWIN ROPE,AGRICU-LTURE NETTING FISHNET(NYLON) SYNTHETIC FAB-RICS & KNITT-ED FABRICS	2.00	NO	-
GARWARE _ ROPES ITED _E-83931)	B.D.GARWARE	1976	ROPES(SYNTH-ETIC),TWINE (SYNTHETIC), CARGO NETS & SLINGS	8.75	YES	U.S.A.
GREAVES ECO ITED _E-82135)		1958	FOUNDRY FLUXES & CHEMICALS	5.00	YES	U.K.
HIND ENSOR TED _E-82425)	M.T.GURSAHANEY	1959	POWER CAPA-CITORS,COND-ENSORS,MFD CAPACITORS,H POWER CAPA-CITORS,3 PHASE	2.76	NO	-

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RENT REACTOR
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VOLTAGE

AME OF THE COMPANY	NAME OF THE CHAIRMAN/MD	YEAR OF COMML PRODN.	PRODUCT	TURNOVR IN CROR OF RS	FOREIGN COLLABO RATION YES/NO	COUNTRY OF COLLABO-RATION
3.THE INDIAN CARD CLOTHING OMPANY LTD (TELE-82738)	M M SHAH	1955	FLEXIBLE AND METALLIC CAR CLOTHING,WOLEN WORSTED,COTTEN WASTE&ASBESTOS CARD CLOTHING &RAISING FILL ETS&SHEETS	7.00	YES	U.K.
.THE INDIAN EAMLESS ETAL TUBES IMITED ELE-61462)	B.R.TANEJA	1977	HOT FINISHED SEAMLESS TUBES HFS BEARING TUBES,COLD DROWN SEAMLESS TUBES,CDS BEARING TUBE	6.78	NO	_
.INDOSWE NGINEERS T LTD TELE-83952)	S.K.JATIA	1965	COPPER&COPPER ALLOY PROFILE TUBES,PIPES BRASS RODS IN DIFFERENT SHAPES	3.45	NO	_
.JG.GLASS NDUSTRIES MITED TELE-85111)	J.P.AGARWAL (DIRECTOR)	1956	VIALS,PHARMA-CEUTICAL,GLASS BOTTOLES,SALINE BOTTOLES	9.26	NO	_
2.JG.VACCUM ASKS IMITED	J.P.AGARWAL	1970	FLASKS & REFILLS	3.08	NO	_

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LE-82911)						
J.N.MARSHALL VATE ITED LE-82691)	DARIUS FORBE	1959	STEAM&FUEL ECONOMY EQUIPMENTS, INSTRUMENTS, OTHER ENGG GOODS	5.70	YES	SWEDEN

E OF THE PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO- RATION YES/NO	COUNTRY OF COLLABO RATION
JAYA HIND USTRIES ITED LE-83981)	H.K.FIRODIYA	1947	DIE CASTINGS MAGNATORS, H.T.COILS	4.85	NO	-
JAYA HIND AKY ITED LE-85088)	A.H.FIRODIA	1974	SPOT WELDING MACHINES, SEAM WELDING MACHINES, PROJECTION WELDING M/ES, ETC.	3.25	YES	SWITZ- ALAND
KALPANA USTRIES. LE-70992)		1964	AUTOMOBILE SPARE PARTS, ROCKER ARMS	1.00	NO	-
KALYANI ELS ITED LE-70434)	P.G.CHITALE	1974	FORGING QUALITY INGOTS AND BILLETS	2.00	NO	_
KANADE PUTERS IPHERALS LTD LE-449297)	P.R.KANADE	1984	MINI COMPUTERS MICRO PROCESSORS. CALCULATORS	1.98	NO	_

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E OF THE P( )Y	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML. PRODN.	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO- RATION YES/NO	COUNTRY OF COLLABO RATION
.DEMECH R' AS ISTRUCTION ' TD LE-50934)		1979	TECHNICAL SERVICES	1.36	NO	–
DIVGI METAL E PVT. I ED LE-30375)	A.N.DIVGI	1964	AUTOMOBILE GEARS	5.00	NO	–
EAGLE FLASK LIMITED LE-24-25)	A.C.PADAMSEE	1956	GLASS SHELLS FOR VACCUM FLASKS,VACCUM FLASKS,INSULA- TED WARE LEAD CRYSTAL GRASS WARE	2.40	YES	
LECTRONICA ES AND ICE LE-443532)	S.R.POPHALE	1978	ELECTRIC DIS- CHARGE MACHINE, NC WIRECUT EDM, NC RETROFIT PACKAGES FOR LATHES,MILLING	2.24	NO	–
ELLORA INEERING PANY LTD LE-61380)	KHENY DHARMRAJ	1979	STEEL FORGINGS	2.30	NO	–
F.PUDOMJEE OMPANY		1965	DIFFERENT VARIETIES OF PAPER	2.57	NO	–

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
11.C.T.R.MFG. INDUSTRIES LIMITED (TELE-66317)	A.P.KUMAR	1964	MILLING CUTTER PRESSED STEEL RADIATORS,LT OIL CIRCUIT BRAKERS,ON-LOAD TAP CHARGES FOR TRANSFORMERS	2.20	NO	-
12.CAMBRIDGE INSTRUMENTS (INDIA) PVT. LIMITED (TELE-83495)	DARIVS FORBE	1962	TEMPERATURE INDICATORS & RECORDERS,PH METERS,THERM-OMETERS,ELECTRO CARDIOGRAPH	1.13	YES	U.K.
13.CONSOLIDATED HOISTS PVT. LIMITED (TELE-442019)	M.NEVREKAR	1966	CRANES & HOISTS	1.28	NO	-
14.DAI-ICHI KARKARIA PVT LTD. (TELE-83427)	D.M.NETRAWALA	1960	SURFACE ACTIVE AGENTS,PROCESS AIDS,SPECIALITY CHEMICALS	5.61	NO	-
15.DECCAN EMB. MFG.COMPANY PVT LTD. (TELE-67741)	S.P.SHROFF	1960	SEWING THREAD INDUSTRIAL YARNS	2.00	NO	-
16.DECCAN MECHANICAL & CHEMICAL INDUSTRIES PVT LTD	K.R.NATU	1969	CONVEYORS, BUCKET ELE-VATORS,COAL & ASH HANDLING SYSTEMS,	2.84	NO	-

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~E OF THE ~PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO RATION
ARBOR ACRES ..M INDIA MITED __E-65987)	R.K.HANDA	1962	ONE DAY OLD BROILER AND LAYER CHICKS.	1.00	NO	-
ATLAS OMOTIVE MPONENTS ~LE-83856)	D.K.NANDY	1969	ALUMINIUM ALLOY DIE CASTINGS AND SAND CASTINGS	3.00	NO	-
B.G.SHIRKE ~ COMPANY ~LE-70151)	B.G.SHIRKE	1944	FABRICATED STRUCTRUAL STEEL,PREFA-BRICATED HOUSES OF STEEL WOOD PANEL PRODUCTS BUILDING COM PONENTS, CONSTRUCTION MACHINERY, TRANSMISSION LINE TOWERS.	4.84	NO	_
B.K.BENZYL ~E-62889)			CHLOROQUIN PHOSPHATE, AMODIAQUIN DIHYDROCHLO-RIDE.	2.40	NO	_
.THE BRIHAN ~ARASHTRA ~GER SYNDI-~E LTD. ~LE-444491)	D.C.AGHSHE (JT.M.D.)	1934	WHISKY RUM BRANDY,GIN, VODKA, DENATURED SPIRIT	4.00	NO	_

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3.12 MEDIUM INDUSTRIES (DATA IS BASED ON YEAR 1984-85)
(TURNOVER BETWEEN RS 1 CRORE & RS 10 CRORES)

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
1.AGARWAL CONTAINERS PVT LTD. (TELE-83741)	M.S.AGARWAL	1974	200 LITERS CAPACITY M.S.BARRELS, 10TO160 LITERS DRUM,FUEL TANKS	4.00	NO	_
2.AJAY METACHEM PVT. LIMITED. (TELE-54943)	P.G.PAWAR	1968	FOUNDRY CHEMICALS AND FUELS	3.50	NO	_
AJIT SOAP FACTORY (TELE-26382)		1955	WASHING SOAP, DETERGENTS, CLEANING POWDER.	7.00	NO	_
4.AMERICAN REFRIGERATOR COMPANY LTD. (ARCO-WHITNEY HYDRAULIC DIVISION) (TELE-85127)	A.R.KAMAT	1960	HYDRAULIC EQUIPMENTS, AIR-CONDITIONERS WATER COOLERS, INDUSTRIAL BLOWERS.	5.47	YES	U.S.A.
5.AMPHETRONIX LIMITED (TELE-83363)	PAUL VARGHES (CHIEF EXCT)	1972	ELECTRONIC CONNECTORS	3.00	YES	U.S.A.

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[N]AME OF THE [C]OMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN.	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
3.KINETIC ENGINEERING LIMITED. (TELE-84301)	H.K.FIRODIYA	1970	MPOEDS & AUTOMOBILE PARTS.	19.44	YES	JAPAN
4.RUSTON & HORNSBY (INDIA) LIMITED (TELE-83564)	C.MATHRANI	1939	DIESEL ENGINE 5 TO 150 H.P. FOR VARIOUS APPLICATIONS LIKE MARINE, INDUSTRIAL, AGRICULTURE & GENERATING SET.	29.65	YES	U.K.

[N]OTE-HINDUSTAN ANTIBIOTICS LTD.IS THE ONLY PUBLIC SECTOR [I]NDUSTRY IN POONA.REST ALL ARE IN PRIVATE SECTOR.

[I]NHOUSE RESEARCH & DEVELOPMENT.

[I]N MOST OF THE ABOVE COMPANIES THE TECHNOLOGY WAS IMPORTED. [O]VER THE YEARS THE IMPORTED TECHNOLOGY HAS BEEN ABSORBED BY [I]NTERNAL RESEARCH & DEVELOPMENT, AND THE CHANGES WERE MADE [A]CCORDINGLY TO SUIT THE RESOURCES AVAILABLE LOCALLY AND [T]O OPERATION CONDITIONS.

[T]HUS IN BIG COMPANIES INHOUSE RESEARCH & DEVELOPMENT FACILITIES [A]RE AVAILABLE AND THEY ARE WELL ORGANISED AND MANAGED. BUT ITS [N]ATURE AND ANNUAL BUDGETS, COMPANY BY COMPANY CANNOT BE GIVEN, [B]ECAUSE SUCH DATA IS NOT PUBLISHED SEPARATELY.

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			SLOTTING MACHINES, LATHES ETC.			
42. YASHWANT SAHAKARI SAKHAR KARKHANA (TELE-79281)	KANCHAN	1969	SUGER, MOLLASSES, BAGASSE	12.50	NO	–

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37.TATA ENGG. & LOCOMOTIVE COMPANY LTD. (TELE-84261)	SUMANT MOOLGAOKAR	1966	TRUCK & BUS CHASIS, MARINE ENGINES, GENERAL AND SPECIAL PURPOSE MACHINES ETC.	294.45	YES	JAPAN

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D.	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
38.THERMAX PVT.LTD. (TELE-85903)	R.D.AGA	1980	STEAM BOILERS PROCESS HEAT EQUIPMENT, WATER TREATMENT PLANTS, AIR POLUTION CONTROL EQUIPMENT ETC.	59.70	NO	-
39.VANAZ ENGINEERS PVT LTD. (TELE-31344)	S.K.KHANDEKAR	1949	LPG CYLINDER VALVES,LPG PRESSURE REGULATORS, PRESSURE DIE CASTINGS, ETC.	12.84	NO	-
40.VULCAN LAVAL LIMITED (TELE-86321)	V.A.DATAR (M.D.)	1961	DAIRY MACHINERY,BREWERY MACHINERY, MATCH MAKING MACHINES, MILK TANKERS ETC.	33.04	YES	SWEDEN
41.WALCHANDNAGAR INDUSTRIES LIMITED (TELE-85161)	V.L.DOSHI	1960	CNC MACHINE TOOL,SUGER MACHINERY, SHAPING PLANNING &	116.94	YES	W.GERMANY

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32.PADUMJEE PULP & PAPER MILLS LTD (TELE-82032)	S.L.KIRLOSKAR	1964	PULP AND DIFFERENT VARIENTIES OF SPECIALITY PAPERS	18.43	YES	ITALI

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D.	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
33.THE RAJA BAHADUR MOTILAL MILLS LTD (TELE-66331)	NANDLAL M. PITTIE	1926	CLOTH PRINTED & DYED DRESS MATERIAL, BED COVERS, LONG CLOTH ETC YARNS, POPLIN, CAMBRICS	16.06	NO	
34.RECONDO LIMITED (TELE-25296)		1947	CONSTRUCTION, COOLING TOWERS & FAN BLADES	16.62	NO	-
35.SANDVIC ASIA LTD (TELE-86491)	NAWAL S. PHATARPHEKAR	1960	TUNGSTON CARBIDE PRODUCTS, TOOLS,TC TIPPED COROMANT TOOLS,SPE-CIALISIED TOOLS, HYDROGEN GAS.	19.63	YES	SWEDEN
36.SUDERSHAN CHEMICAL INDUSTRIES (TELE-67334)	R.J. RATHI	1951	PIGMENTS, INTERMEDIATES, PESTICIDES.	24.76	YES	U.S.A.

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OIL ENGINES LIMITED (TELE-55341)			& SPARES, BIMETAL BEAR-ING & STRIP, CRUSHER D.P. SETS.			

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORES OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
27.KIRLOSKAR PNEUMATIC COMPANY LTD. (TELE-70133)	A.KIRLOSKAR	1970	COMPRESSED AIR & GAS EQUIPMENTS, AIRCONDITION-ING & REFRIGE-RATION EQUIP-MENT,TRACTORS ETC.	62.35	YES	U.K.
28.MAHARASHTRA SCOOTERS LIMITED (TELE-83396)	RAHULKUMAR BAJAJ	1975	PRIYA SCOOTERS	28.40	NO	_
29.NAV MAHARA_SHTRA CHAKAN OIL MILLS (TELE-66406)	S.LUNKAD	1961	EDIBLE OILS, DE-OILED CAKES PULES & BASIN CATTLE FEED, SOAPS.	24.12	NO	_
30.PAPER & PULP CONVERSIONS LIMITED (TELE-55301)	M.S.PARKHE (M.D.)	1942	PAPER & PAPER BOARDS, PAPER MAKING MACHINES, COATED PAPER AND BOARDS	17.85	NO	_
31.PEICO ELECTRO-NICS & ELECTRI-CALS LIMITED (TELE-83547)	W.MACLAINE PONT	1930	TAPE RECORDERS LOUD SPEAKERS, RADIOS, TRANSISTORS, ELECTRONIC & SCIENTIFIC INSTRUMENTS, PAS ETC.	176.89	YES (NOW TERMNA-TED SINCE 1977)	HOLLAND

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
21. INTERNATIONAL COMPUTERS (IND) MANUFACTURE LTD. (TELE-65285)	V.D.KHER (ASST M.D.)	1963	MAIN FRAME COMPUTERS, MINI/MICRO COMPUTERS, LINE PRINTERS, MAG TAPES ETC.	26.34	YES	U.K.
22. K.K.NAG PVT.LTD. (TELE-66456)	K.K. NAG	1965	LEAD COILS, LEAD VALVES PVC & FRP DUCTINGS, EXHAUST SYSTEM, TANKS, ETC.	10.29	NO	_
23. KSB PUMPS LIMITED (TELE-82006)	V.C.SETALVAD	1962	SUBMERISIBLE PUMPS, HIGH PRESSURE PUMPS, CHEMICAL PROCESS PUMPS ETC.	19.81	YES	W.GERMANY
24. KIRLOSKAR BROTHERS LIMITED (TELE-31056)	S.L.KIRLOSKAR	1920	INDUSTRIAL PUMPS AND VALVES, AGRL. PUMPS, SEALED COMPRESSORS.	68.17	NO	_
25. KIRLOSKAR CUMMINES LIMITED (TELE-30240)	C.S.KIRLOSKAR	1962	INTERNAL CUMBUSTION ENGINES IN THE RANGE OF 60-1600H.P.	115.02	YES	U.S.A.
26. KIRLOSKAR	S.L.KIRLOSKAR	1949	DIESEL ENGINES	80.42	NO	_

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABORATION YES/NO	COUNTRY OF COLLABORATION
15.FINOLEX CABLES LTD (TELE-85963)	CHHABRIA	1967	TELEPHONE CABLES,POWER CABLES,AUTO & BATTERY CABLES,AND FLEXIBLE WIRES ETC.	18.52	YES	U.S.A.
16.FINOLEX PIPES(P)LTD. (TELE-82621)	CHHABRIA	1981	REGID PVC PIPES,PVC FITTING.	17.84	NO	-
17.GARWARE NYLONS LTD (TELE-83804)	B.D.GARWARE	1962	NYLON YARN, TWINE,CORD & POLYESTER FILAMENT YARN	99.21	YES	U.S.A & W.GERMANY
18.HINDUSTAN ANTIBIOTICS LTD. (PUBLIC SECT (TELE-86511)	D.B.TELANG	1954	PENICILLIN, STREPTOMYCIN, AMPICILLIN, FORMULATIONS, DIAGNOSTIC KIT-NANCY-KIT	34.60	NO	-
19.THE INDIAN CABLE CO:LTD (TELE-70011)	K.TAPURIAH	1920	ELECTRICAL CABLES & WIRES	66.78	NO	-
20.INDUSTRIAL OXYGEN CO. PVT LTD. (TELE-65616)	L.K.JAIN	1964	OXYGEN, ACETELYNE, NITROGEN, HYDROGEN AND AIR SEPERATION PLANTS	10.76	NO	-

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39.KHOSLA METAL POWDERS PVT LTD (TELE-51181)	ANIL R.SHAH	1961	ALUMINIUM POWDERS&PASTE ZINC POWDER TIN POWDER MAGNELIUM POWDER&LEAD POWDER	1.66	NO	-

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NAME & ADDRESS	ACTIVITY	REASONS OF SICKNESS
29. SEMICONDUCTOR AHMEDNAGAR ROAD POONA-411014	ELECTRIC ITEMS	1. STEEP RISE IN R M PRICES
30. KEY NUTS & BOLTS MIDC BHOSARI POONA-411026	MANUFACTURING OF HOT FORGED NUT COMPONENTS	1. INADEQUATE WORKING CAPITAL
31. EXPERTO INDUSTRIAL ENGRAVERS P LTD HADAPSAR INDUST-RIAL ESTATE POONA-411013	MANUFACTURING OF PRECISION DIES FOR CASTINGS & PRINTING TYPES	NOT KNOWN
32. SANJYOT PHARMACEUTICALS MIDC BHOSARI POONA-411026	MANUFACTURING OF FINE CHEMICAL DRUGS	1. PETROLEUM PRICES HIKE IN 1980-81
33. MRUNAL POLYMER ENTERPRISES MIDC BHOSARI POONA-411026	RUBBER MANUFACTURING UNIT	1. ILL HEALTH OF THE PROPRIETOR & SUDDEN DEATH
34. CHAITNYA OPTICALS HADAPSAR POONA-411028	MANUFACTURING OF VARIOUS OPTICAL LENCES	1. INADEQUATE FUNDS 2. POWER CUT 3. UNIT SHED PROBLEM

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NAME & ADDRESS	ACTIVITY	REASONS OF SICKNESS
23. BHOR RUBBER PRODUCTS MIDC BHOSARI POONA-411026	SUNCTION DELIVERY TUBING	1. SHORTAGE OF WORKING CAPITAL
24. OPTICAL SCIENTIFIC INSTRUMENTS MIDC, BHOSARI POONA-411026	OPTICAL & SCIENTIFIC INSTRUMENTS	1. SICKNESS OF THE OWNER
25. DIEMAKE PIMPRI POONA-411017	MAKERS OF PLASTIC & RUBBER DIES & SHEET METAL DIES & PRESS COMPONENTS	1. INADEQUATE FINANCE
26. SWIFT INDUSTRIES 1225/1 SHIVAJI-NAGAR POONA-411004	MANUFACTURING OF SHAFT KEYS & JOB WORK	1. INADEQUATE WORKING CAPITAL 2. POWER CUT 3. THREFT
27. ASHRAN ENGINEERING MIDC PIMPRI POONA-411018	FABRICATION WORK	1. INADEQUATE WORKING CAPITAL 2. DECOITY
28. J P HANDMADE PAPER & BOARDS MFG. COMPANY 1206, SHIVAJI-	MANUFACTURING OF HANDMADE PAPER AND BOARDS	1. M S F C DUES 2. LABOUR PROBLEM

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NAME & ADDRESS	ACTIVITY	REASONS OF SICKNESS
17. VIJAY DAL MILL 597, GANESH PETH POONA-411002	MANUFACTURING OF DAL	1. SHORTAGE OF WORKING CAPITAL
18. SAMMCO MACHINERY PVT LIMITED 38/39 HADAPSAR INDUSTRIAL ESTATE POONA-411013	FABRICATION IN MS & MANUFACTURE OF HEAT EXCHANGERS AIR RECEIVABLES.	1. POWDER CUT 2. RISE IN PRICES OF M S PLATE
19. DHERE CONCRETE PRODUCTS COMPANY 731 BUDHWAR PETH POONA-411002	MANUFACTURE OF RCE (SPAN PIPES & ALLIED CONCRETE PRODUCTS)	1. ABSENCE OF TECHNICAL GUIDANCE 2. FAULTY PRODUCTION 3. RAW MATERIAL SHORTAGE
20. MACHINE COMPONENTS 507, GULTEKADI POONA-411009	ENGINEERING	1. SICKNESS OF THE PROPRIETOR
21. TRIFORT ELECTRONICS 52 SHIVAJI HSG SOCIETY POONA-411016	MANUFACTURE OF RIKSHAW METERS ETC.	1. LACK OF FUNDS 2. DEFAULT OF SELLING AGENTS
22. KIRTI ELECTRICALS AKURDI POONA-411019	MANUFACTURE OF POWDER & DISTRIBUTION TRANSFORMERS, ELECTRICAL & MECH FABRICATORS.	NOT KNOWN

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NAME & ADDRESS	ACTIVITY	REASONS FOR SICKNESS
11. BALBIRSINGH AND COMPANY SHANKARSHET RD. POONA-411009	MANUFACTURING OF CYLINDER LINERS, GREY IRON CASTINGS	1. POWER RESTRICTIONS
12. ASHOK FLUSH DOORS LIC BUILDING SHIVAJINAGAR POONA-411005	MANUFACTURING OF LAMINATED BOARDS AND DECORATIVE PLYWOODS	1. SUPPLY OF ELECTRICITY 2. SALES TAX PENALTY
13. KULKARNI FOUNDRIES P LTD HADAPSAR INDL. ESTATE POONA-411013	MANUFACTURING OF CASTINGS, ELECTRIC ARC FUNACE FOUNDRY EQUIPMENTS	1. INADEQUATE FINANCE 2. DUES OF PROVIDENT FUND E S I KEPT PENDING
14. FARMA FINE CHEMICALS MIDC, BHOSARI POONA-411018	MANUFACTURING OF CHEMICALS LIKE PARACENTAMOL	1. INADEQUATE FINANCE
15. UNITED MARKETING COMPANY NASIK RD CORNER POONA-411018	MANUFACTURING OF QUALITY FIBRE GLASS, TEXTILES ETC.	1. INADEQUATE FINANCE
16. SHREE PAINTS AND INKS P LTD 583, SOMWAR PETH POONA-411030	MANUFACTURING OF PAINTS, PRINTING INKS AND WATER PROOFING COMPOUNDS.	1. INADEQUATE FINANCE

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NAME & ADDRESS	ACTIVITY	REASONS FOR SICKNESS
6. KUSUM SERVO COMPONENTS OFF GANESH KHIND ROAD POONA-411016	MANUFACTURE OF MACHINES, TRAILERS, CHEMICAL PLANT ETC. & GENERAL FABRICATION	1. POWER SHORTAGE 2. IMPROPER SUPPLY OF R.M 3. LABOUR PROBLEMS
7. MUSE ART PROCESS PANCHAVATI POONA BBY ROAD POONA-411003	DUPLEX BOARD, MILL BOARD, GREY BOARD, CORRUGATED SHEETS. SHEETS.	1. INADEQUATE FINANCE
8. TECHNO INDUSTRIES M I D C BHOSARI POONA-411029	MANUFACTURING PLASTIC MOULDED PLOLETHENE TAPS AND VALVES	1. POWDER CUT 2. SHORTAGE OF RAW MATERIAL
9. DECCAN DYES & CHEMICALS 38, VIJAYANAGAR COLONY POONA-411030	MANUFACTURING OF BASIC SYNTHETIC DYESTUFFS.	1. FINANCE PROBLEM
10.ARKAND INDUSTRIES PIMPRI POONA-411018	WORKSHOP	1. MISMANAGEMENT DUE TO DOMESTIC TROUBLES.

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INFORMATION REGARDING SICK UNITS IN SMALL SCALE INDUSTRIES

NAME & ADDRESS	ACTIVITY	REASONS FOR SICKNESS
1. GLOBE ELECTRICALS 68, M G ROAD POONA-411001	MANUFACTURING RAILWAY CARRIAGE FANS & EXHAUST FANS	1. DISPROPORTIONATE INVESTMENT IN LAND AND BUILDING 2. INSPITE OF CONTINUOUS LOSSES NO DIVERSIFICATION WAS MADE. 3. LACK OF MANAGEMENT FORESIGHT 4. RISE IN WAGE BILL & LABOUR TROUBLES 5. DELAY IN PASSING TENDERS ON PART OF DGS & D 6. SAD DEATH OF KEY PARTNER
2. OPEL INDIA 2037-B, SADASHIV PETH, TILAK ROAD POONA-411030	MANUFACATURING MINISCOPE CARRYSCOPE OPTICAL, ELECTRICAL & ELECTRONICS INSTRUMENTS	1. RAW MATERIAL PROBLEMS 2. LACK OF WORKING CAPITAL
3. VAISHALI ENTERPRISES PIMPRI POONA-411017	MANUFACTURING OF SINGLE PHASE PREVENTOR	1. FAILURE OF SELLING ARRANGEMENTS
4. INDUSTRIAL ELECTRONICS 324, NARAYAN PETH POONA-411030	MANUFACTURING OF ELECTRIC & ELECTRONICS COMPONENTS	1. DUE TO STRIKES IN WHOLE POONA 2. DELAY IN GETTING IMPORTED MACHINE 3. INADEQUATE WORKING CAPITAL
5. ADARSHA PRINTING PRESS 538 SHANIWAR PETH POONA-411030	PRINTING PRESS	1. DELAY IN PAYMENTS BY CUSTOMERS 2. LEGAL NOTICE BY THE OWNER TO VACATE THE PREMISES

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1 LARGE AND MEDIUM SICK INDUSTRIES

IT IS VERY DIFFICULT TO MENTION THE NAMES OF THE COMPANIES WHICH ARE SICK UNITS. BECAUSE EVEN THOUGH TECHNICALLY THEY ARE SICK IN THEIR OPERATIONS & THE AGENCIES eg.SICOM W M D C ETC AND FINANCIAL INSTITUTIONS BANKS MAY BE NURSING THEM TO COME UP BY GIVING SOME SORTS OF CONCESSIONS, THERE NAMES ARE NOT ON LIST OF SICK UNITS AS SUCH.

HOWEVER, IF WE TAKE A CRITERIA, SAY, (1) THERE SHOULD BE CONTINUOUS CASH LOSSES FOR CONSECUTIVE 3 YEARS WITH NO GAPS. (2) THE PAID UP SHARE CAPITAL IS ERODED BY THE ACCUMULATED LOSSES, ---THESE UNITS COULD BE TAKEN FOR GRANTED AS SICK UNITS.

ON THESE LINES FOLLOWING COMPANIES CULD BE MENTIONED AS SICK UNITS-

1. WANDLESIDE NATIONAL CONDUCTORS.
2. C T R MFG INDUSTRIES.
3. J G GLASS INDUSTRIES.
4. SWASTIK RUBBER PRODUCTS.
5. THE RAJA BAHADUR MOTILAL MILLS LTD.

THE MAIN REASONS FOR THE SICKNESS ARE-

1. INSUFFICIENT WORKING CAPITAL
2. INEFFICIENT MANAGEMENT
3. CONTINUOUS LABOUR PROBLEMS
4. DELAYS ON THE PART OF FINANCIAL INSTITUTIONS

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3.13 SMALL SCALE INDUSTRIES

PARTICULARS	POONA	PIMPRI-CHINCHWAD	TOTAL PMR
NO OF UNITS	3350	2100	5450
EMPLOYMENT	45550	27740	73290
INVESTMENT (RS.IN LAKHS)	12796	8020	20816
TURN OVER (RS.IN LAKHS)	22961	15294	38255

PRODUCTS OF SMALL SCALE INDUSTRIES

NEARLY 35-40% OF THE COMPANIES ARE ENGAGED IN ENGINEERING INDUSTRIES & 20% IN CHEMICALS, CHEMICAL PRODUCTS.THE PRODUCTS MANUFACTURED BY THE SMALL SCALE INDUSTRIES COULD BE CLASSIFIED AS

1.CONSUMABLES

2.EQUIPMENTS & COMPONENTS IN INDUSTRIAL APPLICATIONS

ENGINEERING PRODUCTS BROADLY CLASSIFIED AS BASIC METAL AND ALLOY PRODUCTS METAL PRODUCTS AND SPARE PARTS TO AUTOMOBILES & DIESEL ENGINES ETC., FASTNERS & WASHERS, PRECISION INSTRUMENTS,MEASURING INSTRUMENTS, GAUGES, ETC. IT ALSO INCLUDES JOB WORKS AND FABRICATIONS.

SOME OF THE COMPANIES ARE ALSO ENGAGED WOOD & WOOD PRODUCTS,PAPER & PAPER PRODUCTS, RUBBER & PLASTIC ITEMS, ELECTRICAL AND ELECTRONIC COMPONENTS. FOUNDRY, POWDER METALLURGY, HEAT TREATMENT & ELECTROPLATING ARE ALSO THE IMPORTANT AREARS WHERE SMALL FIRMS ARE DOING WELL.

OF THE PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
TRINITY (TELE-30327)		1974	CLOSED DIE STEEL FORGINGS	1.42	NO	-
VACCUM PLANT & INSTRUMENT MFG.COMPANY VT.LTD. (TELE-70258)	T.R.KIRAD	1965	OIL FILTERATION PLANT, IMPREGNATION PLANT, FOIL WINDING	3.15	NO	-
ENKATESHWARA HATCHERIES VT.LIMITED (TELE-442748)	DR.RAO	1972	DAY OLD CHICKS, TABLE EGGS, Poultry ~~PITY~~ VACCINES, Poultry ~~PITY~~ FEED, BOILER HATCHING EGGS, ~~PITY~~ Poultry HEALTH PRODUCTS, LAYER HATCHING EGGS.	3.75	NO	-
ANDLESIDE ATIONAL CONDUCTORS IMITED (TELE-65221)	R C [illegible]	1981	COPPER CONDU-CTORS, COPPER WIRES, WOVEN TAPES, TEFLON MOULDED COMP-ONENTS, NOMEX COVERED COND-UCTORS.	5.46	NO	-
ATERLOO IESEL FUEL [illegible]		1960	REPAIRING & [illegible]	1.00	NO	-

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SYSTEMS,
PROCESS CONTROL

NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE IN RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
1.SIMMONDS MARSHALL LIMITED (TELE-84335)		1960	INDUSTRIAL FASTNERS, NYLON INSERTS AND ALL METAL LOCKING NUTS, WHEEL & CHECK NUTS.	1.85	NO	-
2.SIPOREX INDIA LIMITED (TELE-70755)	B.G.SHIRKE	1969	SIPOREX SLABS, & SIPOREX BLOCKS	1.77	NO	-
5.SPACE AGE ENGINEERING PROJECT PVT. LIMITED (TELE-56480)	KUDCHADKAR	1972	CONVEYOR SYSTEMS, STACKER RECLAIMERS, EOT CRANES, LIFT ELEVATORS, GEAR BOXES	5.96	YES	W.GERMANY
6.SPACCO CARBURETTORS (INDIA) LIMITED (TELE-82176)		1970	CARBURATORS AND PARTS THERE OF FOR 2 & 3 WHEELERS, STATIONERY ENGINES.	3.56	YES	SWITZERL-AND
5.SIRAX MARSHALL PVT.LIMITED		1959	STEAM TRAPS, STEAM OR AIR SEPERATORS.	5.70	YES	U.K.

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ME OF THE PANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS.	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
.THE SATHE BISCUITS AND CHOCOLATE CO. LIMITED (TELE-21817)	M. G. Sathe	1948	FOOD PRODUCTS BISCUITS, AND CHOCOLATES.	4.50	NO	-
SEMICOND-UCTORS LIMITED (TELE-67481)	G.M. Matlani	1962	TRANSISTORS, DIODES, INTEGRATED CIRCUITS, RECTIFIERS	2.53	NO	-
.SHIRKE CONSTRUCTIONS EQUIPMENTS PVT.LIMITED (TELE-70232)	V.B.SHIRKE	1970	TOWER CRANES, EOT CRANES, SEAFFOLDING, WELL CRANE ETC. AND MATERIAL HANDLINGS EQUIPMENTS	2.35	YES	FRANCE
.THE SHIRKE PAPER MILLS PVT.LIMITED (TELE-70151)	A.B.SHIRKE	1980	KRAFT PAPER	2.00	NO	-
.SIDDHARTH MOTORS (TELE-85152)		1979	SPARES OF LUNA MOPEDS	1.00	NO	-
SIGMA ENGINEERS LE-82100)		1978	POWER LECTRONICS EQUIPMENTS, MICRO PROCE-SSOR BOARD	1.00	NO	-

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AME OF THE OMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
1.RATHI INDUSTRIAL EQUIPMENTS CO.PVT. LTD. (TELE-34709)		1950	AIR POLLUTION CONTROL SYSTEM, CONVEYING SYSTEMS,VALVES MATERIAL HAND-LING EQUIPMENTS HEAT EXCHANGERS, PROCESS EQUIP-MENTS ETC.	2.00	YES	U.K.
2.ROPLAS INDIA LIMITED (TELE-82783)	I.CHATTERJEE	1965	FIBRE GLASS MOULDINGS,JEEP BODY KITS SCOOTER SIDE CARS,FIBRE GLASS HELMETS AND CHAIRS.	3.41	YES	U.K.
3.SAHYADRI DYE STUFFS & CHEMICALS (TELE-30570)	D.C.MEHTA (M.D.)	1950	INK BLUE AUROMINE, RHODAMINE 6 GDN RESORCINOL, DEMAP.	2.94	NO	-
4.SAJ FROUDE TEST PLANT PVT LTD (TELE-70882)	P.S.JAGTAP	1974	DYNOMETERS-HYDRAULIC, EDDY CURRENT, CHASIS, FUEL MEASURE-MENT EQUIPMENT, ENGINE HAND-LING SYSTEMS, INSTRUMENTA-TION.	1.25	YES	U.K.

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CASTINGS ETC.

OF THE ANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE OF RS	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
ERFECT NDUSTRIES (TELE-32818)		1964	TWO WHEELER ACCESSORIES PRESS COMPO-NENTS.	1.00	NO	-
ONA OTTLING OMPANY IMITED TELE-85004)	R.K.MORE	1959	GOLD SPOT THUMPS UP,DO IT RIM ZIM &SODA LIMCA	1.28	NO	-
RAV ELECTROSPARK VT LTD TELE-441639)	S.R.POPHALE	1976	ELECTRIC DISCHARGE MACHINES	2.25	NO	-
REMIER ARAGE TELE-54149)		1947	AUTOMOBILE REPAIRING &MAINTENANCE	2.99	NO	-
REMIER RRIGATION QUIPMENT TED TELE-66728)		1964	ALUMINIUM PIPES,COUPLERS, SPRINKTERS, PUMPS,HYDRAMS	1.50	NO	-
ACORD PPLIANCES VT.LTD. TELE-82944)	K.P.SETHI (M.D.)	1946	WATER HEATER WASHING MACHINES,SPIN DRYERS,COOKING RANGE,OVENS ETC.	2.50	NO	-

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AME OF THE OMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE	FOREIGN COLLABO-RATION YES/NO	COUNTRY OF COLLABO-RATION
0.MATCHWEL ELECTRICALS (INDIA)LTD. (TELE-65798)	RAMKRISHANA BAJAJ	1946	ELECTRIC FANS, CEILING FANS TABLE & MISC FANS	8.35	NO	-
1.MORRIS ELECTRONICS LIMITED (TELE-82811)	S.B.TILLU	1963	ANTENA RODS, SOFT FERRITIES FOR RADIO & MAGNETIC STRIPS, DEFLECTION COMPONENTS FOR TV,RING MAG-NETS,SEGMENTS MAGNETS ETC	4.90	NO	-
2.PAISA FUND GLASS WORKS (TELE-328)	P.R.KIBE (CHIEF EXEC)	1905	GLASSES & GLASS ITEMS	2.00	NO	-
3.PARANJAPE AUTO CAST PVT LTD (TELE-82187)	N.G.PARANJPE	1981	CYLINDER LINER BLOCKS FOR-AIR COOLED/ WATER COOLED, ENGINES OF MOPEDS,COM-PRESSORS, ETC.	1.50	NO	-
4.PEFCO FOUNDRY & CHEMICALS LIMITED (TELE-82741)	R.R.KEDIA	1969	CYLINDER LINERS USED IN RAIL-WAYS,AUTOMO-BILE COMPONENTS LIKE VALVE SENT INSERTS, VALVE TAPPETS, SPACER RING,	2.11	NO	-

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OF THE ANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE	FOREIGN COLLABO-RATION YES/NO	COUNTRY & COLLABO-RATION
AHARASHTRA AFETY LASS WORKS VT LTD TELE-84623)	Y.R.DAUGALL (WORKS MGR)	1975	WINDSCREEN GLASSES, AUTOMOBILE GLASSES, TOUGHENED GLASSES ETC.	1.93	NO	-
AHAVIR TEEL VT LTD TELE-82971)		1968	IRON&STEEL PRODUCTS,FLATS, ANGLES,CHANNELS, SQUARES & ROUNDS	6.05	NO	-
AHINDRA NGINEERING CHEMICAL RODUCTS IMITED TELE-82771)	R.K.PITAMBER	1964	CABLE JOINING KITS,EPOXY PUTTY COMPOUNDS, AR CHAMBER HOUSINGS FOR CIRCUIT BREAK-ERS & OTHER CAST RASIN-COMPONENTS FOR ELE.SWITCHGEARS	3.60	NO	-
AHINDRA WEN IMITED TELE-85045)		1958	TRAILERS,AUTO MOBILE EQUIPM-ENTS,AXELS, JACKS,AIR BRAKE EQUIPMENTS TRUCK BODIES ETC.	6.76	YES	U.K.
AHINDRA INTERED RODUCTS IMITED TELE-82632)	B.M.KATARIA (EXE.DIR)	1960	SINTERED BEARINGS & PARTS,COPPER POWDERS,TIN IRON &LEAD POWDERS, SINTERED FILTERS	6.32	YES	U.K.

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NAME OF THE COMPANY	NAME OF THE CHAIRMAN/M.D	YEAR OF COMML PRODN	PRODUCT	TURNOVER IN CRORE	FOREIGN COLLABORATION YES/NO	COUNTRY & COLLABORATION
0.KIRLOSKAR ELECTRODYNE PRIVATE LTD (TELE-86121)	S.R.MIRASHI	1981	DIESEL GEN-SET ABOVE, 100 KVA,CLEAN AIR SYSTEM, MODULAR,CONTROL PANNELS,BASE FRAMES,FOR DG SETS, MODULAR ETC.	5.10	NO	-
1.KIRLOSKAR FILTERS PVT.LTD. (TELE-55390)		1969	FILTERS	1.60	NO	-
2.KISHORE PUMPS PVT LTD. (TELE-82616)	N.N.DESAI	1963	PROCESS PUMPS	1.35	YES	W.GERMANY
3.KRAN RADER PRIVATE LIMITED (TELE-60688)	S.A.MALKANI	1972	WHEELS&AXLE SETS FOR TRANSFER CARS&CRANES, GEAR BOXES GEAR COUPLINGS, ELECTRIC HOISTS, HOOKS,FORGINGS	2.25	NO	-
4.LIPI BOILERS PVT.LTD. (TELE-61278)		1974	BOILERS & BOILER ACCESSORIES	4.00	YES	FRANCE

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35. SADANAND TEXTILES & CALLICO PROCESSORS HADAPSAR POONA-411013	HOSIERY FABRICS	1. POLICY OF THE BANKERS

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3.15 LABOUR

	1983	1984	1985
NO OF MONDAYS AVAILIABLE	185 lakhs	214 lakhs	239 lakhs
NO OF MONDAYS LOST	16.95 lakhs	16.36 lakhs	19.87 lakhs
% OF MONDAYS LOST	9.162	8.579	8.315

Pl. Note - office & management staff excluded

(THIS DATA IS APPROXIMATE)

3.16 MAJOR TRADE UNIONS

POONA BEING ONE OF THE MAJOR INDUSTRIAL CITIES IN INDIA, HAVI' ALL SORTS OF WORKERS CATEGORY, TRADE UNION ACTIVITIES DO FORM IMPORTANT PART IN THE FIELD OF INDUSTRIES. WORKERS OF MOST LA & MEDIUM INDUSTRIES HAVE, THEREFORE FARM THE TRADE UNION ORGANISATION TO SAFEGUARD THE INTERESTS OF THE WORKERS. IN SOM OF THE CASES, FUNCTIONS ARE GUIDED BY SOME LEADING ORGANISATIO CONTROLLED BY POLITICAL PARTIES IN THE STATE. FOLLOWING ARE FE MAJOR TRADE UNIONS

NAME OF THE TRADE UNION	LEADER
1. BHARTIYA MAJDOOR SANGH	SHRI MANORE
2. PUNE ZILHA MAJDOOR SANGH	SHRI SHARMA
3. GIRNI KAMGAR SANGHATANA	SHRI DE'SOUZA
4. INDIAN NATIONAL TRADE UNIONS CONGRESS	
5. ALL INDIA TRADE UNION CONGRESS	
6. NATIONAL DEFENCE EMPLOYEES UNION	RAMKRISHNA MORE

3.17 INFORMATION REGARDING FINANCIAL INSTITUTIONS

A. STATE FINANCIAL INSTITUTIONS

1. MAHARASHTRA STATE FINANCIAL CORPORATION

THE MAIN FUNCTION OF MSFC IS TO MEET THE TERM LOAN REQUIREMENTS OF SMALL SCALE & MEDIUM SCALE INDUSTRIES FOR ACQUSITION OF FIXED ASSETS. LIKE LAND. BUILDING. MACHINERY AND EQUIPMENT. THE OFJECTIVE OF MSFC IS TO PROMOTE MORE INDUSTRIES IN BACKGROUND & DEVELOPING AREAS OF MAHARASHTRA AND GOA REGION. BUT LOANS FOR WORKING CAPITA CAPITAL AND FOR REPAYMENT OF LOANS ARE NOT CONSIDERED. IT GRANTS TERM LOANS TO THE LIMITED COMPANIES AND REGISTERED CO-OPRATIVE SOCIETIES UPTO RS 60 LAKHS AND TO THE PROPRIETARY & PARTNERSHIP FIRMS UPTO RS 30 LAKHS.

CHAIRMAN OF MSFC - SHRI S R DAMANI

REGIONAL MANAGER OF MSFC SHRI S G JADHAV

(FIGURES ARE IN LAKHS)

	1983-85			1984-85		
	NO OF UNITS	SANCTIONED AMOUNT	DISBURSED AMOUNT	NO OF UNITS	SANCTIONED AMOUNT	DISBURSED AMOUNT
POONA REGION	122	356.88	267.37	173	422.98	297.52
MAHARASHTRA STATE	2661	5665.70	4101.50	2348	5783.16	3559.10
BREAK UP OF MAHARASHTRA						
SMALL SCALE	2580	4704.00	-	2277	4959	
OTHER UNITS	81	962.00	-	71	824	

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TOTAL OUTSTANDING & RECOVERY POSITION

	AMOUNT DUE	AMOUNT RECOVERED	% RECOVER
1983-84	CRORES OF RS	CRORES OF RS	
PRINCIPAL AMOUNT	23.42	16.72	71.39
INTEREST AMOUNT	24.85	16.76	67.44
	48.27	33.48	69.36
1984-85			
PRINCIPAL AMOUNT	30.92	19.62	63.42
INTEREST AMOUNT	31.20	19.99	63.91
	62.12	39.60	63.67

ADDITIONAL INFORMATION ABOUT WORKING OF M S F C

1. OTHER SERVICES PROVIDED

1. MSFC ALSO FINANCE PROJECTS WITH LARGE CAPITAL OUT LAY UPTO RS 3 CRORES IN PARTICIPATION WITH SICOM / ALL INDIA FINANCIAL INSTITUTIONS / BANKS .ETC. BUT IN THIS CASE ALSO SHARE OF MSF IS LIMITED TO RS 60 LAKHS
2. MSFC PROVIDES SEED CAPITAL ASSISTANCE TO THE NEW ENTREPRENEL ENTREPRENEURS WHO POSSESS NECESSARY SKILL OR PRACTICAL EXPERI NCE BUT LACK REQUISITE FINANCE FOR SETTING UP SMALL SCALE INDUSTRIAL UNIT, TO MEET THE GAP IN THE PROMOTER'S GAP.
3. MSFC GIVES SHORT TERM LOANS WHICH ARE INTEREST FREE FOR FIRST 6 MONTHS IN CASE OF SSI UNITS AGAINST THE SANCTION OF CENTRAL SUBSIDY.

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2. THE LOANS ARE GIVEN FOR SETTING UP NEW INDUSTRIAL UNITS AS WELL AS FOR EXPANSION & MODERNISATION OF THE EXISTING UNITS.
3. VENTURE CAPITAL IS NOT PROVIDED.
4. THE DEMAND FOR HIGH TECHNOLOGY AT PRESENT IN THE UNITS IS NIL.
5. THE USE OF COMPUTER IS HARDLY 1% IN RESPECT OF THE UNITS WHO HAVE RECEIVED THE ASSISTANCE FROM MSFC.

2. WESTERN MAHARASHTRA DEVOLOPMENT CORPORATION

WMDC WAS FORMED WITH AN OBJECTIVE FOR THE DEVELOPMENT OF INDU -TRIAL ACTIVITIES IN 9 WESTERN DISTRICTS OF MAHARASHTRA IN THE FOLLOWING WAYS IT ASSISTS THE UNITS -

1. EQUITY PARTICIPATION
2. JOINT PROJECTS IN ORDER TO PROVIDE INCENTIVE TO THE ENTERPRENUERS, WHO ARE READY TO START BUSINESS TO BACKWARD AREAS.
3. SETTING UP INDUSTRIAL ESTABLISHMENTS
4. INDUSTRIAL TRAINING.
5. IMPLEMENTATION OF GOVT. SCHEMES.

MANAGING DIRECTOR--MRS.LEENA MEHENDALE

1984-85 DATA	POONA REGION		TOTAL 9 DISTRICTS	
LOAN SCHEMES	NO OF UNITS	AMT DISBURSED IN LAKHS OF RS	NO OF UNITS	AMOUNT DISBURSED IN LAKHS OF RS
SEED CAPITAL LOAN	214	40.00	1156	173.63
LOAN UNDER SCHEMES OF 1976-1979-1983	-	37.78	-	470.93
TECHNICAL ENTREPRENUER'S SCHEME		4.88	-	8.20
		82.66		652.76
1985-86 DATA				
SEED CAPITAL LOAN	213	40.00	1432	172.94

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LOAN UNDER SCHEMES OF 1976-1979-1983	-	2.61	-	111.67
TECHNICAL ENTREPRENEUNERS SCHEME	-	3.23	-	5.98
		45.84		290.59

RECOVERY OF SEED CAPITAL AS ON 1985-86

	PRINCIPAL AMOUNT IN LAKHS	INTEREST AMOUNT IN LAKHS
POONA REGION	21.46	4.93
TOTAL 8 DISTRICTS	93.22	19.39

ADDITIONAL INFORMATION

1. OTHER SERVICES

   1. TECHNICAL & FINANCIAL GUIDANCE TO ENTREPRENUERS
   2. INDUSTRIAL TRAINING
   3. JOINT PARTICIPATION

2. MOSTLY THE ASSISTANCE IS GIVEN TO THE NEW ENTREPRENUERS
3. THE VENTURE CAPITAL IS PROVIDED IN SOME CASES.
4. THE CONCEPT OF HIGH TECHNOLOGY IS NOT KNOWN TO MOST OF THE LOAN RECIPIENTS.
5. USE OF COMPUTER IS VERY RARE IN RESPECT OF LOAN RECIPIENTS.

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B. REGIONAL OFFICE OF ALL INDIA FINANCIAL INSTITUTIONS

1. INDUSTRIAL FINANCE CORPORATION OF INDIA

THE BRANCH OFFICE OF POONA IS RECENTLY STARTED FROM MAY 85. TO BEGIN WITH, ITS ACTIVITIES WERE RESTRICTED TO CO-OPERATIVE SUGER INDUSTRIES & TEXTILE MILLS. BUT SINCE LAST FEW MONTH THIS BRANCH OFFICE HAS BEEN OFF - LOADED BY THE BOMBAY OFFICE IN RESPECT OF CORPORATE SECTOR ALSO FROM POONA. AND IT HAS SANCTIONED & DISBUR DISBURSED THE FUNDS TO M/S KINETIC HONDA, M/S AMPHETRONICS, M/S SPACE AGE ETC. THE ROLE OF IFCE EXTENDS TO THE ENTIRE INDUSTRIAL SPECTRUM ENCOMPASSING PRIRY PALLY (A) PROJECT FINANCING OPERATIONS AND (B) PROMOTIONAL ACTIVITEIS,

INFORMATION REGARDING POONA BASE INDUSTRIES IS AS FOLLOWS -

NO OF UNITS	SANCTIONED AMOUNT	DISBURSED AMOUNT (CORPORATE SECTOR)
7	6.29 CRORES DURING 1984-85	6.29 CRORES DURING 1984-85

OF WHICH RS.4 CRORES IN RUPEE VALUE AND RS.2.29 CRORES IN FOREIGN CURRENCY.

TOTAL OUTSTANDING AMOUNT FOR POONA (CORPORATE & CO-OPERATIVES) As on Sept

NO.OF UNITS	PRINCIPAL AMOUNT	INTEREST AMOUNT
70	4203.09 LAKHS	395.00 LAKHS

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ADDITIONAL INFORMATION ABOUT IFCI ACTIVITIES

DURING LAST 38 YEARS OF ITS SERVICE TO INDIAN INDUSTRY, IFCI HAS ASSISTED 2272 PROJECTS AND HAD BEEN INSTRUMENTAL IN MOBILISING RS 27,282.62 CRORES FOR THE COMPLETION OF THESE PROJECTS.

1.0 OTHER SERVICES PROVIDED

1. FOUR NEW PROMOTIONAL SCHEMES AIMED AT PROVIDING MARKETING ASSISTANCE TO SMALL SCALE UNITS, ENCOURAGING MODERNISATION OF TINY, SMALL SCALE AND ANCILLARY UNITS, CONTROLLING OF POLLUTION IN SMALL & MEDIUM SCALE INDUSTRIAL UNITS, GIVING INTEREST REBATE SUBSIDY TO WOMON ENTERPRISES WITH REGARD TO THEIR ENTERPRICE SETTING ENDEAVOURS ETC., WERE INTRODUCED FOR THE FIRST TIME.
2. A SCHEME OF TECHNOLOGY DEVELOPMENT & FINANCE WAS FORMULATED WHICH IS LIKELY TO BECOME OPERATIONAL FROM THE 1ST JAN 1987.
3. IFCI CONTINUED TO PROVIDE SUPPORT TO TECHNICAL CONSULTANCY ORGANISATION EDP CONDUCTING AGENCIES, RISK CAPITAL FOUNDATION, MANGEMENT DEVELOPMENT INSTITUTE, ENTERPRENEURSHIP DEVELOPMENT INSTITUTE OF INDIA ETC. THESE ORGANISATIONS WERE ABLE TO ACCELRATE THE PACE OF THEIR ACTIVITIES AND PROVIDE BENIFITS TO THEIR RESPECTIVE TARGET GROUPS TO A SUBSTANTIAL EXTENT.
4. MERCHANT BANKING SERVICES
5. LEASING OPERATIONS.

2. IFCI RENDERS ASSISTANCE TO BOTH NEW INDUSTRIES & EXPANSION OF EXISTING INDUSTRIES. BUT IT ITS MAIN CONDITIONS ARE-
1) THE INDUSTRY MUST HAVE A INDUSTRIAL LICENCE AND
2) IT MUST BE FROM NATIONAL PRIORITY SECTOR.

3. NO VENTURE CAPITAL IS PROVIDED BUT RISK CAPITAL IS PROVIDED

4. IFCI MAINLY RENDERS THE FUNDS FOR IMPROVEMENT OF TECHNOLOGY

5. EXCEPT VERY FEW BIG COMPANIES LIKE M/S KINETIC HONDA FROM POONA, NO OTHER LOAN RECIPIENTS USE THE FACILITIES OF COMPUTER SERVICES, AS MAIN RECEIPENTS FROM POONA ARE FROM CO-OPERATIVE SECTOR.

C. SELECTED COMMERCIAL BANKS

BANK OF MAHARASHTRA IS SUPPOSED TO BE LEAD BANK OF POONA BASED INDUSTRIES, MAINLY SMALL SCALE INDUSTRIES.

FOLLOWING IS A CONSOLIDATED PERFORMANCE OF ALL THE BANKS FOR POONA REGION

ASSISTANCE TO	TARGET FOR 1985		ACHIEVEMENTS FOR 6 MONTHS OF 1985	
SMALL SCALE INDUSTRIES FOR	NO OF A/CS	CREDIT TO BE PROVIDED (RS IN 000) (RS IN 000)	NO OF A/CS	CREDIT PROVIDED (RS IN 000) (RS IN 000)
1. ENGINEERING UNITS	86	6955	32	781
2. RURAL & COLLEGE UNITS	541	3572	49	751
3. OTHER	412	4323	367	22583
TOTAL	1039	14850	448	24115

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BANK WISE DISBURSEMENT DURING LAST 3 YEARS FOR POONA

(FIGURES ARE IN LAKHS)

NAME OF THE BANK	NO OF BRACHES	1983	1984	1985 6 MONTHS	YEARLY TARGET FOR 1985
1. BANK OF MAHARASHTRA	57	550.14	571.20	439.53	774.25
2. BANK OF INDIA	25	373.96	234.79	195.02	359.85
3. CENTRAL BANK OF INDIA	19	172.70	157.21	149.64	234.95
4. UNION BANK OF INDIA	11	41.21	112.58	19.91	70.10
5. DENA BANK	11	25.78	39.66	15.96	35.05
6. BANK OF BARODA	17	209.66	104.91	95.98	179.95
7. CANARA BANK	15	146.53	106.32	185.00	114.85
8. SYNDICATE BANK	9	32.31	64.94	73.01	90.00
9. INDIAN BANK	5	44.38	29.10	10.00	35.05
10. INDIAN OVERSEAS BANK	3	22.15	4.45	1.27	9.95
11.UNITED COMMERICAL BAN	14	33.40	85.28	26.42	59.90
12. ALLAHABAD BANK	2	0.44	7.82	4.82	7.05
13. VIJAYA BANK	4	3.28	2.73	1.23	14.95
14. STATE BANK OF INDIA	19	322.67	338.70	161.90	389.95
15. UNITED WESTERN BANK	11	38.12	51.62	14.71	35.05
16. SANGLI BANK	10	99.19	95.80	141.65	29.80
17. BANK OF KARAD	5	1.05	0.35	26.50	5.30
18. P D C C	21	1833.38	1762.56	1120.62	2000.00
19. L D BANK	1	515.07	408.59	311.69	600.00
20. M S F C	1	17.06	44.54	4.55	30.00
TOTAL		4482.48	4223.16	2999.41	5076.00

3.18 CENTRAL GOVERNMENT INSTITUTIONS PROVIDING ASSISTANCE TO INDUSTRIES

AS FAR FINANCIAL PART IS CONCERNED ICICI IDBI & IFC ETC. DO PROVIDE ASSISTANCE TO THE INDUSTRIES IN AND AROUND POONA. BUT THESE INSTITUTIONS HAVE NO BRANCH OFFICIES IN POONA . RECENTLY INDUSTRIAL FINANCE CORPORATION OF INDIA HAS STARTED ITS BRANCH OFFICE IN POONA FROM MAY 85 TO DEAL WITH THE SUGAR CO-OPERATIVES & TEXTILES IN THE POONA REGION. AND, THE CORPORATION HAS STARTED DEALING WITH CORPORATE SECTOR IN POONA, DIRECTLY. IT MEANS, THIS SECTOR NEED NOT RUSH EITHER TO DELHI OR BOMBAY FOR FINANCIAL ASSISTANCE.

AS FAR AS RESEARCH/TRAINING PART IS CONCERNED, THE DETAILS HAVE BEEN GIVEN UNDER SECTION 3.8

3.19 STATE GOVERNMENT INSTITUTIONS PROVIDING ASSISTANCE TO INDUSTRIES

NAME & ADDRESS	CHIEF PERSON	NATURE OF ASSITANCE
1. MAHARASHTRA INDUSTRIAL DEVELOPMENT CORPORATION CHINCHWAD POONA 411 019	S B PANDE EXECUTIVE ENGINEER S G KULKARNI SUPT. ENGINEER	1. TO PROVIDE THE INDUSTRIAL SECTORS TO THE INDUSTRIES 2. TO PROVIDE THE INFRASTRUCTURE FACILITIES TO INDUSTRIES
2. MAHARASHTRA SMALL SCALE INDUSTRIES DEVELOPMENT CORPORATION LTD KAMALA CHAMBERS 687 BUDHWAR PETH POONA-411002	P G KAPALE DIVISIONAL MANAGER	1. FINANCIAL & TECHNICAL ASSISTANCE TO SMALL SCALE INDUSTRIES.

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NAME & ADDRESS	CHIEF PERSON	NATURE OF ASSISTANCE
3. WESTERN MAHARASHTRA DEVELOPMENT CORPORATION KUBERA CHAMBERS DR RAJENDRA PRASAD MARG POONA-411005	MRS LEENA MEHENDALE (M.D.)	1. DEVELOPING THE INDUSTRIAL ACTIVITIES IN DISTRICTS IN WEST PA OF THE MAHARASHTRA STATE. 2. EQUITY PARTICIPATION 3. JOINT PROJECTS 4. IMPLEMENTING THE DIFFERENT STATE GOVT SCHEMES SUCH AS EDUCATED UNEMPLOYMENT SCHEME ETC.
4. MAHARASHTRA INDUSTAIAL & TECHNICAL CONSULTANCY ORGANISATION LTD KUBERA CHAMBERS DR RAJENDRA PRASAD MARG POONA-411005	S P RANADE MANAGING DIRECTOR	1. CONSULTANCY SERVICES TO INDUSTRIES & INSTITUTIONS. 2. ORGANISING SEMINARS FOR INDUSTRIAL DEVELOPMENTS 3. PREPARING PROJECT REPORTS
5. DISTRICT INDUSTRIES CENTRE AGRICULTURAL COLLEGE COMPOUND SHIVAJINAGAR POONA-411005	S P WAGH SUPDT. IND OFFICER	1. TO HELP THE SMALL SCALE INDUSTRIES IN DIFFERENT TALUKAS OF POONA DISTRICT 2. TO IMPLEMENT THE STAT GOVT SCHEMES OF DEVELOPMENT OF INDUSTRIES
6. MAHARASHTRA STATE FINANCIAL CORPORATION S P COLLEGE COMPOUND TILAK ROAD POONA-411030	S G JADHAV REGIONAL MANAGER	1. FINANCIAL ASSISTANCE UPTO RS 60 LAKHS TO SMALL & MEDIUM INDUSTRIES FOR THE PURPOSE OF LAND, BUILDING, PLA & MACHINERY. 2. FINANCIAL ASSISTANCE TO PROPRIETORS & PARTNERSHIP FIRMS UPTO RS 15 LAKHS.

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NAME & ADDRESS	CHIEF PERSON	NATURE OF ASSISTANCE
7. SMALL INDUSTRIES SERVICE INSTITUTE NEAR PMT BUILDING SHANKARSHET ROAD POONA-411009	T D SRINIVASAN ASSTT DIRECTOR	1. DEVELOPMENT OF SMALL SCALE INDUSTRY 2. PROVIDING A WIDE RANGE OF FACILITIES & SERV-ICES IN TECHNOLOGICAL ASPECTS,TRAINING,MARK-ETING
8. SUB REGIONAL EMPLOYMENT OFFICE RASTA PETH POONA-411011		1. TO REGISTER THE NAMES OF CANDIDATES FOR THE EMPLOYMENT 2. TO PROVIDE EMPLOYMENT TO SUCH CANDIDATES IN AND AROUND INDUST-RIES/OFFICES IN POONA
9. MAHARASHTRA ELECTAONICS TESTING & DEVELOPMENT CORPORATION (MELTRON) S.I.D.I. PREMISES AGRICULTURAL COLLEGE COMPOUND POONA-411005	P H BHAVE DIRECTOR	1. TO DEVELOP THE ELECT-RONICS INDUSTRY IN MAHARASHTRA 2. TO ASSIST SUCH ANCIL-LARY UNITS IN RESEARCH & DEVELOPMENT 3. TO BUILT UP THE MARK-ETING ORGANISATION.
10. MAHARASHTRA STATE KHADI & VILLAGE INDUSTAIES BOARD 727 SADASHIV PETH POONA-411030		1. TO DEVELOP THE ACTI-VITIES OF 22 KHADI & GRAMODYOG UNITS. 2. TO LOOK AFTER THE MARKETING PROBLEMS OF SUCH UNITS 3. TRAINING 4. FINANCIAL ASSISTANCE

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3.20 INDUSTRIAL ASSOCIATION

NAMES & ADDRESS	CHIEF PERSON	NATURE OF SERVICE
1. MAHRATTA CHAMBER OF COMMERCE & INDUSTRIES TILAK ROAD POONA-411002	B R SABADE SECRETARY	1. DISSEMINATION OF INFORMATION 2. COMMERICAL REFERENCE LIBRARY 3. STASTICAL INFORMATIOI REGARDING IMPORT/ EXPORT TRADE, INDUST RIAL LICENCING, INDU' RIAL PRODUCTION/EMPL- OYMENT DATA ON JOINT STOCK COMPANIES, PRICES ETC. 4. SPECIAL PROBLEMS OF SMALL SCALE INDUSTRII ARE LOOKED AFTER BY THE SMALL SCALE INDU- STRIES WING. 5. PUBLICATIONS OF BULLF TINS, MONTHLY JOURNAL & COMMERCIAL DIREC- TORIES. 6. TO LOOK AFTER THE PROBLEM OF INFRASTRU. TURE & LOCAL PROBLEMS 7. ADVISORY SERVICES ON LABOUR, EXCISE, IMPOF /EXPORT, INDUSTRIAL ENGG ETC 8. ORGANISING FOREIGN STUDY TOURS 9. CONDUCTING CONFERENC SEMINARS,LECTURES & WORKSHOPS.
2. AUDYOGIC TANTRA SHIKSHAN SANSTHA MIDC INDUSTRIAL AREA CHINCHWAD	M S JAMBHEKAR DIRECTOR	1. TRAINING FACILITIES FOR TECHNICAL JOBS 2. CONDUCTING I T I TRAINING COURSE FOR

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SCIENCE & TECHNOLOGY PARK

UNIVERSITY OF POONA
Ganeshkhind, PUNE - 411 007.

POONA-411019

2 YEARS

INSTITUTE & ADDRESS	CHIEF PERSON	NATURE OF SERVICE
3. OLYMPIA INSTITUTE OF TECHNOLOGY PREM KUTIR SADHU VASWANI ROAD POONA-411001	VIJAYKUMAR KHANNA DIRECTOR	1. CONDUCTS TRAINING COURSES FOR QUALIFYING EXAMINATIONS CODUCTED BY THE DEPT OF TECHNI-NICAL EDUCATION,GOVT OF MAHARASHTRA, INDUS-TRIAL TRAINING INSTI-TUTE THE CITY & GUILDS OF LONDON. 2. CODUCTING CERTIFICA-TION COURSES OF 1 TO 4 MONTHS DURATION IN VARIOUS TRADES.
4. INSTITUTE OF ENGINEERS	GANESH RAO DIRECTOR	1. CONDUCTING INDUST-RIAL LECTURES WORKSHOP & SEMINRAS 2. INDUSTRIAL PUBLICA-TIONS
5. SCIENCE & TECHNOLOGY PARK POONA UNIVERSITY CAMPUS	M D APTE DIRECTOR	TO CONDUCT THE ACTIVITIES FOR FOLLOWING 1. TEST & MEASUREMENT FACILITY CENTRE 2. RESEARCH & DEVELOPMENT CENTRE 3. INSTRUMENTATION TECH-NOLOGY AND MICRO ENGINEERING 4. BIOTECHNOLOGY 5. COMPUTER SCIENCES 6. HIGH TECHNOLOGY & MANUFACTURING AND PRODUCTION CENTRE

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3.21 STOCK EXCHANGE FACILITIES

OVER THE LAST 25 YEARS, PUNE AND THE SURROUNDING AREAS HAVE COME UP AS MAJOR INDUSTRIAL COMPLEX WITH A LARGE CONCENTRATION OF MODERN ENGINEERING AND ALLIED INDUSTRIES. THE INVESTING PUBLIC IN THIS AREA NEED DIFFERENT TYPES OF 'SERVICES' WHICH ARE QUALITATIVELY DIFFERENT FROM THOSE OFFERED BY BIGGER STOCK EXCHANGES. THE PROTECTION OF INTEREST OF SMALL INVESTORS AND ACCELERATING THE ECONOMIC DEVELOPMENT OF THE REGION WERE THE MAIN GUIDING PRINCIPLES IN REGISTERING POONA STOCK EXCHANGE LTD AS A COMPANY UNDER THE COMPANIES ACT ON 14TH JUNE 82. THE RECOGNITION AS THE 11TH RECOGNISED STOCK EXCHANGE IN THE COUNTRY WAS OBTAINED ON 2ND SEPT 82.

THE BANK OF MAHARASHTRA, PUNE, HAS BEEN APPOINTED AS THE BANKERS AND THE MANAGEMENT OF THE STOCK EXCHANGE CLEARING HOUSE HAS BEEN ENTRUSTED TO THAT BANK. AT PRESENT, ~~WHILE~~ THE NUMBER OF AUTHORISED MEMBERS ARE 38 AND THE NUMBER OF LISTED COMPANIES WAS 68 AS ON JUNE 85.

FOR THE POONA REGION, POONA STOCK EXCHANGE IS THE PRINCIPAL EXCHANGE AND LISTING AT POONA IS COMPULSARY FOR THOSE COMPANIES INTERESTED IN PUBLIC ISSUE HAVING HEAD OFFICE IN POONA REGION/ OTHER THAN BOMBAY REGION. THE SETTLEMENTS ARE DONE FORTNIGHTLY AND ONLY CASH TRANSACTIONS ARE ENTERTAINED.

FOR NEW PUBLIC ISSUE POONA STOCK EXCHANGE OBSERVE THE FOLLOWING THINGS-

1. MINIMUM ISSUED CAPITAL IS RS 50 LAKHS, OF WHICH 60% TO BE OFFERED TO THE PUBLIC.
2. THE PERMISSION OF CAPITAL CONTROL ISSUE IS REQUIRED FOR THE

CAPITAL ABOVE ONE CRORE.

3. RESOLUTION OF BOARD OF DIRECTORS IS REQUIRED FOR PUBLIC ISSUE.

4. THE COMPANY HAS TO PRESENT FOLLOWING DOCUMENTS TO THE EXCHANGE

4.1 THREE YEARS BALANCE SHEETS.

4.2 ARTICLES OF ASSOCIATION

4.3 CAPITAL DISTRIBUTION SCHEDULE.

4.4 AUDITOR'S CERTIFICATE.

4.5 COST OF PUBLIC ISSUE.

5. THE UNDERTAKING IS REQUIRED FOR NON TRANSFER OF PROMOTERS QUOTA FOR THREE YEARS.

6. APPROVAL OF PROSPECTUS FROM THE REGIONAL OFFICE.

THE PUBLIC ISSUES FOR THE FOLLOWING COMPANIES HAVE BEEN EFFECTED THROUGH POONA STOCK EXCHANGE-

1. ZF STEERING GEAR (INDIA) LTD.
2. KALYANI BRAKERS LTD.
3. LITAKA LABORATORIES
4. V.M. JOAG CONSTRUCTIONS LTD
5. FINOLEX CABLES LTD
6. KALYANI STEELS LTD

OUT OF THE ABOVE 6 COMPANIES FIRST THREE ARE TOTALLY NEW COMPANIES.

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3.22 NAME & ADDRESS OF INDUSTRY LEADERS

1. SHRI S. L. KIRLOSKAR
'LAKAKI BUNGLOW
MODEL COLONY
POONA - 411016

PHONE - O - 60018
R - 56471

2. SHRI B. D. GARWARE
CHAIRMAN & MANAGING DIRECTOR
GARWARE NYLONS LIMITED
PIMPRI
POONA - 411018

PHONE - O -
R -

3. SHRI H. K. FIRODIA
CHAIRMAN & MANAGING DIRECTOR
BAJAJ TEMPO LTD.
BOMBAY POONA ROAD
POONA - 411035

PHONE - O - 86380
R - 53153

4. B. R. MALHOTRA
VICE PRESIDENT & MANAGING DIRECTOR
WEIKFIELD PRODUCTS COMPANY
(INDIA) PVT LTD.
WEIKFIELD ESTATE
NAGAR ROAD
POONA - 411014
PHONE - O - 64944
R - 64202 - 67638

5. SHRI N. A. KALYANI
MANAGING DIRECTOR
BHARAT FORGE CO. LTD
MUNDHAWA
POONA - 411036
PHONE - O - 67343
R - 440181

6. SHRI M . G. SATHE
MANAGING DIRECTOR
SATHE BISCUIT & CHOCOLATE CO. LTD.
820, BHAVANI PETH
POONA - 411002
PHONE - O - 70391
R - 67271

3.22 NAME & ADDRESSES OF INDUSTRY LEADERS

7. SHRI RAHULKUMAR BAJAJ
CHAIRMAN & MANAGING DIRECTOR
BAJAJ AUTO LIMITED
AKURDI
POONA 411035
PHONE - O - 82851
R - 82857

8. SHRI R D AGA
MANGAING DIRECTOR
THERMAX PVT LTD.
CHINCHWAD
POONA 411019
POONA - O - 51125
R - 64543

9. SHRI C S KIRLOSKAR
CHAIRMAN
KIRLOSKAR CUMMINES LTD
CORPORATE OFFICE
CORPORATE OFFICE
11 KOREGAON PARK
POONA 411001

10. DR R J RATHI
CHAIRMAN
SUDARSHAN CHEMICAL INDUSTRIES LTD
162 DR AMBEDKAR ROAD
162 DR AMBEDKAR ROAD
POONA 411001

PHONE - 0 - 60019
R - 55467

PHONE - 0 - 67343
R - 62618

11. SHRI A S WARDEKAR
MANAGING DIRECTOR
WESTERN INDIA ERECTORS LTD
SAHYDRI SADAN TILAK ROAD
POONA 411030
PHONE - 0 - 30127
R - 33009

12. SHRI B G SHIRKE
MANAGING DIRECTOR
SIPOREX INDIA LIMITED
72-76 INDUSTRIAL ESTATE
MUNDHAWA POONA-411 036
PHONE - 0 - 70353
R - 56712

13. SHRI M S PARKHE
CHAIRMAN & MANAGING DIRECTOR
THE CENTRAL PAPER MILLS LTD
1183 SHIVAJI NAGAR
POONA 411005
PHONE - 0 - 55090
R -

14. SHRI N M PITTIE
CHAIRMAN & MANAGING DIRECTOR
THE RAJA BAHADUR MOTILAL MILLS LTD
5 R B MOTILAL ROAD
POONA 411001
PHONE - 0 - 63242
R - 63084

15. SHRI V S VAIDYA
CHAIRMAN
SWASTIK RUBBER PRODUCTS LTD
SWASK HOUSE KHADKI
POONA 411003
PHONE - 0 - 54813
R - 58700/53164

16. SHRI S K KHANDEKAR
MANAGING DIRECTOR
VANAZ ENGINEERS PVT LTD
85/1 PAUD ROAD
POONA 411029
PHONE - 0 -
R - 31139

3.23 NAME & ADDRESS OF LOCAL POLITICAL LEADERS

1. BARR V N GADGIL
419 SHANIWAR PETH
POONA 411030
PHONE DELHI 0 384782 R-3014488
POONA R 470697/31456

2. SHRI SHARAD PAWAR
BARAMATI
DISTRICT POONA
PHONE 428

3. SHRI R G MOZE
ROOM NO 57/1

4. SHRI L S (ANNA) JOSHI
704, SADASHIV PETH

SANGAMWADI
PHONE R 64279

POONA 411030
PHONE O 448148
R 443073

5. SHRI SHARAD RANPISE
R-211 SHASTRI NAGAR
YERWADA
POONA-411006
PHONE O 66333
R 66222

6. SHRI ULHAS KALOKHE
705 BUDHWAR PETH

POONA 411002
PHONE R 447785

7. SHRI PRAKASH DHERE
179 GURUWAR PETH

POONA 411002
PHONE O 56989
R 470504

8. SHRI VITTHALRAO TUPE
ROOM NO 47
TUPE VASTI HADAPSAR
POONA 411028
PHONE O 70163
R 70385

3.24 NAMES & ADDRESSES OF STATE GOVT OFFICERS

1. SHRI K S SIDHU
COMMISIONER
PUNE DIVISION COUNCIL HALL
POONA 411001
PHONE O 62223
R 62233

2. SHRI V P RANE
COLLECTOR

POONA 411001
PHONE O 62570
R 61488

3. SHRI S G ZENDE
PRESIDENT ZILLA PARISHAD
Z P BUILDING
POONA 411001
PHONE O 26052
R 62854

4. SHRI DEVINDER SINGH
COMMISIONER OF INCOME TAX
12 CANNOUGHT ROAD
POONA 411001
PHONE O 62159
R 67821

5. MRS LEENA MEHANDALE
MANAGING DIRECTOR
W M D C
KUBERA CHAMBERS
SHIVAJINAGAR
POONA 411005
PHONE O 55324
R 440118

6. SHRI P P SHINDE
JT DIRECTOR OF INDUSTRIES
PUNE REGION
UDYOG BHAVAN A'BLOCK
TILAK ROAD
POONA 411030
PHONE O 445844

7. SHRI C B DINGRE
ADDL COMMISIONER OF LABOUR
BUNGALOW NO 5
BOMBAY POONA ROAD

POONA 411005
PHONE O 56172
R 470653

8. SHRI N R DESHPANDE
JOINT COMMISSIONER
FOOD & DRUG ADMINISTRATION
PUNE DIVISION
791/93 GURUWAR PETH
POONA 411002
PHONE O 442555
R 35589

3.24 NAME & ADDRESSES OF STATE GOVT OFFICERS

9. SHRI T D SRINIVASAN
ASST DIRECTOR
SMALL INDUSTRIES SERVICE INST
NEAR PMT BUILDING
SHANKARSHET ROAD

10. SHRI S V TAMBAKE
DEPUTY CHIEF INSPECTOR
OF FACTORIES
694/1 II PUNE SATARA ROAD

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POONA 411009
PHONE O 470594

POONA 411037
PHONE O 35918
R 34979

11. SHRI S G JADHAV
REGIONAL MANAGER
M S F C
S P COLLEGE COMPOUND
TILAK ROAD

POONA 411030
PHONE O 470551
R 54356

12. SHRI P G KAPALE
DIVISIONAL MANAGER
MAHARASHTRA SMALL SCALE INDUSTRIES
DEVELOPMENT CORPORATION LTD
KAMALA CHAMBERS
687 BUDHWAR PETH
POONA 411002
PHONE O 470551
R 54356

13. SHRI S P PANDE
EXECUTIVE ENGINEER
M I D C
CHINCHWAD

POONA 411019
PHONE O 83305
R 84577

14. SHRI A K MHASKAR
REGIONAL OFFICER
MAHARASHTRA PREVENTION OF WATER
POLLUTION BOARD
41/6 TARATE COLONY KARVE ROAD
POONA 411004
PHONE O 33534

15. SHRI P G SARDESAI
DIRECTOR OF TOWN PLANNING
CENTARAL BUILDING
POONA 411001
PHONE O 66742
R 31747

16. SHRI S V BHAVE
COMMISIONER OF POLICE
VASWANI ROAD
POONA 411001
PHONE O 82202
R 63592

3.25 POWER SITUATION & LOAD SHADING

THE POWER PROBLEM DURING THE YEARS 1982 & 1983 WAS VERY SERIOUS & THERE WERE POWER CUTS & LOAD SHADINGS. MOST

OF THE MEDIUM & SMALL SCALE INDUSTRIES HAD TO WORK IN 2 SHIFTS ONLY. VERY FEW COMPANIES HAVE GEN SETS TO PROTECT AGAINST THE POWER SHORTAGES.

SINCE 1985 , HOWEVER SITUATION IS MUCH IMPROVED AND THAT WAS WHY THE INDUSTRIAL PICTURE WAS GOOD. HOWEVER, LOAD SHADING IS STILL OBSERVED FOR FEW LOCATIONS.

3.26 WATER SUPPLY FOR INDUSTRIAL & DOMESTIC PURPOSE

AS COMPARED TO POWER AVAILABILITY THE POSITION OF WATER SUPPLY IS VERY GOOD IN POONA & AROUND. DUE TO WATER SHORTAGE THERE ARE NOT MUCH CUT DOWNS IN THE PRODUCTION. BUT THE WATER CHARGES IN MIDC AREAS ARE VERY HIGH AS AGAINST THE CITY AREA. THIS POSED PROBLEM IN PCMC AREA AND ESPECIALLY TO THE SMALL UNITS FROM THAT AREA.

ANNEX "N"

INNOVATIONS IN INDUSTRIAL DEVELOPMENT AND COMPETITIVENESS IN KARNATAKA

January 1987

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Hyderabad - 500 034

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PREFACE

This report, prepared for the United States Agency for International Development (USAID) under the direction of the Office of Technology Development and Enterprise for the State Technology Development & Enterprise (STDE) Project in Karnataka, covers almost all Bangalore instituitons involved in programs to promote industrial growth and competitiveness in Karnataka, with emphasis on technology development, human resources development, capital resources, export trade and entrepreneurship at the state level. The report also describes initiatives for national programs in science, technology and financing. Its format is based on the report **Innovations in Industrial Competiteness at the State Level** prepared in December 1984 by SRI International for the United States to allow comparison of the activity matrix for both Bangalore and the national level in the above mentioned areas.

Case studies include information on the organization, objectives, programs and accomplishments of each institution. The report reflects the diversity of innovative programs at the state and national levels, and offers suggestions for further encouragement of these programs.

We acknowledge our sincere thanks to Dr. M. Krishna Moorthy, Mr. J. Balachandra and Mr. K.A. Krishnan for their contributions to this report and to all those who furnished information on their programs. We are thankful to Mr. V.V. Narasimha Rao for his assistance in preparation of this report and Mr. M.S. Sarma for his untiring efforts in typing the manuscript.

M. Ramakrishna Rao

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The Sahyadri on the eastern side slowly slopes down to meet the Deccan Plateau. The average height of the plateau is about 600 to 1000 meters. The ghats have very rich tropical forests called the Malnad which spread further east for a good distance in a belt 20-30 miles wide.

Because of topography and climate, Karnataka can be conveniently divided into three regions. The hot and humid coastal plain tobether with the Western Ghats that rise from it constitute coastal Karnataka (the ghats are considered sometimes as a separate region - the Malnad). The two other regions on the Deccan Plateau are termed Northern Interior and Southern Interior.

An estimated 667,324 hectares are irrigated by wells and tanks. Southern Interior Karnataka is mostly in the Cauvery Basin with an area of 36,000 sq. km. Since 1974 KRS has irrigated 79,300 hectares. Harange, Hemavathy, Kabini and seven other projects may give a total of 544,747 hectares when completed. The Krishna River base in Northern Interior has a drainage of 113,000 sq. km. within the state. Eleven major and 27 medium projects including Tungabhadra, Ghataprabha, Bhadra and Upper Krishna will in time irrigate 1,800,000 hectares. A small part of Karnataka is in the Godavari Basin.

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Karnataka has a long history of industrialization. Two hundred years ago Tippu Sultan, the visionary monarch of Mysore, laid the foundation for an industrial Karnataka. The illustrious statesman, Sri. Visveswaraya, continued the policies. These policies combined with the enlightened outlook of the Maharajas of former Mysore State have resulted in Karnataka being the home of many key industries. As a pioneer and trailblazer Karnataka stands head and shoulders above other states in the country. Some of the pioneering early ventures in the development of Karnataka have been the Krishnarajasagar Dam to harness the potential of the Cauvery River, the Sivasamudram Hydroelectric Power Station, the Mysore Iron and Steel Works, which produce charcoal pig iron (presently called the Visveswaraya Iron & Steel Works), Mysore Sugar Factory, Mysore Paper Mills and Cement Factory, Hindustan Aircraft Ltd., Mysore Silk Mills and Textile Mills, Mysore Porcelain Factory, Kolar Gold Field etc.

Because of the congenial climate and availabilty of skilled labor, high technology industries such as machine tools, electricals, aircraft manufacturing and electronics have been set up in Karnataka which now house prestigious public and private sector undertakings including HAL, BHEL, TATA, ASEA, ITI, Kirloskar, BPL, VISL, BEL, HMT and Wheel and Axle Plant.

Karnataka today is also the home of electronics. Acknowledged as the Silicon Valley of India, Karnataka produces over 35% of the country's electronic goods for different fields varying from defence, medicine and aeronautics to entertainment and computers.

Infrastructure

Industrialization is a continuing tradition in Karnataka. Rich natural resources, technological talent and manpower have contributed greatly to the strong infrastructure that makes Karnataka the ideal location for any industry. Karnataka can utilize talent from its 44 engineering colleges and 122 polytechnics. The prestigious Indian Institute of Science at Bangalore is renowned for fostering world famous scientists.

Numerous R&D laboratories provide research and testing facilities to the highly professional disciplines of aerospace, aeronautics, machine tools, defence, medicine and other fields of electronics, gas turbine and power research. The Indian Space Research Organization (ISRO), Electronics and Radar Development Establishment (ERDE), National Aeronautical Laboratory (NAL) and Aeronautical Development Establishment (ADE) provide valuable services in their respective fields. The Center for Development of Telemetries is a prestigious development organization in the field of telecommunications, active both in hardware and software. The Electronics Test and Development Center established by the Department of Electronics, Government of India, provides testing and quality control facilities of national and international standards. There are a large number of small-scale and ancillary industries. Some of the multinationals such as Texas Instruments (USA), Philips and Blue Star have set up industries in Bangalore.

Bangalore, the capital of Karnataka, is well connected by road, rail and air. Industries are located in several districts of the state and not merely concentrated in Bangalore. Special attention is being paid to the development of backward areas. Karnataka has the unique ability to produce mulberry silk and is a major exporter of prestigious Mysore silks. Reeling, spinning and weaving facilities have been widely developed.

In the field of electronic components there are about 29 industries; in the area of consumer electronics there are 10; in communications 10; in computers and peripherals areas about 28 units; and the field of control and instrumentation also has 10 units. This indicates the wide range of production facilities and activities in electronics.

The turnover figures of the Central Public Sector share is about 66.94%, Private Sector 27.93%, the State Public Sector 0.85% and Small-Scale Industries 4.28%. This indicates the major roles played by the Central Public Sector and the Private Sector in the industrialization of the state. Small-scale industry which is very often ancillary to major industry also shows a growth potential.

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PART 'I'

STATE LEVEL ACTIVITIES

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A. BACKGROUND

Introduction

A developing country such as India needs rapid industrialization for the society's advancement and for a high standard of living. The growth of industries during the last few decades has been phenomenal. Indian industries were intially geared to meet domestic demand and cut import bills thrugh import substitution which took place at the cost of efficiency and cost competitiveness. They tended to export what they produced. This resulted in not responding to market demand when current technologies in other countries were upgraded for the introduction of high quality and cost competitive products in the international market.

Initially industries were set up with foreign collaboration and technical know-how from the developed countires. The developed countries were forced to leave low-tech areas and concentrate on high-tech and state-of-the art technologies which encouraged developing countries to enter these former markets. Instant success and a huge market share were enjoyed by those countries which could restructure themselves easily and meet the requirements of the market. Today this mainly revolves around customer orientation, preference for new product design, and performance efficiency.

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The restructuring ability of the newly developed econimies initiated a price war. The world is now set to move from technology to technology with the ultimate aim of satisfying human needs at the most competitive price. Indian industry cannot survive these onslaughts unless it reorientates itself to new and modern technologies at a rapid pace.

The Government of India is very much aware of this newly emerging complex situation and has started to adopt innovative approaches in its industrial, export and science and technology policies. The Karnataka State Government also has made a number of initiatives for industrial growth, promotion and competitiveness.

State Level Innovations

Karnataka State initiated a large number of programs for industrial development through incentives and concessions, investment opportunities for Non-Resident Indians (NRI), providing infrastructure facilities, and offering technical consultancy and financial assistance, etc.

The new strategies emphasize :

* Statewide industrial development through promotion of large, medium, small-scale, and tiny and cottage industries.
* Promoting high technology utilization.
* Providing financial and management assistance to entrepreneurs.

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* Developing human resources in terms of training and retraining with skills to meet new tasks and new technologies.
* Enhancing competitiveness to capture the major share in the domestic market and also in the export market.

The range of state level activities is summarized in this report with a focus on activities in four major areas: technological development, human resource development, capital resources and export trade. Specific innovations in each area are described in case studies within each section. At the national level, two major areas, science and technology development and financial sources, are summarized along with case studies in each area. While doing this, all major initiators' programs are reviewed.

* <u>Technological Development</u>

  Several efforts are underway to increase utilization of new technologies by encouraging university-industry research arrangements. State initiatives include research and development partnerships, targeted technical assistance and technology commercialization programs.
  Section B describes some of these examples.

* <u>Human Resources Development</u>

  There are many initiatives by academic institutions, R&D laboratories and private institutions for training and retraining engineers, workers and executives at all levels.

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These educational programs are reflected in the proficiency courses organized by the Indian Institute of Science, short refresher courses by the Central Machine Tool Institute and vocational training courses by Nettur Training Institute.

Section C describes some of these examples.

* **Capital Resources**

  Numerous efforts are being made by Karnataka State Finance Corporation of India (KSFC), Karnataka State Industrial Investment and Development Corporation (KSIIDC), Industrial Finance Corporation of India (IFCI) and Industrial Development Bank of India (IDBI) to provide entrepreneurs with financial assistance to start new industries and to encourage private sector investment in new enterprises. Management training programs are also offered.

  Section D of this report provides examples.

* **Export Trade**

  A number of organizations were initiated by Central Government to promote export markets for Indian goods. The Trade Development Authority, State Trading Corporation, and Engineering Export Council are some of the organizations successfully implementing the programs.

  Section E of this report describes examples in this area.

National Level Programs

This section deals with science and technology policies of the Government of India and initiatives taken by the Council of Scientific and Industrial Research, National Research and Development Corporation etc. The major programs of financial institutions such as IDBI, IFCI and ICICI are given in this section.

Conclusions

This review offers an insight into state and national activiites and initiatives taken by different agencies for industrial development, promotion and competitiveness during the last two decades. All efforts are aimed at rapid industrial growth and expansion. However, efforts for technological advancement in hi-tech areas are at a low ebb due to the lack of emphasis on commercial R&D for innovations in new technologies. Dependence on older foreign technology caused industry to stagnate as these technologies became obsolete. To meet market demand high technologies from abroad are either not available or prohibitively costly. In coming years, the country will have to depend on commercial R&D closely interacting with academic institutions, industry and state agencies for accelerated progress and to meet market demand with sophisticated technologies. Cooperative joint efforts with other developed countries for mutually beneficial innovations in commercial R&D and to meet the rapidly changing technologies and competitiveness in the world market are also important.

B. TECHNOLOGICAL DEVELOPMENT

Description of the State Activities

Comprehensive efforts have been undertaken by Karnataka State to promote large-scale and medium-scale industries in addition to numerous small-scale industries during the last two decades. The state has given high priority to hi-tech and electronics industries. Full-fledged plans are underway to make Bangalore, the Capital of Karnataka, an electronic city. It is often compared with Silicon Valley in the United States. The introduction of hi-technology industries, modernization of existing industries, building of an infrastructure for new entrepreneurs all over the state, establishment of testing facilities for quality control and initiation of commercial R&D programs are some of the measures initiated by the state government to promote technological development. To increase productivity and enhance competitiveness in the domestic market, collaborations with industries in the developed countries, technical know-how transfers, indigenous efforts to interact with R&D institutions, etc., have been encouraged by state government and other industrial promotion agencies.

Our review covers all institutions whose efforts are for industrial growth and indigenous technology development. The major initiators are state and central government agencies, viz., academic institutions and R&D laboratories.

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To make the review comparable with the SRI International Report, the same definitions of the initiatives and matrix of state activities in technological development are maintained and given below.

<u>**Advocacy, Policy-making and Oversight**</u> - In general, these initiatives concentrate on identifying, developing and marshalling resources that are conducive to fostering a state's technological development - its high technology infrastructure. Ideas or concepts for more concrete or direct action usually orginate from these initiatives.

<u>**Technical Centers, Institutions, and Research Consortia**</u> - These are university-industry arrangements geared toward enhancing the research and development process. Usually targeting specific areas (e.g., microelectronics and biotechnology), these arrangements involve the provision of physical facilities, equipment and faculty and staff, separate from existing university facilities.

<u>**Development Facilities**</u> - Unlike research centers, these are university arrangements that focus on the commercial applications of basic and applied research knowledge. In these arrangements, facilities and access to university resources are provided to help entrepreneurs develop innovative ideas into commercially viable products.

Direct Technical Assistance Programs - These university-industry arrangements involving the provision of consulting, market assessment, project evaluation, and other support services for both start-ups and established firms. Services may vary from developing contacts for the new firm to enhancing the productivity of an existing firm's manufacturing process.

Overall, a wide variety of initiatives involving state, corporate and university sectors, exist on the state level. Though the following matrix on technological development is a listing of these efforts, it illustrates the diversity of initiatives in this area.

Matrix of State Activities in Technological Development

The matrix is presented on the following pages. Case studies of particularly innovative and/or successful initiatives and also potential organizations which could become important in technology development are reported.

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Technological Development - Karnataka State

Initiator	Advocacy Policy-making and Oversight	Technical Centres Institutes and Research Consortia	Developmental Facilities	Direct Technical Assistance Programmes
State	Department of Science and Technology (State board/implementation and policy making/oversight	Indian Institute of Science, Bangalore (Research & Development) Karnataka State Council for Science and Technology, Bangalore (State board/R&D assistance and sponsorship)	Indian Institute of Science Park, Bangalore (under active consideration) Technological Park, Mysore (under progress)	Technical consultancy service - Department of Industries and Commerce (Technical Assistance) Council of Scientific and Industrial Research - Polytechnology. (Technical assistance) Electronics Test and Development Centre (ETDC) (Testing/Certification)
Central	--	--	--	National Aeronautical Laboratory, Bangalore (Technical assistance) Central Machine Tool Institute, Bangalore (Technical assistance) Indian Space Research Organisation (Technical assistance) Central Power Research Institute, Bangalore (Technical assistance) Controllerate of Inspection, Electronics, Radar and Power Systems, Bangalore. (Testing/Certification)

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Technological Development - Karnataka State (Continued)

Initiator	Advocacy Policy-making and Oversight	Technical Centers, Institutes and Research Consortia	Developmental Facilities	Direct Technical Assistance Programm
University	--	Indian Institute of Science, Bangalore i) Centre for Electronics Design and Technology (CEDT) ii) Centre for Microprocessor Applications iii) Centre for Computer Aided Design iv) Computer Centre v) Cell for Application of Science and Technology to Rural Areas (ASTRA)	--	Centre for Scientifi Industrial Consulta Indian Institute of Science, Bangalore (Technical assistan
Corporate (Foundation)	--	Raman Research Institute, Bangalore (Research & Development)		

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INDIAN INSTITUTE OF SCIENCE

(IISC)

The story of the Indian Instiute of Science is long and full of innovations, creativity and productivity. The uniqueness of this institute provides models in research and development, human resources and technological development to present and future innovation programs for industrial growth and competitiveness.

Historical Background

The founder J.N. Tata (1839-1904), a great visionary realized that the future progress of India depended crucially on research in science and engineering. An endowment was created in September 1898 to establish a university of science to educate and develop the best of our young men. This scheme later bacame a tripartite venture with the association of the Government of India and the Government of the Maharaja of Mysore.

The Institute was to be devoted to experimental science and aimed at training students in experiemntal methods, carrying out original research, and discharging the functions of an accepted authority and referee on all scientific problems arising within its own domain.

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After independence the President of India became the "Visitor". The "Council" continues to be the prinicpal authority governing the Institute. It is assisted in the formulation of the academic policies of the Institute by the "Court". The "Director" is the executive authority and is assisted in the management of the Institute by the "Senate" and the Science and Engineering Faculties.

With the establishment of the University Grants Commission (UGC) by the Government of India in 1956, the Institute became one of the thirteen "deemed" universities under its purview.

During the past 75 years many alumni and faculty have directed science and technology programs in the country, created and nurtured other laboratories and scientific instituions, and founded key industries. C.V. Raman, H.J. Bhabha, Vikram Sarabhai, J.C. Ghosh, M.S. Thacker, S. Bhagavantam, S. Dhawan and scores of others who have played a key role in the scientific and technological progress of our country have been closely associated with the Institute. The present director is Shri C.N.R. Rao, an internationally reputed scientist.

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Programs

Because of its unique character the institute has been able to make many significant contributions. It is neither a national laboratory which concentrates solely on research and applied work to the exlusion of teaching nor a conventional university which concerns itself mainly with teaching. The Indian Institute of Science is concerned with reseach in frontier areas and education in current technologically important areas. Because it is a relatively small institution, it is able to innovate and introduce newer learning systems such as offering courses under a unit system, and testing the reliability of methods of evaluation and assessment. For example, this is one of the few institutes which have introduced a four-year integrated M.E. Program based on the Nayudamma Committee Report on reforms in postgraduated engineering education in the country; at the same time the Institute retains a few Bachelor of Engineering programs for graduates who wish an engineering career after acquiring a Bachelor's degree in science.

The Institute has pioneered in aerospace, communicatons, electronics, electrical, metallurgical and chemical engineering, automation, bio-chemistry and bio-physics, material science and solid state and structural chemistry, and has acted as a reservoir from which the leadership and the manpower for future scientific developments and industries can be drawn.

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Work has been initiated in several emerging areas of importance such as space science and technology (including astronomy and astrophysics), environmental science (including theoretical, meteorological and monsoon dynamics), life sciences (including genetic engineering), developmental studies in rural technology and energy problems.

Besides formal education and research, through the Continuing Education Center, the Institute has played an active part in offering short-term educational and training programs to scientists and technologists in service. The Continuing Education Program cover a wide range of topics and are popular since the professional societies assisted in their organization. Approximately 1000 students go through these programs every year.

In keeping with its aims and objectives, the Institute has organized a Center for Scientific and Industrial Consultancy (CSIC) and, through this, done a significant amount of R&D work on identified projects sponsored by industries. The know-how generated in the Institute in certain specific areas has been transferred to industries. To mention one, the work on silicon-based chemicals initiated at the institute has developed into a major collaborative program with Mettur Chemicals and Industrial Corporation.

In a similar way, facilities available at the Institute (e.g., the wind tunnels - low and high speed, water tunnel, the major computational facilities and high voltage and high current generators) have helped both public and private sector industries and Defence.

There has also been social utilization of work in biosciences, inlcuding plant tissue culture of sandal wood, eucalyptus and teak wood, disease control in silk works and nutritional value enhancement of rice strains. Some technologically important development work recently performed concerns the technology of cryogenic containers, studies of fluid flows in relation to cooling water pumps and cooling tower baldes, and design of large water tunnel and microhydroelectric power plants.

In all these endeavours the Institute strives to contribute to the scientific, academic and technological goals of our country with a keen awareness of its noble tradition and the need to maintain high quality in all its activities.

Accomplishments

The Institute, which started with less than a handful of departments, a small faculty and hardly 20 students, today has more than 30 departments and centers, 350 faculty members and 1300 students and research scholars.

During the last 25 years, 900 Ph.Ds. in Science and 600 Ph.Ds. and 250 MSc. in Engineering were conferred. About 700 graduates and post-graduates in engineering have received degrees during this period.

In recognition of their excellent research and development work, the scientists were honored with distinctions and awards of national and international importance such as the Indian Academy of Sciences and the Indian National Science Academy (fifty faculty members), the Royal Society of (FRS) London (two distinguished scientists) and by Jawaharlal Nehru Fellowship (four faculty members). Twenty-five Shantiswarup Bhatnagar Prizes, eight UGC Awards, four Federation of Indian Chamber of Commerce & Industries Awards and five Vasvik Awards were bestowed on faculty members during the last 25 years. The financial outlay has increased from Rs. 5 million recurring in 1960 to Rs. 55 million and less than Rs. one million non-recurring in 1960 to Rs. 28 million in 1984.

Lessons Learned

Well-defined goals and objectives: periodical review of programs, alertness to innovations, awareness of the needs of the country in science and technology and nuturing excellence and competence are major factors placing the Institute as "No. 1" in the country.

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THE KARNATKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY

(KSCST)

Histotrical Background

The Karnataka State Council for Science and Technology was formed on September 9, 1975 after several Ministers, administrators and scientists in Karnataka decided to collaborate on using science and technology to solve state development problems.

The objectives of the State Council are :

* To identify areas for application of science and technology to the development needs, objectives and goals of Karnataka and in particular to the prevailing conditions of backwardness, rural unemployment and proverty.

* To advise government on the formulation of policies and measures including technical, administrative and legal devices, which will promote such applications to identified needs, objectives and goals, in particular to health, education and manpower utilization with special emphasis on the development of human skills in the rural areas in the slums; and which will promote the scientific management of the natural resources of the state.

* To promote effective coordination and to develop and foster communication and other skills between centers of scientific and technological research, government agencies, farms and industries so that promising research and development work is initiated, promoted and effectively deployed in agriculture, in government and elsewhere.

* To initiate, support and coordinate applied research programs in universities and other institutions in areas identified as specially suited to the application of science and technology.

* To prepare science and technology plans relevant to the development needs of the state.

* To consider and advise government on such other matters as are relevant to the application of science and technology to the problems of Karnataka State.

* The work of the council is carried out through specific projects and programs. Nearly three-fourths of the council's expenditure is on projects and programs with the rest spent on secretarial services, library and computer center. It employs approximately 125 persons with close to 100 people working in projects and programs and the remainder in support services.

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From the beginning KSCST has been using the existing infrastructure in the state; viz., various scientific research institutions, professional colleges, laboratories etc., and has not set up any new institutions. During the year 1985-86 nearly 40 institutions and professional colleges were involved in KSCST's work. The council's projects are directed by eminent scientists who voluntarily contribute their time and skills even though the projects are not in areas of specialist research.

Broadly there are seven project areas; viz., energy, industry, food, water, housing and habitat, information and health. Of these, energy with seven projects in a total of 23 has received major attention with an expenditure of Rs. 0.78 million during 1985-86 out of a total expenditure on projects of Rs. 1.54 million (about 50%). The next has been Housing and Habitat with five projects and Rs. 0.4 million expenditure. A total expenditure of Rs. 1.54 million has been distributed among rural, urban and urban and rural with 13 projects in the rural sector with an expenditure of Rs. 0.86 million, the urban with four projects with an expenditure of Rs. 0.28 million and the remainder spent in six rural and urban projects.

Accomplishments

Technologies developed :

In the last 11 years some technologies that could be used in the development process of the state have been developed by KSCST. These include Astra ole; efficient jaggery furnace; wood gasifier; solar pond; Astra mud-block making machine; helogium process; sisal decortocator; Energy Food; silencers for auto-rickshaws; winnower; design procedure for percolation tank; shell roof based on weather proof tiles; turbines for microhydel plants etc. KSCST administrators and scientists are together in a single body and are therefore better equipped to offer support to government development agencies efforts for technology diffusion. In addition KSCST has established a support unit for Karnataka development agencies entering technologies such as solar collectors, windmills and photovoltaic devices.

It has also helped Hutti Gold Mines Ltd. in setting up fuel saving wood stoves in canteens and Mysore Minerals in designing a low cost housing colony.

Association with Industries

KSCST has taken steps to involve organisations such as Karnataka State Finance Corporation, Mysore Mineral Corporation, Mangalore Chemicals and Fertilizers Ltd. and Hutti Gold Mines in its work. They are eager to support some of the projects and help in its activities.

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Activities in various projects :

Some of the activities in the various projects undertaken by KSCST under various categories are

* Development of woodstoves Phase II
* Demonstration of solar ponds for low temperature process heat
* Woodgas Generators for small engines
* Efficient kilns for bricks and tiles
* Activated carbon from coconut shells
* Sisal industries demonstration unit at Umgra
* Alternative building technologies for low cost housing
* Occurrence of Paralytic Shellfish Poison (Saxitoxin) in shellfishes of Karnataka
* Survey of Allergy in Bangalore due to partherium
* Conservation of surface and ground water

Lessons Learned

Thus KSCST has demonstrated the efficacy of tripartite collaboration between academic institutions, industry and state government in solving some of the problems of development.

TECHNICAL CONSULTANCY SERVICES ORGANISATION OF KARNATAKA

(TECSOK)

Technical consultancy to entrepreneurs and industries paves the way for efficient management and speedy implementation of industrial projects. Industrial Finance Corporation of India has set up 12 technical consultancy organizations all over the country in collaboration with national and state level financial institutions and banks to provide consultancy services, from concept to commissioning stage, to rural, cottage, tiny, small, ancillary and medium scale enterprises.

Background

Karnataka has its own Technical Consultancy Organization (TECSOK) set up in 1976, as a Registered Society jointly by the Government of Karnataka, the Directorate of Industries and Commerce, the Karnataka State Financial Corporation, the Karnataka State Small Industries Development Corporation and the Karnataka State Industrial Investment and Development Corporation. It has an expert team with specializations in chemical, electrical, electronics, mechanical, metallurgy, textiles, drugs & pharmaceuticals, cements, leather and marketing. A branch office was opened in Hubli in 1983 to cater to the needs of North Karnataka and seven District Training Officers were appointed to advise entrepreneurs at district and taluk levels.

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The objectives of the organization are

* Assisting prospective enterpreneurs in setting up industries from tiny sector to large-scale sector. Services range from identification of project idea to implementation.

* Identification of projects and selection of investment opportunities.

* Dissemination of information on industrial policies and procedures of central as well as state governments.

* Selection of suitable locations for setting up industrial units.

* Preparation of detailed techno-economic feasibility reports/ project reports.

* Conducting market surveys, industrial potential surveys.

* Co-ordinating and conducting entrepreneurship development programs.

* Identification and development of ancillary industries.

* Co-ordinating, monitoring and evaluating development projects.

* Assistance in selection of technical and managerial personnel.

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* Implementing, monitoring and coordinating projects and turnkey assistance.

* Providing project consultancy to Non-Resident Indians (NRI) and also escort services.

* Assistance in obtaining necessary licenses and clearances.

* Assistance to government in the formulation of new policies, programs and schemes.

Programs

The programs include techno-economic feasibility studies, training programs, promotional activities for rural technology, etc.

So far TECSOK has completed 769 project reports; 85% of the reports made are for tiny and small-scale sectors in the field of electronics, electrical, mechanical, chemical etc. It has done pioneering work in rendering consultancy in promoting mini cement plants based on VSK process in association with National Council for Cement and Building Materials (NCBM), New Delhi. Consultancy was provided in preparing techno-economic feasibility reports for 20 mini-cement plants involving an investment of Rs. 2,300 lakhs (one lakh= 100,000) and providing direct employment to 2,000 people.

Entrepreneurships and management development programs at District/ taluka levels were organised to impart necessary training to prospective entrepreneurs in various procedures, policies and formalities in setting up industrial units. Similarly, export training programs are organised to train potential exporters in various aspects of export management and documentation.

Industries Development Project was established in Kolar in association with the District Industries Centre, Kolar, and the Rural Development, IIT, Madras; financial assistance for this project has come from Canara Bank. The objective is to provide training and employment to rural youth. Two more such projects are under implementation at Kanakpura and Chikmagalur. A Rural Technology Cell has been set up to advise rural and agro-based industries. In order to provide suitable guidance to NRIs who want to set up industries in Karnataka, a separate NRI cell has been created in TECSOK.
Non-Resident Indians are provided with information about incentives available, identification of suitable projects and the infrastructural facilities available at industrial estates. A separate cell has been created with assistance from the Ford Foundation with the objective of formulating projects which are oriented towards participation of women. Only women Project Officers work on this project, to give guidance to women entrepreneurs.

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TECSOK is recognised as a "Specified Agency" for implementing IFCI promotional schemes such as subsidy for encouraging the adoption of indigenous technology; assistance for development of technology through in-house efforts; subsidy to new entrepreneurs for meeting the cost of market studies; subsidy to entrepreneurs for meeting the cost of feasibility studies in tiny sector; subsidy for promotion of ancillary and tiny industries; subsidy for revival of sick units in tiny sector; and assistnace for development and self-employment of unemployed young persons.

TECSOK also operates the Modernisation Scheme and Sick Unit Rehabilitation Scheme of the Industrial Development Bank of India (IDBI). It undertook an assignment in monitoring, co-ordinating and evaluating the Rs. 18 crore (one crore=10 million) Dutch-aided project for construction of industrial sheds in Karnataka and prepared a feasibility report on development of silk handloom. This project envisages an investment of Rs. 457.64 million and is expected to directly benefit 15,000 weavers and 75 cooperatives. In addition TECSOK prepared a report on Development of Sheep in nine Districts of Karnataka with an investment of Rs. 319.57 million. The project is expected to benefit 79,718 shepherds and 87 cooperatives. Both the projects have sought World Bank assistance of Rs. 157 million and Rs. 104 million respectively.

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Accomplishments

During the last decade, TECSOK carried out many different programs. Its major achievements are : 769 Techno-Economic Feasibility Reports including appraisals, Rs. [illegible] lakhs investment catalysed, 48 thousand employment potential catalysed, 84 sick units studied, 23 market surveys done, 37 Entrepreneurship & Management Development Programs organized, 1428 potential entrepreneurs trained, nine Export Training Programs organized, and 377 existing and potential exporters trained.

Lessons Learned

Technical consultancy services promotes industrial growth as it helps new entrepreneurs with necessary assistance. But services are confined to guidance in starting industries only. These organisations were not able to succeed in drawing upon the services of technical experts in various R & D institutions to advise and to interact continuously in upgrading or solving technical problems relating to quality of products and competitiveness in the market.

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INDIAN SPACE RESEARCH ORGANISATION

(ISRO)

Programs

Indian Space Program Goals are self-reliant in development and deployment of space technology for operational large-scale national applications in

* Mass communications, T.V. and education (formal and non-formal)
* Remote sensing for
  - Survey and better management of natural resources
  - Meteorology and environmental monitoring
* Development of spacecraft, launch vessels, applications, payloads, ground hardware, services and management systems and mechanisms to realize these goals on a self-reliant basis.

Participation of industry and other high technology institutions and various national agencies has been essential for the success of these programs. The evolution of partnership with industry has a close and logical pattern conforming to the phases of development of the space program itself.

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Much of the work during the sixties was carried out in the laboratories established by ISRO. Only common materials, chemicals and simple hardware were procured from industry. The work related to a range of sounding rockets and their use for space science experiments and collection of meteorological data.

In the second phase during the seventies, ISRO took up the design and development of satellite launcher SLV-3 and the satellites Aryabhatta, Bhaskara I & II, Rohini and Apple. In this, industry participated in ground-based facilities and major fabrication tasks. The participation also covered ground electronics, chemicals, and a wide range of tools, equipment, jigs and fixtures, testing and transportation equipment. The collaboration ranged from specification to final product stage. Only a few industries participated in this effort. At this stage ISRO started licencing industries to use its' technology to supply ISRO requirements as well as the needs of others.

During the third phase of the early-eighties, plants, production lines and divisions of large industrial undertakings were set up with ISRO technology or a combination of ISRO R & D and the experience of the industry itself, to meet the needs of space programs as well as the applications of other departments of the government. Now ISRO licensed technologies have been widely exploited by industry.

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The next development was the creation of technical consultancy services by ISRO. This service covers a wide range of technological disciplines for the use of industry. With the major space program - USLV & PSLV launch vehicles - the INSAT II and cryogenic stage development involving an expenditure of Rs. 1,000 crores in 1985-90 intensive industry co-operation and participation is involved. Active industrial participation not only directly helps space activities but is also technologically and, in the long run, economically profitable and industry. The consultancy services are being effectively used by many public sector and private sector industries. The expertise has been made available to the concerned industries at various stages of development of the programs.

NATIONAL AERONAUTICAL LABORATORY

(NAL)

Introduction

National Aeronautical Laboratory was established in 1959 as one of links in the chain of laboratories of the Council of Scientific and Industrial Research. The laboratory's primary responsibility is servicing the needs of Indians aeronautical and aerospace industry and contributing to achieving self reliance in this vital sector.

Background

From its inception NAL closely interacted with the aeronautical industry, Aerospace and Defence Section, and has established a close working relationship with all the user organizations in the country through the advisory committees of the divisions of which representatives of user organizations are members. It has also been extending consultancy services to these organizations and through such close interactions has identified short-term and long-term needs of the aircraft industry and aerospace activity. Thus the users fund the majority of programs.

Apart from this the broad spectrum of facilities and expertise built up have been of interest to other engineering industries, both public and private sector. The laboratory has made a significant contribution to the energy sector.

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Programs

To achieve its primary objective of serving the needs of the aeronautical and aerospace industry, NAL established a wind tunnel testing facility and developed it into a National Test Facility. The laboratory laid emphasis on deliberate and planned growth of disciplines related to flight vehicle development. The R&D programs of NAL are organised under six major disciplines; viz., Aerodynamics, Fluid Mechanics, Materials Science, Propulsion, Structural Sciences, and Systems Engineering. Supporting services include, Engineering services, Computer services, Information Centre for Aeronautics, Graphic Arts and Administration.

Externally funded projects encompass a wide variety of tasks such as data generation useful to designers, development of new facility/product, and the setting up of sophisticated facilities not available elsewhere in the country. Development and supply of selected and specialised items of hardware for defence organisations, public sector undertakings, Department of Space, etc. are also undertaken since such hardware is usually not available elsewhere in the country. All externally funded research projects undertaken at NAL fit into one of the following three categories :

* Sponsored project — Specific problems referred by the user organization. These are entirely funded by them.

- <u>Grant-in-aid project</u> — Undertaken by the laboratory with the funds given by the Technical Departments of the user ministries such as ARDB, DST, Electronics Commission, etc. The funds are provided as a grant and may be full or partial.

- <u>Collaborative projects</u> — Those which are undertaken with an understanding of selective sharing by the laboratory and the user of expertise, facilities and work to be done at the laboratory. The advantage is optimising of time, effort and costs in the composite development. The collaborator, besides sharing costs, actively supplements through providing industry related inputs.

<u>Mechanisms for Collaboration</u>

Sponsored research schemes are among the most commonly used mechanisms to establish linkages between NAL and user agencies. User agencies may sponsor programs for the development of new technologies for commercial utilization, the development of sytems not available in the country, or the utilization of existing specialised facilities for generation of data useful for design of facilities which lead to import substitution - all related to the main stream of activities of the laboratory.

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These objectives are achieved through an instrument of contract or memorandum of understanding executed depending upon the nature and character of the sponsoring agencies. Expert advisory consultancy and testing/analysis service are other mechanisms available through which linkages could also be developed betwee- the users and NAL.

Benefits to Sponsors

Benefits - Sponsor has the first option to utilize the knowhow commercially. Sponsor may be given an exclusive right to use the knowhow for an agreed period of time. Sponsor will be eligible for a share in the premium and royalties on a pre-agreed basis if the sponsor participates in a horizontal transfer of technology to a third party. Patent protection is extended to technologies at CSIR cost. Time, effort and cost are effectively optimized in the case of collaborative projects.

Rights - The rights in the intellectual property and the knowhow rest in the CSIR. In the case of collaborative projects joint patents are possible.

Incentives to Sponsors

The following fiscal benefits are available to the user when collaborating with NAL.

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THE CENTRAL MACHINE TOOL INSTITUTE

(CMTI)

Introduction

The machine tool industry plays a vital role in the industrial economy of India. Supplying, as it does, machinery to manufacture machines, it acts as a pace setter for the manufacturing industry with the quality, variety and technology package it delilvers. Realizing the needs of the growing nationwide network of the machine tool industry, both in the public and private sectors and the research and development task that would be faced for its progress, the Government of India established the Central Machine Tool Institute as an industry oriented research and development organisation.

Background

The institute was formally established at Bangalore in 1962 and began its technical activities in 1965. Initially the Government of Czechoslovakia provided technical assistance, a gift of machinery and services. The institute benefits from technical aid programs of UNIDO and various advanced countries from time to time.

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CMTI is a Government of India Society registered under the Societies Registration Act of Karnataka and is governed by a council consisting of members drawn from the Union Ministry of India, Directorate General of Technical Development and Machine Tool Industry both in private and public sectors. Financing of the Institute is mainly through grants from the Central Government.

The Institute has the necessary equipment and facilities for prototype manufacture, heat treatment, precision measurement and testing research. It has a staff strength of more than 450 of whom about 100 are graduates/post-graduate engineers.

The main objectives of the Institute are to render technical assistance to machine tool and other engineering industries in the areas of

* Design and development of machine tools, attachments/ accessories and control systems.

* Research and investigation in machine tool technology, prototype testing and evaluation.

* Standardization of machine tools, its elements, accessories and cutting tools.

* Development of tools and tooling.

* Production advisory services in progressive machining techniques, solution to specific problems in machining, selection of production equipment and designing manufacturing systems.

* Promoting numerical control technology through servicing, programming and maintenance facilities.

* Precision measurement.

* Technical information and technical enquiry services and bringing out publications.

* Training courses in various aspects of machine tool industry.

Programs

In the area of Design and Development the institute's activites include evolving improved designs of machine tools - general purpose, special purpose and CNC machine tools, low cost automation systems and accessories/attachments. Computer aided design is being progressively employed at all stages of design.

Design tasks are focussed on machine tool manufacturer's and user's needs as well as on recommendations and suggestions from other sources, e.g. DGTD and Development Counicl for machine tools.

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The design projects vary from total technical knowhow to joint developmental efforts, which might include a technical report on the product, comparative study, product design, integration of documentation with the licensee's standards, manufacturing and assembly procedures and operational instructions.

In the area of research in machining technology a wide range of services is offered including development and testing of tools, toolings and production aids, newer methods of machining and productivity improvement. Specific problems in machining are undertaken for investigation. These activities are backed by a well-equiped technology processing laboratory and computer facilities. A separate Metal Cutting Tool Division has been created for intensive research and development work in the field of cutting tools, machinability research, tool testing and computerised machining data service. Group technology has come to be known as an effective tool for increasing productivity in small and medium batch production which constitutes nearly 80% of engineering manufacture in the country.

With the advent of CNC machines, the application of group technology has led to the concept of flelxible manufacturing systems to further improve the productivity of batch manufacture. A special cell with trained and experienced engineers has been created to offer consultancy services in the field.

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Quality and performance assessment of machine tools, noise and vibration analysis including condition monitoring and predictive maintenance, development of hydraulic systems and controls, electrical drives and logics and investigations into metal finishing are undertaken in research and testing.

Development and use of largely imported precision machine tools and measurement equipment calls for precision engineering technology support. For this purpose the institute has initiated a few activities in this field. These include, design and development of precision equipment, metrology and calibration and the development of related software and laser measuring services. Some of the precision equipment developed are in process gauge, auto balance, centering projector and optical readout. The services available in metrology are calibration of gauges, surface plates, plain and threaded gauges, rotary tables and dividing heads and inspiration of gears and lead screws, measurement of surface finish and training of personnel.

In the area of Numerical Control (NC) Technology, the Institute assisted by UNDP, has been active in establishing a center to provide necessary technical support and services to NC machine users and to accelerate the development and use of such machines. The advantages of these NC machines such as shorter set-up time in the manufacture of small and medium batches, reduced tooling and lead time, higher repetitive accuracy and flexibility in manufacture are well known.

Apart from the representative NC machines available the institute has developed the NC software - e.g., UNIAPT & APT processors for various NC machines and has set up a center - Computer aids for metal working industry (CAMW) with assistance from UNIDO/UNDP to provide CAD/CAM facilities to the industries and also to assist in the introduction of CAD/CAM Technology in the metal working industry. For the purpose the UNIGRAPHICS, CAD/CAM System which runs on PDP 11/34 is provided with auxiliaries for user interphase. This enables the creation of drawings using automatic dimensioning, annotation, notes lable scaling etc. and their outputs drawing on the Digital Platter Control Tape for manufacture of the component. For NC Tape preparation FAN UC System P Model D is available.

The rapid advances in technology render scientific workers and engineers obsolescent in their knowledge unless they keep pace with the changes. The pressure of competition, higher productivity and quality in metal working necessitates a constant awareness of the latest practices and processes. The institute disseminates information to industries of their own expertise as well as that available elsewhere through refresher courses, seminars, conferences and workshops organized from time to time. The training division in CMTI coordinates the programs and organizes short term training programs on a continuing basis for sponsored candidates from the engineering industry. The courses offered include

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Introduction to CNC Machines; Interfacing of CNC Systens; Computer Application in Metrology; Machine Tool Inspection and Testing; Manual Part Programming; CNC Machine Maintenance; CNC System Maintenance; Hydraulic Sarco Systems for Machine Tools; Introduction to CAD/CAM; Computer Aided Design; Noise and Vibration; Precision Measurements & Metrology; Group Technology; Advances in Machining Technology; Laser Application in Metrology; Non-traditional Machining; Emerging Trends in Manufacturing.

The Institute also regularly organizes seminars, conferences and workshops in the fields of machine tools and production engineering at various centers in the country.

During the year 1986, 25 training courses on some of the topics indicated above were arranged. Out of this eight were repeat courses and two were advanced courses. Candidates for the courses designed for ideal training, were sponsored by organizations including railways, ordinance factories, machine tool and allied industries both in the private and public sectors. Response through the years indicates that these courses have been well appreciated by the sponsors. The participants have been mostly managerial and supervisory staff.

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In addition to these training programs, seminars were arranged at Bangalore for top executives on important topics, on introduction to CNC machines at five places outside Bangalore and some in-house programs at the request of some of the organizations.

At the Institute a National Information Center for Machine Tools and Production Engineering (NICMAP) has been set up as a part of the National Information System for Science and Technology (NISSAT). This center acts as a clearing house of information on machine tools and production engineering. It collects, organizes, stores, retrieves and disseminates world information on machine tools and production engineering produced in different media and languages. The services are offered to practising engineers, scientists, technicians and researchers.

For this purpose it maintains a good library with over 50,000 items including books, periodicals, research reports, standards and trade catalogues. To cater to the needs of interested parties, trained professional staff offer technical enquiry service relating to latest products and processes, research and development, manufacturers and suppliers among other things. Selective dissemination of information (SDI) has also been introduced. Other library srevices are available. Periodically the Institute brings out publications on topics of current interest. Periodicals published include "Metalworking Abstracts" and "Metalworking Bulletin".

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The former abstracts, important articles published in about 150 major periodicals and is a priced monthly publication. The latter covers trends and developments in machine tool technology and production engineering among other items of general interest. It is a monthly publication supplied free on request. The Institute has also published several handbooks and directories of interest to metal working industries. NICMAP services are available to industries and institutions who enroll as annual members.

From the various activities discussed above, the Institute has established itself as a valuable link in the development of metal working and machine tool industry in the country. Over the years it has produced a team of well-trained and experienced engineers and scientists with the capability and competence for organized research developmental activities in the field. It has designed and developed a number of machine tools, NC systems, cutting tools and production aids licensed for production apart from evaluation and performance tests for clientele and has won national awards for import substitution.

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CENTER FOR SCIENTIFIC AND INSUTRIAL CONSULTANTY (CSIC)

INDIAN INSTITUTE OF SCIENCE, BANGALORE-12

The Consultancy Center nurtures academia-industry interactions in the over-all framework of development. The faculty of the Institute have actively participated in advising, planning and execution of research programmes as well as design and development work for a number of laboratories, R&D facilities and industries. The links between the Institute faculty and the industry are growing stronger day by day. The scope of work of consultancy projects encompasses a wide range of scientific disciplines, offering technical challenges. This has led to the natural creation of multi-disciplinary teams of the campus. Problem solving in real life situations has provided the scientific community with an enriching experience. Participating faculty claim a desirable effect on the quality of their teaching and student involvement in technical projects. This has led to the formulation of dissertations and other projects at the institute.

An advisory committee looks into matters of policy and general management under the overall purview of the council. Each consultancy proposal is scrutinized and evaluated by a technical panel drawn from the Institute faculty. The committee evaluates the projects both technically and financially. The CSIC operates a Fund for Applied Research (FAR) financed primarily by surplus funds from consultancy projects.

The fund, which may be accumulated up to Rs. 5 crores, is expected to provide important internal resources for in-house research and development of future technologies.

For purposes of communication, dissemination and exchange, the Center prepares documentaries and publishes a newsletter mailed quarterly to industries, R&D centers and national institutions. This highlights the scientific and technological developments at the institute.

During 1984 - a total of 104 new projects were undertaken involving a gross project fee of more than Rs. 8 million.

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C. HUMAN RESOURCES DEVELOPMENT

Description of State Activities

With newly emerging technologies, workforce skills in existing industries become outdated unless they are replenished with new knowledge, new skills and new talents. Human resource development in the form of continuing education programs with retraining and refresher courses, and new curricullum to meet the modern engineering trends is necessary. Initiatives in this area are proficiency programs for engineers, vocational training for future entry level workers and upgrading the skills of current workers. These efforts may be classified under the following categories :

- Education Reforms - Efforts to improve the quality of education, especially in mathematics and the sciences. Initiatives in this category include policy making boards and action groups, curriculum reform, teacher and student competency programs and public residential high schools for "gifted" children.

- Labour-Management Relations - Efforts emphasizing collaborative efforts between unions and management. These include innovative shared-management arrangements such as "quality of working life" groups, joint labor-management councils and joint corporate venture projects.

* Training and Retraining - Efforts geared towards retooling and retraining the workforce. Initiatives include custom-designed training programs for expanding firms or industries and training or placement for displaced workers.

* Entrepreneurship and Corporate "Intrapreneurship" Development - Efforts geared toward creating an entrepreneurial environment. Primarily focussing on small business "start-ups," product development, and managerial practices, these efforts may be undertaken by either state or corporate initiators. "Intrapreneurialism" refers to efforts by a company to create internal "entrepreneurial fervor" through corporate venturing.

Matrix of State Activities in Human Resource Development

Our review found that Central Government, private agencies and Indian Institute of Science are more involved than state universities in human resource initiatives in Karnataka. The following matrix covers all the major institutions engaged in this program. Case studies of innovative and/or successful initiatives follow the matrix.

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ithtor	Education Reforms	Labour-Management Relations	Training and Retraining	Entrepreneurship and "Intrapreneurship" Development
ate	--	--	State Educational Research and Training, Bangalore	--
ntral	--	National Productivity Council - Regional Office-Bangalore	Central Machine Tool Institute, Bangalore	Small Industries Service Institute, Bangalore
iversity	--	--	Centre for continuing Education Program Indian Institute of Science, Bangalore i) Proficiency ii) Quality Improvement Program (QIP) iii) Faculty Improvement Preference (FIP) iv) School Teachers Training College Science Improvement Program (COSIP) Bangalore University State Educational Research and Training, Bangalore	--
rporate	--	--	Nettur Technical Institute, Bangalore (custom designed job training/vocational training)	--

INDIAN INSTITUTE OF SCIENCE - CENTER FOR CONTINUING EDUCATION

Introduction

The Indian Institute of Science, Bangalore, has a three -pronged approach designed to cater to the needs of the country particularly with respect to trained personnel. This is apart from its usual activities as an institution of higher learning, operating several disciplines imparting education to graduates leading to post-graduate degrees in Science, Engineering, Humanities and Industrial Management.

The Center for Continuing Education which started in 1975 operates :

* Proficience
* Training of teaching personnel in colleges designated to offer refresher courses leading in some cases to advancement in their academic qualifications (QIP & FIP)
* Teacher Training Program for high school science teachers

Proficience

Proficience, established in 1980, is the collaborative effort through which professional institutions in Bangalore can interact with the Indian Institute of Science.

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It acts as a federation of professional institutions in Bangalore to foster the common cause of continuing education.

Provides educational facilities which are accessible to individuals without undue financial strain.

Provides a convenient way that scientists and engineers can update their knowledge and acquire the necessary background in their chosen fields of work or employment.

Provides rigorous, thorough, and long-term professional training of pedagogic excellence in areas of fundamental and current interest.

Periodically reviews curriculum, course content and sequencing of courses offered.

Engages experts from academic institutions, professional bodies, industrial and R & D establishments to offer well organized full-time course activities to fulfill the centre's goals.

Until December 1986, more than 230 courses had been offered under the program in the past 18 sessions with 13,500 participants enriching their knowledge and benefitting professionally. Many industrial establishments and institutions have repeatedly sponsored their employees in the courses. Sponsoring organizations are satisfied that their staff have been kept up-to-date with the latest developments of science and technology.

Evening classes are conducted in various subjects including several topics in science and engineering, computers, industrial management, languages, etc. Spread over a semester and apart from lectures, tests and examinations are conducted to evaluate participant performance. Certificates are awarded on the basis of performance.

Quality Improvement Program(QIP) and Faculty Improvement Program(FIP)

The QIP sponsored by the Ministry of Education and Culture, is directed towards improving the teaching standards of lecturers in colleges all over the country. A limited number of lecturers sponsored by colleges on deputation qualify for the program with the expenditure borne by the institute. The deputees enroll for M.E./M.Tech., attend courses, undertake research and qualify for advanced degrees.

The FIP program is sponsored by the UGC to allow teachers in science, medicine, and agricultural colleges to conduct research leading to the Ph.D. degree.

Teacher Training Program for High School Science Teachers

This program, conducted every year in Bangalore and some district headquarters, is intended to update the knowledge of science teachers of high schools. The program generally consists of Refresher Courses Practicals (model building demonstration, etc.), Lectures/ Demonstrations and visits to other educational institutions. It is being conducted in collaboration with the Department of Public Instruction, Government of Karnataka, through the Directorate of Study.

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NETTUR TECHNICAL TRAINING FOUNDATION

(NTTF)

Description

Nettur Technical Training Foundation (NTTF), an educational foundation established in 1983, is a living symbol of Indo- Swiss cooperation aimed at promoting a purposeful technical education for youth in India. In its mission, the foundation is actively supported by the Swiss Government, HEKS and Swiss contact, and Development Agencies of Switzerland.

The Government of India and the state governments where NTTF has its training centers have also extended their support. The fourfold objectives of the Foundation's Training Program are :

* To impart the highest degree of skill in the appropriate area of training.
* To inculcate a sense of discipline and stimulate logical thinking amongst its trainees, in order to shape them into highly skilled personnel with a sense of purpose and direction.
* To expose them to the existing social structure of the society and provide them with the opportunities to be useful within it.
* To give trainees a sense of confidence making their contribution to the industrial sector more tangible and increasing their employability.

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NITF implements its program of technical training in Tool and Die making and allied metal working trades through its Training Centres in Tellicherry (Kerala), Dharwad and Bangalore (Karnataka), Katpadi (Tamil Nadu), Gannavaram (A.P.). In addition to the above the NTTF Electronics Centre at Konnapana Agrahara, Hosur Road, Bangalore, provides a four-year training program in Electronics.

The core areas of training are Tool and Die Making and Electronics for a period of four years in two stages. Other ongoing courses of varying length conducted at different training centres of the foundation are : nonformal training programs, apprentice training programs, further education program (evening courses) and a post-graduate course in Tool Engineering. The courses are a good blend of practice and theory with the focus on equipping trainees to immediately use their knowledge in industry. Diplomas awarded are recognised by all public and private sector industries in India and abroad for employment purposes. Except for NAC (National Apprenticeship Certificate), NTTF Certificates are issued for other courses.

Training is given free of cost to all trainees except sponsored candidates for special courses, FEP&P GTE students. Preference for admission is given to meritorious students from economically weaker sections of the society.

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INDIAN INSTITUTE OF MANAGEMENT, BANGALORE

Programs

The Indian Institute of Management, Bangalore, was established in 1973 by the Government of India through the Ministry of Education & Social Welfare in cooperation with the Government of Karnataka. It is the first of its kind in the South and the third in the chain of National Institutes of Management. The institute aims at augmenting the management resources of the nation through programs of teaching, training, research and other professional services.

In addition to meeting the needs of the Business & Industry Sector, the institute also strives to enhance the effectiveness of the public system in Agriculture & Rural Development, Education, Energy, Human Settlements & Environment, Population and Health and Transportation. The academic programs are oriented towards developing human resources for managing business and industry and public and socially relevant sectors.

The two teaching programs are : the Post-Graduate Program in Management and the Fellow Program in Management.

The two year PG program is in management with sectional specialization (equal to the M.B.A.). The Fellow Program in Management is equivalent to the Ph.D. Others include Teacher Traning & Development program, Management Development programs, seminars and workshops, organization-based programs (incompany programs), research and publication.

In the PG Program specialization streams are offered in the following sectors (a) Business & Industry (b) Agriculture and Rural Development (c) Energy and Power (d) Human Settlements and Environment (e) Population and Health and Transportation.

The curriculum seeks to inculcate entrepreneurial values and promote the formation of specific skills. Designed to meet specific needs of public sector enterprises, courses can provide placement in private industry for the trainees.

The Fellow Program in Management is recognized as equivalent to the Ph.D. by the Association of Indian Universities. This program provides for development of concepts and skills necessary for advanced research in the field of management. The graduates of this program pursue careers in teaching and training institutions as well as in corporate bodies.

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The program consists of course work followed by the dissertation in management related to important sectors of the economy, such as Business and Industry, Agriculture and Rural Development, Education, Energy, Health & Population, Human Settlements & Environment and Transportation.

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SMALL INDUSTRIES SERVICE INSTITUTE

Background

The Small Industries Service Institute (SISI), Bangalore is a part of the Small Industries Development Organization (SIDO) of the Ministry of Industry, Government of India.

The SIDO was set up in 1954 on the basis of recommendations of the Ford Foundation Team which was invited by the Government of India to study the Small Scale Industries Sector and advise the Government on its development. Accordingly the Government of India set up four regional institutes in Delhi, Bombay, Calcutta and Madras to provide Techno-Managerial Services & Economic Information Service to the Small Industries Sector. This network of institutes was subsequently expanded to cover the entire country with one SISI in each state. Thus the SISI, Bangalore, came into being in 1957. Initially the SISI, Bangalore, had one Branch Institute at Hubli and two Extension Centers at Mysore and Belgaum. Later on, to provide a thrust for the development of backward districts, the branch SISI at Hubli was upgraded to the status of fullfledged institute. A branch institute at Gulbarga and another at Mangalore were also established.

The SISI, Bangalore, is equipped with the following divisions: Mechanical, Electronics, Electrical, Chemical, Glass & Ceramics, Economic nvestigation, Industrial Management & Training, Ancillaries, Subcontract Exchange and Modernization.

A mechanical engineering workship, a carpentry shop, an electrical laboratory, an electronics laboratory, a laboratory for galss and ceramics, a workshop for leather are also annexed to the Institute. An audio-visual cell has also been attached to the Institute.

The institute has about 120 personnel on its rolls and is equipped to service all trades of small industires.

Programs

SISI programs are

- Dissemination of economic information and guidance to start small scale industries, identification and solving of technical and managerial problems, assisting entrepreneurs in preparing project reports, finding out subcontracting opportunities.

* Developing ancillary industries to large scale units.
- Registering small scale units to supply products to Government.

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* Conducting technical & managerial training courses.
* Organizing seminars, workshops, openhouse discussions etc. for exchange of ideas & experiences, provididng liaison services for securing inputs and solving specific problems.
* Disseminating overseas marketing information.
* Providing export counselling and guidance in product development, assisting in modernization of units, providing laboratory and workshop facilities.
* Organizing exhibitions and buyer-seller meetings.

Accomplishments

* Workshop and Laboratory Services

  During the year 1984-85 the institute has undertaken 1102 common facility services which benefitted 870 units. Tool room facilities were extended to three units, 85 testing facilities were provided by the institute benefitting 68 units, two prototypes were prepared and 62 other developmental works were undertaken.

* Consultancy Services

  The small industries service institute provided 6416 technical, 276 managerial, 8315 economic and statistical, 96 training, 1848 extension, 167 marketing consultancy services

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and prepared 151 project reports during this period. 569 shed allotments were made, 1120 ancillary/subcontracts were undertaken and 40 study visits were organized by the Institute. Information on incentives has been supplied to 710 pr^spective entrepreneurs and 53 capital goods imports were completed.

* Other Assistance

The Institute has supplied 1358 technical reports and processed 270 shed allotments. 71 techno-economic appraisals on projects were furnished by the institute with export assistance provided in 36 cases. 50 economic and statistical reports were prepared. 19 large scale units were assisted for ancillarization. It has conducted 56 training programs comprising technical 41, EDP 10 and management five. Other details on the achievements of the institute are:

LPG cases processed were 24; blue prints and drawings supplied, 40; seminars/open-house discussions, 13; modernization workshops clinics, registration in sub-contract exchange, 58.

Lessons Learned

Test facilities and laboratory services to small scale industries are essential for qulaity assurance and control. There is a larege scope for establsihement of test centers by government and private agencies to meet the needs of small scale industries.

CAPITAL RESOURCES

Description of State Activities

The role of capital in the creation of small and medium sized businesses is widely recognised. It is also well proven that small scale and medium scale industries are the pillars for stte economy development. The financial instruments generate needed capital to invest for industrial growth. State and Central Government institutions are financing entrepreneurs for hi-tech and high productivity through a number of schemes. A variety of incentive schemes are introduced for rapid industrial expansion and competitiveness. This review of state level effotts in capital formation is more or less comprehensive. Most program initiators are regional branches of central governent and state government agencies or corporations. Some academic institutions also played an important leadership role as well, especially in the area of management and technical assistance.

Matrix of State Activities Concerning Capital Resources

The following matrix classifies state-level capital formation and related initiatives into three main categories:

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- Loan Programs - Several debt financing approaches, including long-term low-interest lending, loan guarantees, and loans for technology commercialization are catalogued here.

- Equity/Venture Capital - This category includes such equity financing approaches as start-up venture capital pools, equity investment guarantees, and support for small business investment companies.

- Management and Technical Assistance - Managerial workshops, seminars on financing and other issues, procurement assistance, and special research programs are classified under this category.

Immediately following the matrix are case studies that provide a more in-depth look at different approaches to capital formation and application. Even though there is an overlapping of the functions of these organizations, they are unique in their approach to different industrial sectors. On the whole, these approaches have successfully promoted the development of new enterprises and competitiveness in the state economy.

Initiator	Loan Programs	Equity/Venture Capital	Management and Technical Assistance
State	Karnataka State Financial Corporation, Bangalore (low interest financing) Karnataka Industrial Co-operative Bank Ltd., Bangalore Karnataka Industrial Areas Development Board, Bangalore (loans to industrial development agencies/development loans) Karnataka State Small Industries Development Corporation Limited, Bangalore (loans/infrastructure to start up industries) Banks (working capital investment debt financing)	Karnataka State Industrial Investment and Development Corporation, Bangalore (equity investment) Karnataka State Electronics Development Corporation, Bangalore (equity investment) Karnataka State Financial Corporation, Bangalore	Indian Institute of Management, Bangalore (business counselling and education programmes) National Productivity Council, Bangalore (for counselling on productivity and education programmes)
Central	Regional Office, Bangalore The Industrial Development Bank of India (low interest financing) Regional Office, Bangalore Industrial Finance Corporation of India (low interest loans) National Bank for Agricultural and Rural Development, Bangalore (low interest loans)	--	Small Scale Industries Institute, Bangalore (assists in locating financial technical and managerial resources)
University	--	--	--
Corporate	--	--	--

KARNATAKA STATE INDUSTRIAL INVESTMENT AND DEVELOPMENT CORPORATION (KSIIDC)

Background

Karnataka is a land of rich resources. Waterfalls, rivers, harbours, mineral wealth, a moderate climate and, above all, technological expertise make the state a a land of thriving agriculture and a pioneer in industry. The state nurtures an industrial tradition dating back to the days of Tipu Sultan. Dr. M. Visweswaraya provided leadership in establishing a number of major industries, numerous educational and research institutions, a well developed infrasturcture and industrial complexes in the state. Karnataka houses as many as 500 large and medium industries and 56,000 small scale units. All entrepreneurs are offered incentives and concessional package schemes in Karnataka. The Government of Karnataka helps entrepreneurs with the necessary infrastructure and also provides financial assistance. As one of the organizations involved in this task, the KSIIDC was established in 1964 as a wholly-owned undertaking of the state government. The KSIIDC's activities center on providng a powerful thrust to the industrial development of the state mainly in the medium and large scale sector.

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Objectives

The KSIIDC achieves its objectives by

* promoting industries in private and joint sectors and in association with public sector units;
* identifying industrial investment opportunities for implementation in Karnataka;
* dispersing industries to the interior, backward and rural areas of the state to ensure a balanced growth;
* exploiting resources which hitherto have remained unused or underutilized;
* encouraging new enterpreneurship; and
* achieving rapid industrial and economic development of the state.

The KSIIDC assists the entrepreneur in deciding on a suitable project for implementation in Karnataka. For this purpose, a project identification cell has been set up by the Corporation. The cell advises the entrepreneur on projects that could be implemented. In the case of certian special projects of public interest the corporation also funds 75% of the expenses required for conducting a preliminary project survey and market survey.

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Another organ of the corporation is its Merchant Banking Division which provides escort services to the entrepreneur from the initial stages to a fairly advanced stage in project implementation. This division assists the entrepreneur in making an investment decision, in obtaining the letter of intent and arranging foreign collaboration. It also helps in the imapct of capital goods by obtaining the necessary clearances from the state and central governments. The Merchant Banking Division helps in the incorporation of the company and in obtaining infrastructural facilities such as land, power, water and so on. It also helps in the preparation of market surveys and detailed project reports and in obtianing sanctions of various sources of funds. All this is done for a nominal fee.

The financial assistance provided by the Croporation includes term laons under the IDBI refinance scheme with a liberal repayment schedule; direct participtaion in share cpaital mainly for joint sector projects; provision of seed capital asssitance as the agent of the IDBI; provision of deferred payment guarantees for the IDBI's bills rediscounting scheme and finally the equipment leasing scheme. The KSIIDC provides term loan facilities under the IDBI refinance shceme for projects whose outlay does not exceed Rs. 30 million and the term loan can be financed jointly with the KSFC and a commercial bank upto Rs. 20 million. The Corporation itself can provide a term loan to the extent of Rs. 9 million under the IDBI refinance scheme. In exceptional cases this limit can be exceeded with the concurrence of IDBI. The assistance is restricted to corporate bodies. It is not only available to new projects but also for expansion and diversification of existing industries. Term loans are available for concerns which are engaged or will be engaged in manufacturing or processing of goods, generation and distribution of electricity or any other form of power and development of industrial estates in selected areas etc. Companies with a paid up capital and free reserves in excess of Rs. 50 million are not eligible for assistance from KSIIDC. Depending on the location of the project, i.e., whether it is in a no-industry district, backward district or more advanced area, the entrepreneur is expected to contribute at least ten to twenty percent of the total project cost. A maximum debt equity ratio of 2:1 is expected. In caluclating this ratio the investment subsidy, development loan and seed capital are treated as equity funds. Further, the seed capital contribution is considered part of the promoters' contribution. In the case of direct participation in share capital which is confined to joint sector companies, the corporation participates up to a maximum of 26%. This participation is subject to a few conditions such as appointment of director, restriction on transfer of shares, appointment of chairman as well as financial director etc. In so far as seed capital asssitance is concerned, the maximum amount of assistance is restricted to Rs. 1.5 million. The assistance is available to projects which have an outlay of less than Rs. 30 million.

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The KSIIDC's equipment leasing scheme is a pioneering effort in the field of finance for equipment. The speicial features of this scheme are that 100 percent of the cost could be financed and formalities are simple. The minimum amount sanctioned under this scheme is Rs. 300,000 and maximum Rs. 2.0 million per company. In deserving cases involving successful corporate bodies, the Corporation is in a position to syndicate lease funds to the extent of Rs. 12 million.

The corporation is the nodal agency for coordinating assistance to Non-Resident Indian entrepreneurs wishing to establish industries in Karnataka.

Accomplishment

The KSIIDC which started on a low key is today a large organization with several departments looking after the various needs of prospective entrepreneurs. A few of the industrial concerns assisted by KSIIDC, Karnataka Oxygen Limited, Mysore Petro-Chemicals Limited, Wiltech India Limited, and Tungabhadra Fibres Limited. KSIIDC also promoted its wholly owned subsidiary Mysore Sales International Limited, a marketing concern and Mysore Cosmetics Limited, which produces high grade cosmetics. In the financial year ended March 1986, the Corporation drew Rs. 231 million from IDBI by way of refinance. It sanctions loans amounting to Rs. 282 million and equity of about Rs. 3.3 million.

Industries which benefitted from these sanctions include cheminal engineering, electrical engineering, mechanical engineering, food, paper, iron and steel, rubber, beverages, cement and miscellaneous others. The largest beneficiaries were in the fields of mechanical engineering and cement. Thirty-six new units have come up during the year because of these sanctions. Another 17 projects are at various stages of processing. Under the scheme to attract Non-Resident Indians to establish industries in Karnataka, about 41 projects have been identified during the year and an investment of the order of Rs. 1280 million is expected to materialize.

Lessons Learned

The KSIIDC has been a very good catalyst in the industrial development of Karnataka. However, there has been a steep fall in its equity support to projects other than joint sector undertaking due to paucity of funds. This needs to be strengthened for sustained growth of industries in Karnataka.

KARNATAKA STATE FINANCIAL CORPORATION

(KSFC)

Historical Background

The state of Karnataka is endowed with abundant forest and mineral resources and offers great opportunities for industrial development. The state also enjoys a unique climate in most parts and is cool, salubrious and surprisingly free from the rigours of either summer or winter. The slogan "industrialise or perish" made popular by the great engineer-statesman Sri M. Visweswaraya has inspired the setting up of many prestigious industries in the state. Carrying on that tradition, the state is now offering special concessions and incentives for industrial investment and entrepreneurship through specialised agencies such as the Karnataka State Financial Corporation (KSFC). This corporation was establihed in 1959 under the State Financial Corporations Act, 1951, for promoting industrial entrepreneurship in the state of Karnataka.

Objectives

The corporation offers assistance to industrial concerns engaged, or to be engaged in

* Manufacturing, processing or preservation of goods;
* Maintenance, repair, testing and servicing of machinery of any description and of vehicles, vessels or motor boats and tractors and trailers;

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* Assembling, repairing or packing articles with the aid of machinery or power;
* Providing special or technical knowledge and other service for promotion of industrial growth;
* Generation and/or distribution of electricity or any other form of energy;
* Mining or development of mines;
* Establishment and development of hotels;
* Transport of goods or passengers by road, water or air or by ropeway or lift;
* Development of industrial areas or industrial estates in contiguous areas;
* Fishing and providing and maintaining facilities on shore for fishing;
* Research and development of any process or product in relation to any of the industrial activities;
* Provision of weigh bridge facilities.

The KSFC does not however provide assistance for trading activity and developing farms such as dairy and poultry. It also does not assist concerns whose paid up share capital and free reserves exceed Rs. Thirty million. The corporation provides asssitance only for the acquisition of capital assets in the form of land, building, plant and machinery. It does not provide assistance for working capital which can be obtained from commercial and industrial cooperative banks.

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The assistance is available to existing industrial concerns for expansion, renovation, modernization and diversification in the line of manufacture in addition to new industrial concerns. The maximum limit of assistance is Rs. 6.00 million in the case of registered cooperative societies and companies and Rs. 3.00 million in other cases such as proprietory or partnership concerns. Assistance is confined to concerns established in Karnataka or to enterprises located in Karnataka of industrial concersn incorporated outside the state. The corporation gives prime consideration to technical feasibilities, economic viabilities, financial soundness and managerial competence of the promoters in sanctioning assistance. It also takes into consideration the employment generated, development of industrially backward areas, promotion of ancillary industries, triggering of other economic activities and other socio-economic benefits of any proposal for assistance.

In addition to the above, there are special schemes to assist qualified or experienced technicians and professionals, the educated unemployed and capital participation in enterprises promoted by small entrepreneurs including craftsmen and artisans. There is a seed capital scheme for providing assistance on liberal terms to new entrepreneurs who do not have adequate resources of their own for setting up industrial projects and with a view to bringing about wider dispersal of ownership and control of industrial undertakings, thus resulting in quicker industrialization.

There are specific eligibility criteria for this type of assistance and the financial assistance available under this scheme for any single project is from Rs. 200 thousand to Rs. 1.5 million. The assistance is interest free. There are other schemes for the artisans, village and cottage industries and other units in the tiny sector and also for disabled entrepreneurs.

Accomplishments

In the last 27 years, KSFC has sanctioned financial assistance of Rs. 4369 million to 19,475 small and medium industries. The amount of loans disbursed manually has increased form Rs. 427 million in 1983-84 to Rs. 683 million in 1985-86. The total income has similarly increased from Rs. 96 million to Rs. 218 million and profit after tax and expenses has increased from Rs. 15 million to Rs. 27 million in the same period. The number of new beneficiaries rose from 2680 to 4795 in these three years. There are projects sanctioned in all the districts of Karnataka. The processing time for applications also has shown a gradual improvement and the average time taken by the corporation to sanction a loan applicaiton was 28 days during 1985-86 compared to 38 days during the previous year. New employment potential during 1985-86 due to KSFC's sanctions is estimated at 86,500.

Lesson Learned

The KSFC has played a very significant role in spreading industrial activities in all districts of Karnataka. It is, however, still giving a very large share of its assistance to the industrially advanced districts. There is a strong case for the KSFC to strengthen its activities in the more backward districts.

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KARNATAKA STATE ELECTRONICS DEVELOPMENT CORPORATION LTD.

(KEONICS)

Introduction

Karnataka has a long history of industrialization. Sir M. Visveswaraya, the illustrious statesman, was a pioneer in the planning and establishment of many high-technology key industries in Karnataka. It now houses many prestigious public and private sector undertakings such as HAL, BHEL, TATA, ASEA, ITI, Kirloskar, BPL, BEML, VISL and BEL.

History

KEONICS was established in 1976 as a specialist organization in the field of electronics. It provides general guidance to entrepreneurs and aids in procurement of raw materials. In addition to manufacture of its own products, it participates in joint ventures wherever necessary and has even set up marketing assistance for "Electronics City", the first of its kind in India. An integrated complex of small, medium and large scale industries has been established on approximately 300 acres 18 km from Bangalore, the capital of Karnataka.

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Several industrial houses and multinationals such as Philips, Tatas, Blue Star, Tandon, Bifora Watches, Amphetronix and ITI have plants in the area. Also located here is an Electronic Technician Training Center with Swiss collaboration. Apart from centralized facilities for trade, communications etc. "Electronics City" has an export zone for 100% export oriented industries.

Programs

On its own KEONICS is active in the areas of Entertainment Electronics, Telecommunications, Electronic components, Instrumentation and Control and Radio communications. The manufacturing units of KEONICS are engaged in the manufacture of B&W TV Receivers, Color TV Receivers and Closed Circuit TV systems. Its components division manufactures High Voltage Resistors and High Voltage Focus Packs, the former in collaboration with Welwyn Electric Ltd., U.K. Collaborating with Marconi Communication Systems Ltd., U.K. in the communications system field, it has begun manufacture of UHF/VHF two ways communications equipment. The Telecommunication Division manufactures subassemblies for telecommunication equipment in addition to marketing 48 line electronic PAX Communication Systems (Microcom), plain paper copiers, calculators and other office communication equipment. In addition it has established a Bio-medical Electronics Service Center. Rapid advance in bio-medical electronics has created the need for a service and consultancy center.

The objectives of the center have been service and maintenance of all electro-medical equipment in hospitals, testing and calibration of equipment, dissemination of technical information and technical advice on the purchase of electromedical equipment.

As mentioned earlier, KEONICS engages in joint ventures at several places in Karnataka. It has promoted some with equity participation. A few of these joint ventures make a valuable contribution in the field of electronics. Monochrome TV Picture Tube Project of KALYAN KEONICS Ltd. produces one million picture tubes per annum and is located at Bidar. Mini Circuits Ltd., a technical collaboration between Canada and KEONICS, produces 100,000 Itybrid Circuits per annum and is located at Jigni.

Raseltronics Ltd., another joint venture with KEONICS, manufactures 10,000 sq.m. of PCBs per annum at Doddaballapur. Another of the joint ventures located at Electronic City itself is Keonics-Shanthi Micro-electronics Ltd. which manufactures integrated circuits with a capacity of 10 million.

In collaboration with M/s Ericsson Information Systems Ltd., Sweden, SWEDE (INDIA) Telectronics Ltd., a joint venture, has been established to produce electronic push-button telephones.

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A joint venture of KEONICS & NGEF, Karnataka Telecom Ltd., has been established to manufacture 500 systems of Power Line Carrier communication equipments per annum.

Keonics Magnevision Computers Ltd. was established to manufacture Mini-Computer systems from 32 bit (excluding mainframes) down to 8 bit Micro-computers with a turnover of 10 crores. In the field of controls and instrumentation KEONICS has established a joint venture with Blue Star and Yokogowa Electric Works of Japan with an anticipated turnover of Rs. 10 crores per annum.

A third aspect of activities in the electronics field apart from the activities of KEONICS on its own and in collaboration, is the location of several industries in Electronic City. In the area of computers, there are five producing computer systems, six producing computer peripherals, 10 active in components manufacture, seven engaged in the field of controls and instrumentation, five in the communications field and one each active in consumer electronics and computer software.

Accomplishments

The investments of KEONICS itself in the ongoing projects and projects under implementation is estimated at Rs. 5330.35 lakhs with an anticipated turnover of Rs. 22,160.00 lakhs and an employment potential of 3845 people.

Further application has been made for issue of LI/DGTD registration for expansion and diversification of activities involving an investment of about Rs. 5132.30 lakhs with an anticipated turnover of Rs. 18182.00 lakhs and an employment potential of 1139 people.

The Karnataka State Government, in order to achieve its industrial policy objectives, offers not only assistance but also several incentives to entrepreneurs. These incentives and concessions are

- Subsidy on the preparation of feasibility studies for tiny and small-scale sectors
- Investment subsidy of 10% to 15% of fixed assets subject to a maximum of Rs. 1.5 lakhs in all sectors
- Sales Tax exemption for tiny sector
- Interest free development loans for small and medium-scale sectors
- Working capital loans of 25% of fixed assets for small-scale and 10% of fixed assets for medium-scale sectors.
- Pioneering with subsidies for medium and large-scale sectors
- Reimbursement of the cost of prototypes for small-scale sectors
- Subsidy on electricity tariff for tiny and small-scale sectors
- Subsidy for purchase of generators for small, medium and large-scale sectors

- Reimbursement of registration fees for promotion councils for tiny and small-scale sectors
- Subsidy for housing for small and medium-scale sectors
- Disbursement of subsidy and other concessions by the General Manager DIC in districts and by the Director of Industries in Bangalore.

For the backward district of Bidar further concessions indicated are a special investment subsidy of Rs. 2.5 million for the first 10 units with an investment of more than Rs. 30 million in addition to the Central Government subsidy of 25%. Entrepreneurs investing in a 100% export oriented industry such as electronics have the unique opportunity of locating in Karnataka.

Further, NRI have an advantage in importing machinery, raw material and components with their own foreign exchange earnings and in retaining their investment in that currency, with fluctuations in the rate of exchange protected and repatriation in free foreign exchange facilitated.

This variety of concessions has been responsible for the growth of the industrial sector in Karnataka. Special emphasis has also been placed on the development of backward areas as an avowed policy of the Government.

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NATIONAL PRODUCTIVITY COUNCIL

(NPC)

Introduction

"The developing nations have a long way to go, and much headway to make, before they can take their proper station with others in the van of human civilization and progress. And they have to hurry, for the time at their disposal is limited, and the pace of the world grows ever swifter" said Pandit Nehru years ago. This is true even today. The main problem facing the developing countries is lack of resources, a low technology base, overpopulation, inadequate trained manpower, poor management techniques etc. As a result, economic growth and productivity are at a lower ebb when compared with the advancement of developed countries. The important sectors in economic growth are industry, agriculture, trade, commerce, banking, transportation and services. Productivity improvement in these sectors can be considered a means of strengthening the economic foundation and thus promoting the standard of living of the country's population.

Historical Background

In the early fifties, the Government of India invited a series of productivity missions from the International Labor Organization (ILO) to study improvements in favor of productivity. The country was deeply awakened to the need to launch a nationwide productivity drive in 1957 after the Indian productivity delegation, headed by Dr. Vikram A. Sarabhai, visited Japan in 1956. This delegation focussed attention on the phenomenal progress made by Japanese industry through the incorporation and application of productivity techniques and procedures and make recommendations for the formation of the National Productivity Council (NPC) as an autonomous and non-profit organization in 1958. While establishing this organization, the Government of India also accepted the "Five Principles of Productivity" which were enumerated by the National Seminar held in November 1857, and form the basis of the country's productivity drive. They are

- In the productivity drive the objective should be to increase production and improve quality by improved techniques which aim at efficient and proper utilization of the available resources of men, machines, materials, power and capital, raise the standard of living of the people, and improve the working conditions and welfare of the laborer, taking into account the social implications of these changes. The movement does not seek the intensification of labor's burden through increasing workloads and speed-up.

* Increased productivity in a growing economy will ultimately help in increasing employment by stimulating development in industry. The government, employers, and labor should take specific measures to obviate the possibility of any unemployment.

* Benefits of productivity increase should be equitably distributed among capital, labor and consumers, and these should lead to reduction in prices, improvement in the standard of living, and to the renewal and expansion of plant, machinery, and equipment.

* The Productivity Drive may eventually be launched in all the spheres of the nation's economy. It is of importance to achieve integrated improvement in productivity in all activities of the nation, particularly agriculture, industry, including transport and communications, and administration. In the field of industry it should cover the large-scale industries as well as the light, the small-scale, and the medium industries in the public and private sectors.

- Increase of productivity cannot be achieved without the fullest cooperation between management and labor. In order to carry through the productivity program effectively, it is necessary to create a climate for increased productivity through the encouragement of joint consultations, participation of labor in management, and agreement, and the promotion of mutual understanding between managament and labor, in each industry and in each individual enterprise.

The council and its governing body, modelled on the ILO pattern, are tripartite in composition. It consists of 75 members with representatives of government, industry and labor, professional bodies and other interests. The Minister of Industry, Government of India is the President of the National Productivity Council. The governing body consists of 25 members from the council, with its chairman and director-general (nominees of Government of India). The council's policies and programs are implemented through 14 regional/sub-regional offices established in all the states in the country. In addition there are 48 local producitivity councils throughout the country to promote local initiative and talent in making the productivity drive a mass movement. In addition to the above, a two year post-graduate diploma course is organized at the Training Institute for Productivity & Industrial Engineering (TIPIE) at Madras. For enhancing supervisory skills, a Supervisory Development Cell promotes the interests of the supervisory cadre and organizes All India National Certificate in Supervision (NCES) examinations through the Supervisory Development Cell at Madras.

Programs

The productivity drive during the "sixties and seventies" sought to stimulate, promote and provide services through training, consultancy, research, publications, audio-visuals etc. The willing cooperation of the working class and trade unions was recognized as a pre-condition for productivity activities. With the productivity movement entering the eighties, management of technology became the focal point for economic progress. Contrary to popular belief, the application of modern technology has unleashed tremendous forces and opportunities for greater employment in the value added and tertiary sectors and in carrying forward the benefits of technology to the rural sectors of the economy.

The methodology adopted is threefold - the popular, the scientific and the behavioral. The mechanisms followed are generating productivity consciousness, providing specialized services for short term and long term benefits and initiating the promotion of participative culture. In the process of productivity, it became necessary to provide an activity mix by seeking the participation of all concerned and by creating a healthy climate and environment for promotion of positive attitudes towards productivity. The year 1982 was declared by the Prime Minister as the year of productivity. The major programs were the establishment of industrywide Productivity Boards, institution of Productivity

Awards, promoting core sector productivity improvement studies, undertaking energy studies and demonstrating productivity improvements in the decentralised sector through appropriate technology and upgrading of skills.

At the national level, the productivity drive has highlighted six major areas; viz., energy conservation, materials management, maintenance management, labor management relations, pollution control, and development of small, tiny and rural sectors. To accomplish the goals, various programs such as industry-enterprise level programs, programs related to developing harmonious labor management relations, productivity efforts at the state level and promotional efforts were launched.

Accomplishments

Some of the major achievements are

* Seven industry-wide productivity boards were formed and awards given to eight major industries (fertlizer, cement, thermal power, road transport, paper, coal, sugar and heavy engineering) for best productivity performance in 1982.
* A number of case studies were carried out for energy audits in oil consuming industries, techno-economics of beneficiation of coal for thermal power stations, etc.
* A quarterly journal on Energy Management and a bimonthly journal, "Maintenance", are published.

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* In the field of maintenance services, six maintenance service centers were established with condition monitoring facilities. These centers carried out extensive studies in condition monitoring of plant and machinery, installing condition based maintenance systems, providing special assistance to small scale industries, etc.
* Special training programs and workshops for technicians, oilmen, supervisors and maintenance engineers are organized regularly.
* The other area of special emphasis is pollution control. NPC is providing its services through consultancy and training to industries in solving air, water and solid waste pollution problems. Other services are productivity improvement programs for the small-scale sector, training of workers and trade unions.

Lessons Learned

The experience has proved that productivity improvements are positive in nature and are congenial for economic and technical efficiency. Urgent attention should be paid to technique-oriented activities and services, industry/utility-oriented activities and services and technology-oriented activities. While undertaking these activities, the major areas of emphasis should be quality improvement, cost effectiveness, productivity measurement monitoring and audit, preparing industry plans on productivity, improving the quality of work life, and training and consultancy services.

E. EXPORT TRADE

Description of State Activities

International trading has undergone a tremendous change during the last decade. The recession in the early eighties coupled with the increasing debt liabilities of many developing countries and increasing pressures of protectionism have brought about this complex change. In the last three years the export of engineering goods has shown stagnation. These phenomena are bound to occur increasingly at a time when competition by developed countries for international markets is increasing with hi-tech and modern technologies.

State government agencies and central government corporations have taken many initiatives to boost exports. These initiatives include government policies, three-year import-export policy, liberalization of licensing policy, international price-reimbursement scheme, preshipment credit etc. State activities are mostly governed by central government policies.

Matrix of State and Central Government Activities Concerning Export Trade

The following matrix lists export trade programs that have been initiated by state or central agencies, corporations and universities. The programs can be classified using these basic categories.

* Finance - This includes direct loan assistance, guarantees, insurance and export finance counselling.
* Distribution - This includes locating, meeting and/or establishing ongoing business relationships in foreign countries with international agents and representatives.
* Resource Center - This approach provides focussed technical assistance, especially in marketing and organizing trade missions and trade shows, export seminars, and foreign buyer programs.

Export trade activity is mainly initiated by the Central Government with their regional offices in the state. It is more or less a central subject. However, export trade development programs are encouraged and initiated by the state department of commerce and trade. The following matrix demonstrates the diversity of the state and center initiatives.

EXPORT TRADE

Initiator	Finance Programmes	Distribution	Resource Centres
State	--	--	Karnataka Export Promotion Centre, Bangalore (Export promotion) Cardamom Board, Bangalore Coffee Board, Bangalore
Central	--	State Trading Corporation of India Limited, Bangalore	Apparels Export Promotion Council, Bangalore Branch, Bangalore Basic Chemicals, Pharmaceuticals & Cosmetics, Bangalore Branch, Bangalore Trade Development Authority, Bangalore Branch, Bangalore Minerals & Trading Corporation of Indi Limited, Bangalore Branch, Bangalore
University	--	--	Engineering Export Promotion Council
Corporate	--	--	--

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STATE TRADING CORPORATION OF INDIA

(STC)

Description

The State Trading Corporation of India, established in 1956, co-exists with private trade in a democratic structure as a unique experiment. Originally meant to channel import and export, as time went on it was transformed into a premier, international trading house implementing various foreign trade policies of the government including undertaking the responsibility of import of critical raw-material and other items, take-up price support, buffer stock and other operations to meet the socio-economic challenge placed before it.

STC with its Head Office at Delhi has a network of 16 offices abroad. In India it has 14 offices spread over the country's port towns and some state capitals. STC's subsidiaries are

* Project Equipment Corporation to look after export of turn key operations
* Cashew Corporation for cashew operations
* State Chemicals & Pharmaceuticals Corporation
* Handloom and Handicrafts Corporation exclusively for handicrafts, handloom products and items of artistic nature such as jewellery etc.

* Central Cottage Industries Emporium.

STC commands an excellent infrastructure of communications and information systems. This incudes: an inhouse computer for speedy processing of data, shortage of informatior and quick retrieval, video screens for real-time display and monitoring of commodity prices and exchange rates in the international markets. These screens are linked thrugh satellite with major international trading centers and enable on-line tapping markets round the clock.

STC today has emerged as the largest trading house in the country with a turnover of Rs. 2200 crores of which exports are around Rs. 800 crores and imports Rs. 1400 crores.

Programs

The following are STC programs

* trading on a global basis.
* managing the import and distribution of various items that are crucial to the economy by buying internationally at competitive prices using its bulk buying power and international presence.

- undertaking price support operations with a view to helping the grower particularly in the areas of tabacco, shellac, rubber, etc.

* locating buyers for products manufacturerd/produced in India.

- providing export assistance in the form of
  - Scarce raw material assistance
  - Information regarding market trends, buyers requirements, acceptability of products etc.
  - Bringing out awareness of Indian products abroad by participating in fairs, exhibitions etc.
  - Catering to brand conscious foreign buyers by giving a common brand of STC to a consortium product manufactured all over the country.
  - Financial assistance for importing machinery to specified commodities.
  - Guides to product modifications and quality control for ultimate customer satisfaction in foreign countries.

- providing feedback from foreign buyers on the reaction to the items offered.

* sponsoring trade promotional visits abroad for export promotion.

* organizing consortia of SSI units to increase bargaining power.

* operating "off-shore trade" to earn foreign exchange.

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Accomplishments

During 1984-85 STC has carried out a total business of Rs. 2810 crores, comprising of exports of non-channeled items Rs. 509 crores, channeled Rs. 195 crores, imports Rs. 2088 crores, domestic Rs. 18 crores. With a view to building an infrastructure within the state and also to diversifying ports, STC embarked upon concerted program to build up its activities through the Mangalore port. Sugar and molasses of 43000 M.T. were exported from Mangalore port for the first time. STC has also opened depots at Mangalore to service the requirements of edible oil. Over a period of 10 years, STC has located markets for a number of products specially covered by small-sector industries entrepreneurs for granite, plywood, fruit juice, ready made garments, silk, hosiery, towels, footwear, surgical instruments, meat products, electric meters, processed tamarind etc. STC, Bangalore, serving the need of Karnataka State for the last 10 years has contributed more than 10% of STC's exports. Major emphasis has been in the areas of coffee, sugar, molasses, construction material, textiles, silk, perfumaries, engineering products etc.

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EXPORT PROMOTION COUNCIL

ENGINEERING EXPORT PROMOTION COUNCIL

(EEPC)

Introduction

India has made rapid strides in the field of exports over the last three and half decades. From an exporter of traditional items like jute, tea and cotton textiles India has emerged as a large supplier of manufactured products to overseas markets. The outstanding record of country's effort has been mainly due to efforts made by the Export Promotion Councils with cooperation and assistance from the government and other agencies involved in exports.

Background

In the early fifties no organized efforts existed at the national level to guide and encourage entrepreneurs to go into export production and overseas marketing. Businessmen lacked informaton of foreign market conditions and knowledge of export marketing techniques. To fill this gap and to meet the growing requirement of foreign exchange, the Export Promotion Councils were set up by the Government of India. The Engineering Export Promotion

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Council is the largest among the councils. The Council extends a host of services to its members. The membership subscription is Rs. 1,000/- per annum for SSI units and Rs. 3,000/- for others. Membership in the Council is a pre-requisite for its export benefits. The Council has its head office in Calcutta with four regional offices in Bombay, Calcutta, New Delhi and Madras and two sub-regional offices in Bangalore and Jullundar. It has thirteen offices abroad located in important countries. The council's present membership is 5,500 which includes manufacturers, exporters, export-houses and firms offering technical consultancy and management services.

Programs

EEPC advises incipient exporters from submission of their offers through realization of government export incentives. It provides information on marketing possibilities for engineering items in different parts of the world and arranges for delegation and study teams to visit foreign countries to explore market opportunities. It fixes floor prices for exports to avoid internal competition and also operates an export award scheme to recognize outstanding contributions. The EEPC also deals with the supply of indigenous iron and steel raw materials on a priority basis and reimbursement of the difference between the domestic and international price of steel, assistance from the market devlopment fund and helping in shipping and transport problems, etc.

The EEPC operates a joint sectoral publicity scheme on a shared basis for overseas publicity of products. It encourages participation of member units in various international trade fairs and exhibitions and it recommends release of foreign exchange for export promotion tours. Other tasks performed by the EEPC are

* publishing survey reports, delegation reports, statistical information etc., publishing and circulating the periodicals "Engineering Export News" and "Indian Engineering Exporter".
* Issuing of certificates of origin.
* Providing specialized services to SSI units.
* Assisting in resolving trade disputes etc.

Accomplishments

The Engineering Export Promotion Council, a nucleus body for promotion of export of engineering products from India has made a beginning in 1956 with significant development in the seventies. Today its exports have reached Rs. 1,000 crores. It has set a target of Rs. 5,700 crores by 1990-91 and launched innovative measures to boost exports. The government also came out with bold measures to augment production and help increase exports.

The EEPC has 884 members in the southern region and contributed 1106% to total exports. Karnataka tops the southern states with Rs. 71 crores contribution to exports. Major exports

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from EEPC are industrial plant and machinery, machine tools, auto parts and batteries.

It also exports electrical products, power machinery and spares, railway wagons/coaches, wires, automobile vehicles, steel products, bicycle and parts, pumps and electronics and numerous other items.

Lessons Learned

Export Promotion Councils play a vital role towards India's export contribution. With active cooperation and assistance from the government and other agencies, the Engineering Export Promotion Council is poised for an outstanding record in exports to achieve its future targets.

BASIC CHEMICALS & PHARMACEUTICAL EXPORT PROMOTION COUNCIL

(BCPEPC)

Introduction

The Basic Chemicals & Pharmaceuticals Export Promotion Council is one among the 19 Export Promotion Councils set up by the Government of India in 1963 to increase exports of various products. The BCPEPC has made an oustanding contribution to the country's exports in basic chemicals & pharmaceuticals.

Background

Previously no organized effort existed at the national level to guide entrepreneurs into export production and overseas marketing. Businessmen lacked information of foreign market conditions and knowledge of export marketing technique. Their focus was the rapidly expanding local market. In order to fill this gap as well as to meet the growing requirement of foreign exchange for maintenance of import, to upgrade India's technology and to widen production capabilities in diverse fields, the export promotion councils were set up by the Government of India. The Basic Chemicals & Pharmaceutical Export Promotion Council was established in the year 1963 to increase exports of basic chemicals & pharamaceuticals.

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This council functions under the aegis of the Ministry of Commerce, Government of India. It is registered as a non-profit organization under the Companies Act. The Federation of Indian Export Organizations, New Delhi, functions as an apex organization coordinating the work of all the export promotion councils.

The BCPEPC performs both advisory and executive functions and has been constituted to secure the active association of producers, manufacturers and exporters in the country's drive for exports. It has six separate panels with each panel being a specialised unit guiding the export interest of items under its purview - drugs, pharmaceuticals & fine chemicals; dyes, intermediates, coal tar chemicals & alcohol; basic inorganic and organic chemicals; glycerine soaps, detergents, cosmetics & toiletries; agarbathis; and merchant exporters' panel. With its head office at Bombay and regional offices at Calcutta, Ahmedabad and Bangalore, BCPEPC Bangalore office covers the four southern states and Pondicherry.

Programs

The council undertakes foreign market studies and surveys and sends out trade missions and disseminates information useful to manufacturers, shoppers and traders including importers abroad through various media. it establishes standards of quality and packing and investigates complaints about quality and other factors.

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The council also works to ensure the supply of good quality products to foreign markets at fair and competitive rates and to establish friendly and permanent business relations between India and foreign markets to the advantage of both.

Accomplishments

During 1983-84 the council exported drugs at Rs. 151 crores; dyes, intermediate chemicals, alcohol and coal tar at Rs. 38 crores; basic inorganic and organic chemicals at Rs. 131 crores; glycerine soaps, etc. of Rs. 29 crores, agarbathis at Rs. 10 crores; and crude drugs at Rs. 44 crores. At the district level it participated in five export promotion programs, promoted a number of activities related to three foreign delegations and participated in overseas exhibitions and training programs. It also assists industries with visas, foreign exchange, commodity profiles etc.

Lessons Learned

The export promotion councils establish the links between Indian and foreign industries. This is a very important link for export promotion at state and district levels.

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TRADE DEVELOPMENT AUTHORITY

(TDA)

The Trade Development Authority was established by the Government of India in 1970 as an autonomous export promotion institution. It is a non-trading institution, committed to export promotion activities with a diverse export marketing stragegy. Novel and innovative approaches are created in target markets throughout the world to achieve its export promotion objectives.

Historical Background

The Trade Development Authority was founded to pursue one of the government's export policy objectives. It is registered as a society under the Societies Registration Act with its own charter and is an autonomous body under the administrative control of the Ministry of Commerce, Government of India. The top policy making and governing body of TDA is its steering committee which consists of senior level representatives from various concerned ministries of the Government of India and representatives of other important export promotion organizations. Secretary to the Government of India, Ministry of Commerce, functions both as Chairman of TDA and the steering committee. The chief executive of TDA who is also a member of the steering committee is the Executive Director.

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TDA is organized into three functional divisions :

* Merchandising Division
* Research & Analysis Division
* Trade Information & Statistics Division

TDA strives to concentrate on specific products, specific exporters, specific markets and specific buyers. Being a non-trading institution, it does not enter into direct commercial transactions but confines itself to a catalyst's role. It does not charge any commission from its members for specific business secured by them with its help. It has a selective approach enabling it to identify major product groups for intensive export development and has target markets spread over 54 different countries throughout the world. Its product range covers a variety of engineering products, consumer goods and others.

Objectives & Programs

The main objectives of TDA are

* to identify and nurture specific export products with long range growth prospects and also to identify technically competent and export-worthy production units in the small and medium scale sectors.

*● to identify and cultivate specific buyers in overseas markets.

* bring contracts to the Indian suppliers and provide package services to execute such contracts.

*● to promote and assist technically competent units in product development and adaptation.

* to organize export intelligence services on modern lines and organize coordinate and assist in undertaking market research and analysis.

The Merchandising Division which is the core division of the Trade Development Authority provides comprehensive services in the field of export production and export marketing by identification of products, manufacturers/exporters, overseas buyers, establishing buyer- seller contacts and other allied strategies. TDA has an export production cell which assists its clients in creation/expansion of export-oriented capacity in the country. It also helps in locating a suitable foreign collaborator for transfer of technology/joint venture and marketing tie-ups.

The Research & Analysis Division conducts research activities for export promotion such as assistance in identification of products and markets, feasibility studies, consultancy services, studies relating to India's foreign trade, GSP and other tariff concessions, inter-firm comparison and short term forecasting of exports. It undertakes preparation of feasibility studies/project reports for setting up export-oriented industrial estates, export processing zones and for establishing new units or for expansion of existing capacity.

The Trade Information & Statistics Division is designed to collect, compile, analyse and store, retrieve and disseminate information on international trade and industry and related fields in India and trade and economy of other countries. A modern trade information centre has been set up to meet the trade information requirments of the exporting community, research organizations and government organizations. The center disseminates information on export-marketing through across-the-desk services, responding to postal enquiries, a weekly trade intelligence bulletin, a market intelligence bulletin, information hand-outs, circulars and market-survey reports. The trade intelligence bulletin and market intelligence bulletin publish important information of various aspects of trade. Services for the supply of status reports on foreign companies in a large number of countries are provided to members as well as to others on payment basis. The service charges are highly subsidized.

The Trade Development Authority, with its Head Office at Delhi, operates through four regional offices at Kanpur, Bombay, Bangalore and Calcutta and five overseas offices at New York, Frankfurt, Stockholm, Monrovia and Tokyo. TDA is a member of the World Trade Centre's Association and has reciprocal arrangements for exchange of trade information with members of the association.

Accomplishments

The Trade Development Authority made a major breakthrough in its target markets by developing exports through the channel of department stores. It organised as many as four "Buy India Campaigns" abroad with prestigious department stores. These "Buy India Campaigns" resulted in firm export orders of Rs. 12.24 crores and a major publicity thrust has been created for Indian merchandise in these markets. Innovative designs, upgrading of quality standards and improvement in packaging in the overseas markets has boosted the circulation of Indian goods abroad. This could be achieved only by the constant and energetic efforts of TDA.

TDA pioneered efforts to introduce cotton fabrics in South Korea, electronic components in Brazil, herbal cosmetics in the USA and exotic designed costume jewellery in Italy. Some of the highlights of TDA's activities during the year 1985-86 are participation in seven trade fairs and exhibitions, assistance to export-oriented units for joint ventures, and transfer of

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technology and prepartion of marketing plans for different states. Product specific and market specific programs were undertaken for a variety of engineering goods, building construction machinery, electronic components, auto ancillaries, computer software, leather goods and household and kitchenware items in many countries around the world. A number of activities have been undertaken in its target market to develop the export of electronic components. In order to penetrate into the US markets, it has undertaken a two-year market development plan for electronic components with the assistance of UNDP.

Auto parts is another area in which TDA concentrated efforts to develop buyer contacts. It organized participation in West Germany for the 11th time and is formulating a long-term strategy for penetrating the US market. There is a good market for hand tools in UK & FRG. In order to tap this potential, contact promotion was organized in these countries which resulted in good trade contacts and consequent business. As a result of sustained efforts made by TDA in Japanese markets, Indian exports of readymade garments reached an all time high of Rs. 40 crores. Buyer-seller meets are also organized periodically by TDA in overseas countries to increase its exports.

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TDA has established a "technology cell" to help its clients transfer technology and set up joint ventures for exports. In order to make Indian industry aware of the type and range of products which are in demand in foreign countries, TDA organizes displays of these samples in various parts of our country. It continues to render services to its clients to expand export capacity and upgrade their quality standards. Its regular membership reached an all time record high of 1178 firms at the end of 1985-86.

TDA assists state governments by formulating marketing plans for export from various states. It has completed a consultancy assignment for setting up a Trade Information System for the Apparel Export Promotion Council. The information services of TDA were widely used by the exporting community and government departments and it will be introducing a new service for quick dissemination of information on global tenders. The five foreign offices of TDA at Frankfurt, New York, Tokyo, Stockholm and Monrovia contributed a great deal in servicing clients and developing exports. Specific targets were given to these offices in terms of export orders, export enquiries, procurement of samples, buyer contacts, joint venture proposals, market surveys etc. Financial and technical support from interntional agencies such as the Commonwealth Secretariat, EEC, CBI and Government of Australia is being extended to the Trade Development Authority regularly for its programs. TDA also maintains a close dialogue with other export promotion organizations in the country such as the Indian Institute of Foreign

Trade, Trade Fair Authority of India, Federation of Indian Exporters' Organization, Indian Investment Centre, Export Promotion of Councils and Chambers of Commerce and trade associations.

Regional Office at Bangalore

TDA's regional office at Bangalore plays an important role in servicing its clients by maintaining continuous dialogue, following up trade enquiries and providing assistance in implementing export orders. It also services buyers' missions coming from abroad by fixing meetings with clients, providing trade information and accompanying them on visits to clients' premises. The Bangalore regional office also actively assists in organizing product and catalogue displays in their centers. Maintains close liaison with state government departments, Chamber of Commerce, industry associations and small industry and export corporations.

Lessons Learned

Autonomous institutions under the control of Government of India has proved to be a success with the best example the Trade Development Authority. During the last 16 years, the activities of this organization have grown multifold contributing a great deal to India's foreign exchange reserves and building up good markets for Indian goods abroad and thereby creating a new image of India in foreign countries.

F. ENTREPRENEURIAL DEVELOPMENT

Introduction

In a growing economy, entrepreneurship plays a vital role as it creates new and independent businesses for rapid industrial expansion. The new entrepreneur not only brings new products and new technologies but also provides a competitive spur to existing companies. New entrepreneurs take industry to different parts of the country especially to backward areas where a number of incentive schemes are available. This helps not only to create job opportunities in these areas but to balance the economy of the state.

Realizing the importance of the entrepreneurial development, many financial institutions such as IDBI and IFCI have established centers and institutes for this program. A wide diversity of program has been organized for women entrpreneurs, technocrats, engineers, artisans and craftsman etc. Many of these efforts, involving state agencies, corporations and universities concentrate on the small scale sector while others concentrate on management and executive development.

Illustrative Analysis

The following selected examples illustrate the efforts taken by different institutions dealing with various aspects of this program.

Management Development Institute

The Management Development Institute (MDI), an autonomous body registered under the Societies Registration Act, was inaugurated in 1973. This is financed largely out of grants made available to IFCI by the Government of India from interest differential funds arising out of various lines of credit. MDI meets parts of its expenses from the fees charged for training programs.

The objectives of the institute are

* to provide training in modern management techniques to entrepreneurs and technologists entering industry as well as to executives of enterprises - large, medium and small - in private, cooperative, public and joint sectors, with special regard to less developed areas and backward regions;

* to provide training and development banking to the staff of financial institutions at state as well as all-India level;

* to undertake research in industrial and business management, developing banking and related subjects.

MDI has conducted many six days to six weeks program designed to the specific needs of participants and their sponsoring organizations. Some of these have become regular, annual and bi-annual features.

Programs held so far cover a large range of topics including fundamentals of managerial finance, industrial marketing, management information systems for marketing, general course on merchant banking, materials management, manpower planning and control, computers, participatory management, project management, financial planning and control, cost reduction, production and operation management, supervision etc.

Development Banking Center (DBC) sponsored by MDI was established in 1977 as a training center for personnel of development banking institutions. Over 200 programs have been conducted involving a total of over 5000 participants. DBC also conducts various research projects such as organization studies, impact studies, case studies, regional studies, etc.

IDBI's Entrepreneurship Development Programs (EDPs)

In India organized entrepreneur development is of recent origin therefore, the program is designed to strengthen entrepreneurial motive and to transmit necessary skills and capabilities. Although Entrepreneurship Development Programs (EDPs) are being conducted by various agencies for different target groups including women, women entrepreneurs, engineers, graduates and technocrats, there is no coordination among these agencies. Hence, IDBI has developed a coordinated program involving technical consultancy organization, state level corporations and commercial banks to organize and conduct the programs. It has taken the lead in setting up the

Entrepreneurship Development Institute of India (EDII) at Ahmedabad with branches throughout the country. The syllabus and course contents of the program are designed by this institute. IDBI has been funding 50% of the cost of conducting EDPs on EDII model. During the current year (1985-86), 15 such programs on the EDII model have been organized in Karnataka.

ENTREPRENEURSHIP DEVELOPMENT INSTITUTE OF INDIA

(EDII)

Background

Entrepreneurial competence plays a major role in determining the success or failure of a project. There are a number of illustrations where strong entrepreneurs have made successes out of even average projects, often inadequately funded by financial institutions. In order to support and accelerate the entrepreneurship training, development and research, Entrepreneurship Development Institute is promoted by all-India financial institutions such as IDBI, ICICI, IFCI & SBI. It provides a national resource of experience and expertise to benefit all organizations and states interested or active in generating new entrepreneurs and improving the performance of existing programs. It is situated at the outskirts of Ahmedabad on 23 acres of land.

Programs

The programs are basically aimed at developing comprehensively competent trainers, capital to carry out entrepreneurship development activities in their respective states. Its programs are

* Phase I - Accredited trainers' course for six to seven weeks dealing with entrepreneurship development process and model, skill development including interpersonal skills,

communication skills, planning skills, problems solving and counselling skills, aptitude behaviour development and achievement motivation training, resource knowledge based inputs, etc.

* Phase II - On-the-job training in the respective states for three to four months.

* Phase III - One week courses for trainer refresher and readjustment training on the experience and outcome of on-the-job training aided by expert counselling and guidance.

Ford Foundation funded project to carry out rural entrepreneurship development experiments in three states with a grant of US $100,000.

Accomplishments

During 1986 four general EDP's were organized in the states of Nagaland, Manipur and Uttar Pradesh. Four training sessions of trainer-motivators were organized at Ahmedabad. Three regional workshops were organized for one to five days. National seminars on monitoring and evaluation of EDP's, organizations prerequisites for EDP's and resources from growth oriented entrepreneurs were organized.

International assignments such as workshops for Francophone countries at the Ivory Coast and a seminar in Nigeria were successfully organized. Seven research programs on characteristics of input-generating or input which generates entrepreneurs, identification of entrepreneurial competencies and entrepreneurship orientation in schools and colleges were organized.

Lessons Learned

This institute provides a number of successful stories from entrepreneurs who are benefiting from EDPs'. Training programs at the district level are required to spread this program in the country for industrial development and competitiveness.

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ANNEX "O"

International Development
New Delhi, India
April 1987

Technology Development on a State Level Focused on National Goals

A Concept Paper Applied to the State of Karnataka, India

Arthur D. Little, Inc. Reference 55194

PREFACE

The United States, through its AID program, has for some time been supporting India's goal to strengthen the country's scientific and technological base. Now, through its Technology Development and Enterprise Strategy, AID has given recognition to the fact that its earlier efforts to support this goal did not place enough emphasis on development of technology for the market place. Recent AID efforts -- Program for Advancement of Commercial Technology (PACT) and Program for the Acceleration of Commercial Energy (PACER) -- explicitly link commerce and business with science and technology. The PACT project provides a financial instrument for funding commercial R&D in U.S.-Indian joint ventures. The PACER project also provides R&D financing, but is focused explicitly on projects in the energy sector.

In the wake of the approval of PACT, and the basic development work on the PACER project, the USAID Mission in India began to consider further technology development initiatives. The leading candidates were a project with an industry focus and one with an area focus. After further analysis, the industry focus was rejected because industries are too dispersed to lend themselves to a manageable AID project.

In mid-1986, turning its atteniton to an area-focused project, Mission staff visited four candidate areas - Poona, Bombay, Hyderabad and Karnataka to appraise their suitability for such a project. Karnataka was finally selected, because of its strong scientific, financial, industrial and government activities and because these assets are concentrated around one city, Bangalore.

In November, a joint meeting was held in the office of the Principal Secretary of Karnataka's Department of Commerce and Industry to discuss the next steps. USAID agreed to fund a workshop on technology development and to arrange for U.S. consultants to attend. Responsibility for the substance of the workshop, and for logistics

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arrangements, was vested in a steering committee comprised of representatives of the Karnataka Industrial Investment Development Corporation (KIIDC), the Indian Institute of Science (IISc) and the Confederation of Engineering Industries (CEI). CEI assumed the leadership role and its staff provided the secretariat.

The resulting Workshop on "Technology Development, Finance & Human Resources in Karnataka" was held between the 5-7th of March. It was a major success. Five sector working groups met for four weeks to prepare for the Workshop. Some 170 leaders of business, academia, finance and government attended the opening session, and attendance remained high throughout. In the final session the Workshop prepared a set of draft recommendations for further action. Most important, the steering committee met four days after the Workshop to plan concrete next steps, including the establishment of an action task force and the creation of a small permanent secretariat.

USAID stimulated and supported the Workshop. Its success, and the interest and activity that it has stimulated, place a three fold burden on USAID.

USAID's first responsibility is to find immediate ways to support the process that it has started. It is essential that the present momentum in Karnataka not be be lost.

Second, USAID needs to develop a project or set of activities which will systematically support and stimulate productive technology development initiatives in Karnataka.

Third, the first two responsibilities must be carried out in a manner which does not co-opt or preempt the technology development process now starting up. If it is to succeed over the long run, the initiative and the leadership must come from Karnataka.

It is also clear that these responsibilities contain an unusual opportunity -- an opportunity to support a development effort of both national and local importance and interest, and to do so in response to a local initiative, rather than an USAID designed concept.

The present paper addresses the basic concept on which the area-focused project is based. It attempts to show that the concept is valid and has relevance in India, specifically, in Karnataka. The paper also outlines a set of actions for Karnataka to follow and suggests how AID might support the Karnataka effort.

The paper was prepared following the Karnataka Workshop and two weeks of meetings and discussions with participants in the Workshop as well as others. It was prepared by William Reinfeld and Peter E. Herman of Arthur D. Little, and William R. Thomas, an independent consultant.

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I. THE CONCEPT

INTRODUCTION

Today, India finds itself at what may be an important turning point in its economic development history. New policies have been introduced which are designed to open markets, create competition and build a commitment to industrial leadership and excellence. These new economic directions can, if actively pursued over the next decade, yield profound changes in the nation's internal economy and its international economic relationships.

The challenge to Indian leaders and policy makers is to identify and implement strategies which can move India in these directions by building on the country's comparative advantages and drawing on relevant experiences elsewhere.

This paper proposes a concept which addresses that challenge through a state-level technology development program. The concept is based on four premises, which, simply stated, are,

- Achievement of national economic development goals can be greatly supported by an effective technology development process;

- The technology development process can be effectively enhanced on a local or state level;

- The State of Karnataka, for one, has the prerequisites for creating an effective state-level technology development program; and

- The United States Government, through USAID, can play an instrumental role in support of this effort.

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Proof of these premises rests largely on experience and observations which are discussed throughout this paper and may be summarized as follows:

- India's long period of relative economic isolation and protectionism kept the country from achieving its industrial development potential and created an environment in which competitiveness and innovation play a small role.

- The history of industrial development in OECD countries and the recent experience of Newly Industrialized Countries (NICs) shows strong evidence that competitiveness and innovation are very important elements in achieving significantly rapid growth. Competitiveness and innovation both depend directly on technology development.

- Experience in the United States and other industrialized nations shows that state-level efforts to develop technology can be very effective. Although states, will be influenced by national policies and decisions, they often provide the critical mass of required resources, autonomy and energy to spawn new technology at a faster pace and more efficiently than the national rate;

- The State of Karnataka has the resources and resolve to pursue a state-level strategy to encourage more rapid development of technology.

- The United States is seen as a leader in both technology and the technology development process. India appears to welcome support from the United States in this effort. Furthermore, the state-level initiative by USAID complements its other efforts in India to develop technology and the private sector.

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A. THE ROLE OF TECHNOLOGY DEVELOPMENT IN SUPPORT OF INDIA'S NATIONAL GOALS

Broadly speaking, technology development refers to the process which upgrades the state of technology and commercializes it. The process may begin with basic research or it may begin with adaptation of existing or imported technology. The important point is that the process involves enhancing the level of technology in the economy through innovation. As used here, new technology may refer to a new production process, a product with new technical applications, or improvement of an existing technology. The various phases of technology development are shown in Figure I-1.

Sustained technology development has been one of the salient contributing factors in the growth and development of industrialized nations. The successful transition of countries in North America, Europe and East Asia, from traditional agricultural to modern industrial societies has been led or accompanied by a fundamental change in general availability of food, shelter, health services and material goods. Application of science and technology, above all, has been one of the key factors and symbols of that change.

India is still predominantly a rural agrarian society looking forward to transform itself into a modern industrial one in which basic necessities will be widely available. In planning for this structural transformation, science and technology have been given high priority from the very outset. Since Independence, the Government of India has invested steadily and heavily in creating science and technology infrastructure. With recent annual expenditures on research and development (R&D) in excess of $1 billion, India today ranks among the top fifteen countries in the world.

This investment has contributed to the achievement of a number of notable successes, but the contribution of technological innovation to

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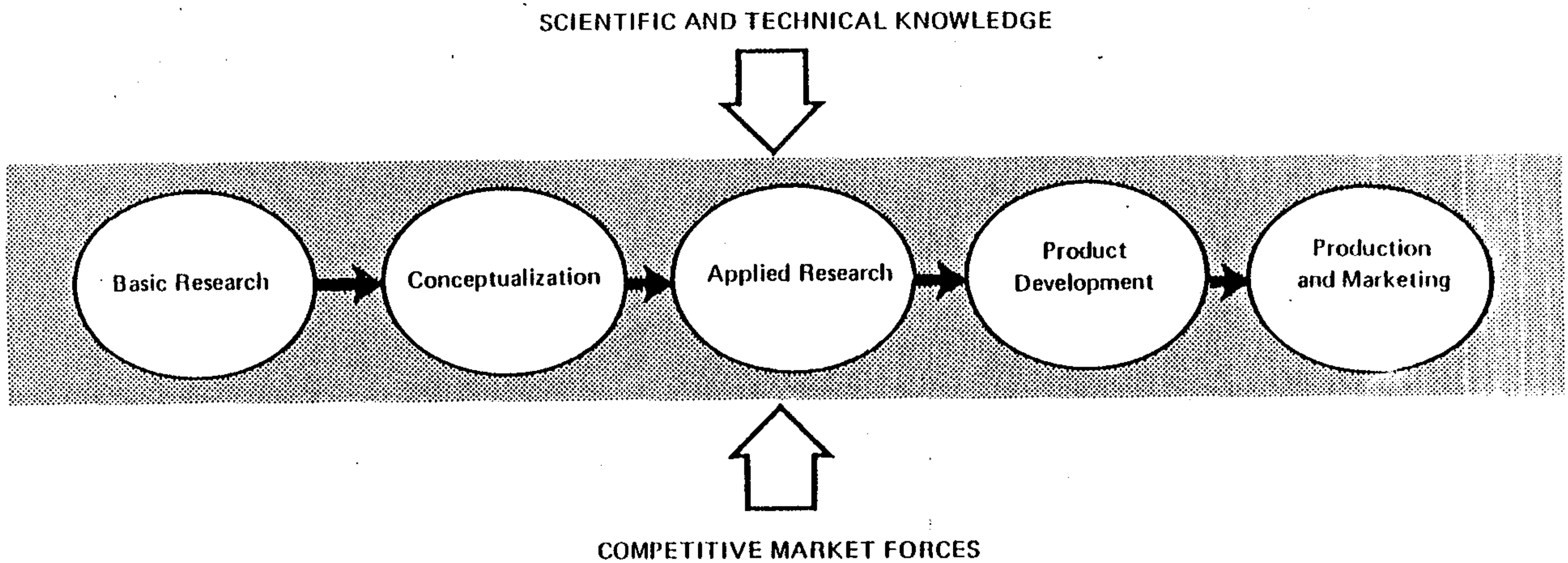

FIGURE I - 1 TECHNOLOGY DEVELOPMENT PROCESS economic growth needs to be greatly expanded. India's GNP of $182 billion, while one of the largest in the world, averages to only about U.S. $240 per capita. To move toward overcoming the pervasive problems of poverty and unemployment, India's Seventh Five Year Development Plan (1985-90) estimates that the annual rate of growth must increase from its recent level of 3.5 to 4.0 percent to a new level of 5.0 percent. This is an ambitious growth target and will require the industrial sector to expand much more rapidly than it did in the previous years.

The expanded industrial growth rate target is predicated heavily on technical innovation. The Approach Paper to the Seventh Development Plan reflects the major change of emphasis in science and technology policy. It states that:

> "The attempt will be to give up the practice of considering science and technology as a sector in its own right and to ensure that the bulk of science and technology effort is an integral part of all economic and strategic sectors."

This statement is an implicit recognition, by the Government, of the underutilization and underachievement of India's science and technology community in the past. Despite its tremendous technical potential, the relatively large investment in scientific infrastructure, and the conscious efforts by the Government to promote science and technology, India's technical community has not contributed as much to national economic performance as hoped. For example, public research institutes, in which over 90 percent of India's R&D expenditures take place, have produced little commercialized technology. The private sector has not fared well either. R&D expenditures in private industry have been very low, even by developing country standards. In 1982/83, private sector R&D amounted to only $300 million -- roughly what was spent by South Korea, a country with an economy 45 percent the size of India, and less than half of Brazil's expenditures. Organized in-house research is concentrated in only a few subsectors, and even in these, R&D intensity is low.

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Many reasons can be cited for the poor conversion of technical potential to economic improvement. The major reasons, however, are the industrial policy environment and a number of unfavorable institutional factors.

Industrial policies have not encouraged application of new technology. These policies placed limits on internal competition and provided high protection from external competition. By regulating the capacity of manufacturing units has been regulated, creating a climate where technically laggard firms not only survived, but thrived. By not actively encouraging investments in new technology, use of outdated designs and problems of substandard quality and low product reliability are now widespread.

Institutional constraints have also been responsible for the poor conversion of technical potential. These include:

- A high concentration of public sector R&D funds in government laboratories, rather than being distributed among a variety of research organizations;

- The lack of clearly defined research priorities, which has led to poor resource allocation among R&D opportunities; and

- A weak peer review process for judging the value of scientific work.

The emphasis of the Seventh Development Plan on technology development and innovation, however, has led to a significant liberalization in industrial policies and can be expected to lessen these institutional constraints.

The reforms intended to increase competition and foster an environment in which technology investments are explicit parts of strategic decisions.

The impact of the reforms, so far, has been to:

- Weaken the shields protecting Indian's markets from outside competition and interaction;
- Increase manufacturers' rights to the output of their R&D efforts;
- Ease access to foreign technology; and
- Simplify the approval process for foreign collaboration.

Some immediate results have already been experienced; for example, foreign joint ventures increased from approximately 550 in 1984 to 1500 in 1985.

B. A STATE-LEVEL EFFORT

In formulating strategies for enhancing the role of technology development, the experience of industrialized countries can be of value to India. Of particular significance, at this time, are the following two lessons learned from these experiences:

1. A state or local effort in technology development may be more effective than one which is nationwide. This is because: (a) the process depends heavily on face-to-face communication; (b) shared physical resources are more readily provided in a small geographic area; and (c) commitment to the process is frequently greater when the ties are closer to home.

2. Effective technology development is usually a collaborative effort by a variety of institutions in the public and private sectors. In the United States these include government agencies, public executives, legislative bodies, public and private universities, national laboratories and other special research institutions, large industrial corporations, small to medium-sized industries and industry associations, banks and other financial institutions.

While there are many variants to the state technology development program, most subscribe to a set of principles and objectives, which form a useful conceptual framework. From this framework one can construct a composite regional model, which is likely to be relevant to India at this time.

The basic principles and objectives upon which a composite regional model is built include:

- A critical mass of talent, financing, facilities and leadership is necessary for self-generating growth. Achievement of this critical mass must be a major objective of a technology strategy.

- Universities are a major source of the intellectual capital and the imaginative ideas from which technological innovation is derived. A strong university provides these resources as well as a nucleus around which a critical mass can accumulate.

- While basic research and the activities in university laboratories are vital, the needs of industry must be the primary concern of technology development strategies.

- Areas should play to their technical and economic strengths when selecting a direction for technology development. This requires careful assessment of the assets and liabilities and a well designed process for improving the former and muting the latter.

- The most effective strategies are opportunistic and much of the growth is dependent on individual actions. Leaders and planners who know which activities can leverage scarce resources can make a significant difference. This, in turn, depends on good information and the ability to act quickly and in a coordinated way.

- These programs are most effective when activities are market-driven within a competitive environment.

In the case of India, the size of the country, the large geographic concentrations of critical resources, the relative autonomy of individual states and the difficulty in making decisions which are acceptable in an all-India context argue for the state-level approach to technology development.

The major concern then is to find the right state(s), in which the environment is favorable for technology and change. Karnataka is such a state. The right conditions exist there, in terms of:

- *Existence of a strong technical-industrial base.* Bangalore is the fastest growing city in India, and much of that growth is due to a rapidly expanding technology-focused industrial base. It is the acknowledged national leader in electronics, and has strong centers in materials, food processing and communications.

- *A broad technology-knowledge base.* Several of the most prestigious universities and national research laboratories in the country are located in or headquartered in Bangalore and Karnataka. These include the Indian Institute of Science (IISc), the Raman Research Institute, the Indian Space Research Organization (ISRO), the National Aeronautical Laboratory (NAL), the Center for Food Technology Research of India (CFTRI) and others.

- *Solid highly-skilled human resource base.* Because industry and institutions are here in such numbers, there is a well trained work force and a large cadre of management talent.

- *Favorable attitudes.* All the relevant sectors in Karnataka have taken great interest in the prospect of enhanced technological development and have demonstrated a willingness and a capacity to foster that development. A number of talented individuals have come forward to support this effort. Commitment has come from the state government, the private sector, the public sector, universities, and research laboratories.

C. U.S. SUPPORT FOR TECHNOLOGY DEVELOPMENT

The United States has had great interest in assisting India in its pursuit of greater technology development and it can be of important assistance in the creation of a state-level effort. USAID's efforts are incorporated in the Technology Development and Enterprise Strategy, whose aim is to help India better utilize its scientific and technological resources in the process of commercial innovation. This strategy is based on the following premises:

- India needs an increased rate of economic growth to compete with rapidly modernizing nations;
- Technology development is a proven vehicle for such growth;
- Technology development has not taken hold in India, in part because there has been no nucleus of support;
- The United States is an acknowledged world leader in technology development; and
- Building on the U.S. experience and capabilities, USAID can create an impetus for innovation and technology which will become self-supporting.

A state-level thrust in technology development is consistent with these aims and the other projects AID now has introduced. These include a wide range of activities that involve not only the USAID Mission in India, but other entities, such as the Department of Commerce, USAID's Bureau for Private Enterprise, and the Embassy's Commercial and Science Sections.

The most relevant projects, in this case, include the Program for Advancement of Commercial Technology (PACT) and a pending Program for the Acceleration of Commercial Energy Research (PACER). PACT is designed to accelerate the pace and quality of technical innovation for products and production process through the medium of joint U.S.-Indian commercial ventures. PACER is designed to promote research and technology development and application in the energy sector as a whole.

PACT was started in June, 1985, and has already demonstrated the premise that the time is ripe for technology development in India. Over 300 inquiries have been submitted concerning PACT grants, and three major financial institutions are in the process of creating their own funding mechanisms, modelled on PACT.

A state technology development project in Karnataka is a logical extension of these activities. It would concentrate resources in a large area (Karnataka has a population of about 53 million), but one which is more manageable than the country as a whole. The project would build on the considerable resource base already in place. It would be patterned after models already known in the United States. The project would also have a substantial demonstration effect. If successful, it could be replicated by AID, other donors, or the Indian Government, in a number of other areas, such as Poona/Bombay and Hyderabad, where the interest and basic resources for technology development exist in an adequate concentration.

II. A STATE-LEVEL MODEL FOR ENHANCING TECHNOLOGY DEVELOPMENT IN SUPPORT OF NATIONAL GOALS

INTRODUCTION

There are a variety of ways to achieve regional-based technology development, but there is a single model from which most of them are derived. Figure II-1 shows a generic version of this model. For each component of the model there are specific conditions or characteristics which describe what must be in place or happen before an effective technology development process can begin to occur. These pre-conditions and characteristics are universal, but in application they must be modified (e.g., in terms of priorities) to fit the particular situation and time in which the model is used. Thus, the statements below represent a version of the generalized model which reflects the stage of development in Karnataka.

Using this model, one can assess each component in Karnataka and determine a program and strategy for enhancing the technology development process.

A. LEADERSHIP AND COORDINATION

Strong leadership is an essential prerequisite for significant technology-oriented growth. Not only must leaders be identified and/or developed in each of the major sectors -- research and financial institutions, industry and government -- but, in the early stages of development, there must be a leadership group. These leaders will serve as "champions" of the technology development process, individually within their institutions and disciplines and collectively across these divisions within the state.

Formal coordination of the various components of the model is also very important in creating proper framework for technology development. This is particularly necessary in an environment such as Karnataka where some technology-based activities need strengthening and where linkages among components are not fully developed.

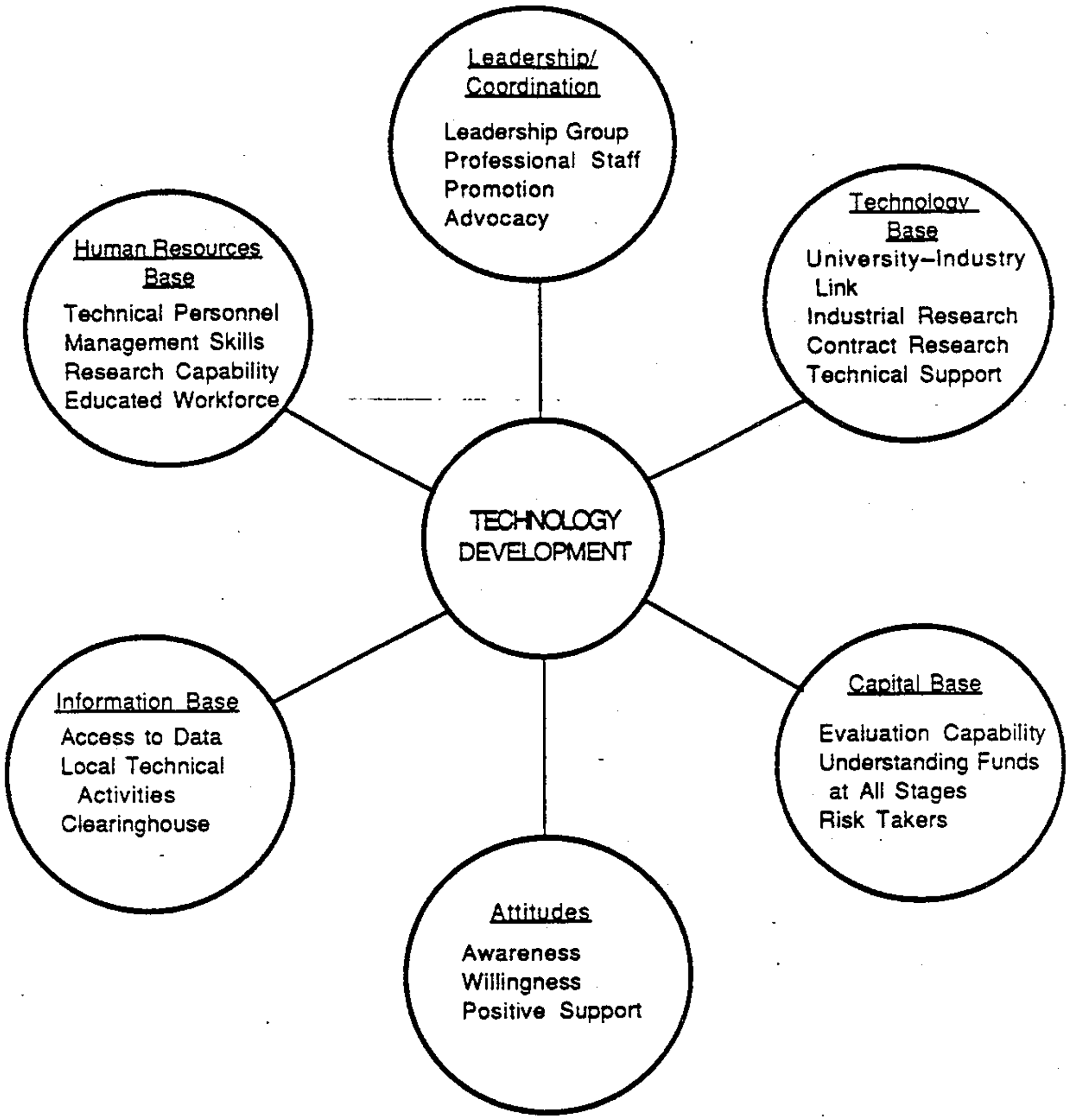

FIGURE II-1
TECHNOLOGY DEVELOPMENT MODEL

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An effective leadership and coordinating element must include the following characteristics:

- o Have the support of leaders in each of the institutions and sectors which are components of the technology development environment -- e.g., government, academia, and industry;

- o Encourage and provide opportunities for leaders to promote and offer programs for technology development;

- o Create structures in which leaders can come together to cooperate in technology growth programs; and

- o Develop ongoing coordinating mechanisms which provide a vehicle for oversight of technology activities and for the exercise of collective leadership.

B. TECHNOLOGY BASE

A technology base is the sum of assets which give a region expertise in scientific and technology areas and the ability to translate that expertise into industrial capacity for whatever purpose. It includes skilled research scientists, engineers and technicians, the facilities necessary for them to work effectively and the organizational environment to convert that work into products and processes which support the regional economy.

In order to be effective, the technology base must have the following characteristics:

- o Linkages between the industrial sector and the research institutions which permit the flow of scientific and technical information from the institutions to industry and which involve industry in the support of research;

- The capacity and the willingness of industry to do in-house research, particularly that which builds on basic discoveries and focuses on product development;

- Mechanisms for fostering independent (non-contract) research in the institutions which will move down the technology development continuum to the applied research and product development stages;

- Appropriate physical facilities and equipment for quality research covering all stages of R&D, including new and emerging commercial ventures; and

- Professional support for existing and proposed technology-based industries. This includes technical assistance, facilities and management services.

C. INFORMATION BASE

Information is a key ingredient in building technical capabilities. Without a steady flow of scientific and technical information from sources within and outside the region, existing technical capabilities will stagnate and quickly become obsolete. Without information about what others in the region are doing or planning, activities are uncoordinated, probably not mutually supportive and possibly contradictory.

In order to be effective, the information must have the following characteristics:

- Be accessible to all researchers in all sectors to enable them to do high quality work;

- Cover technical activities and assets, not only outside the region, but within the region as well; and

- Include that which planners and decision-makers in all sectors require to support effective proposals and evaluations.

D. HUMAN RESOURCE BASE

Technology development in any setting is critically dependent on a the availability of trained people with the skills, imagination, energy and willingness to create and manage the system. This requires the following conditions:

- A general educational level in the workforce high enough to allow workers to understand and apply basic principles of communication, science and mathematics;

- A critical number of trained technical personnel with both generic skills for technology-based employment and skills specific to the particular job they will be doing;

- Competent scientists with an appreciation for the importance of technology to economic development;

- A management cadre who have technical knowledge plus the managerial skills to get the most out of creative people and complex technologies; and

- Leadership which is aware of the importance technology, knows how to manage it and is willing to use it.

E. CAPITAL

The availability of capital at all stages of the R&D process, at reasonable cost, is a necessary condition for the growth and prosperity of the entrepreneurs and progressive industrial firms upon which economic growth depends.

In order for the capital institutions to be effective in supporting technology development, they must have:

- A good understanding of the nature of technology development and the role which capital plays in it;

- The ability to evaluate the viability of R&D investments in terms of technical feasibility, market potential and capabilities of the individual firms; and

- Adequate capital resources for support of technology enterprises, including seed capital at the conceptualization and applied research phases, capital during product development and pilot testing phases, and both secured and working capital in the production stages.

F. ATTITUDES

The attitudes of the major players in this process are an essential part of any technology development effort. This is one of the most difficult areas to evaluate and affect, particularly since the only useful performance measures are the actions of individuals and the results of those actions, rather than promises or rhetoric. Desirable attitudinal objectives include the following:

- Awareness at all stages of development that technology is an important driver of the economic development engine and that more effective use of technology requires positive actions by all collaborating organizations and institutions;

- Willingness by government to support technology development through assistance to and cooperation with the other sectors; and

- Willingness of financial institutions and other investors to risk assets on ideas which show promise for success, but which are untested.

G. SYSTEM IN WHICH MODEL FUNCTIONS

The six components of the technology development model, discussed above, suggest actions or dynamic forces which, when properly applied, can drive technology development in support of national or state goals. In any given situation these forces must act within a system which consists of organizations, institutions, individuals, policies and behaviors which mobilize and harness the forces

Figure II-2 graphically illustrates the relationship between the dynamic forces and the structural elements in a generalized environment within a democratic political system and a basically free enterprise economy. The four corners of the diamond are the structural components of the system -- industry, research and finance organizations, government and the public. The arrows between the components represent the forces and flows which generate technological and economic growth. These are the basic elements of the model -- technology, information, human resources and capital.

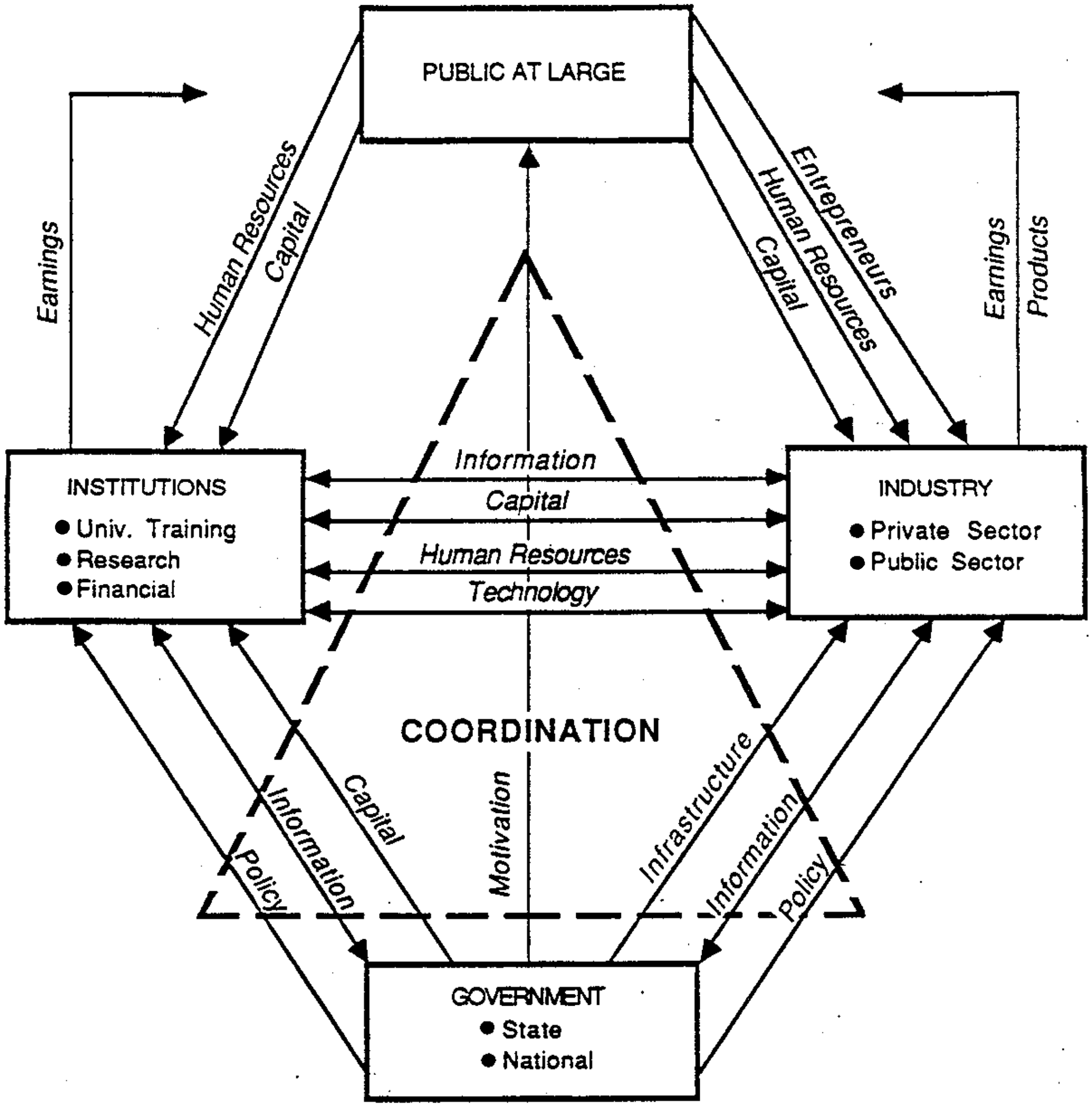

FIGURE II-2
SOCIETAL RELATIONSHIPS
CONCERNING TECHNOLOGY DEVELOPMENT

Overlaying the structure are the necessary leadership and coordination ingredients. These may be embedded in formal set of organizations and institutions or they may be exercised in a less structured way. Even with formal mechanisms, coordination will function differently between each set of actors. Between the government and industry their may be policies which are designed to generate investment and production decisions which are consistent with public goals. Between industry and research institutions the coordination will be less directed and based more on incentives. Between industry and the public the market will frame the responses. Coordination is an important component of most successful technology development efforts, but it cannot be overly directive, even in a relatively well planned economy. Instead, the coordinating bodies (individuals and organizations) should foster mutually beneficial relationships based on the appropriate role of each of the participants.

III. ASSESSMENT OF MODEL COMPONENTS IN KARNATAKA

INTRODUCTION

The institutions, resources, and general environmental support of technology development in Karnataka have been reviewed through various efforts in recent months, as part of the movement to enhance the technology development process. Two of these efforts were the studies and ensuing reports to USAID: Reconnaissance Survey in Bangalore; and Innovations in Industrial Development and Competitiveness at State and National Level, by Dr. Rao Associates (Hyderabad, January 1987). Another important effort in which these elements were reviewed was the Workshop on Technology Development, Finance and Human Resources in Karnataka (Bangalore, March 5-7, 1987). There were also a select number of interviews done by the Consultants, while in Bangalore for approximately two weeks in March.

While these reviews allow the Consultants to make some preliminary statements about the general strengths and deficiencies in the institutions, resources and environment, they are not comprehensive enough to draw more than general conclusions nor to recommend specific projects without further assessment. The findings of these reviews are summarized below. They are organized according to components of the model, as described in the previous chapter.

A. LEADERSHIP AND COORDINATION

Strong and capable leaders exist throughout Karnataka. They are able to "make things happen" in their fields -- locally, nationally and even internationally. However, since the concept of making a concerted regional effort in technology development is a new one in Karnataka, no leadership nor plan for that effort are yet in place.

Coordination, which goes hand-in-hand with leadership in this case, is also missing. Prior to the formation of the Coordinating Committee to plan and conduct the Workshop on technology development, there was little or informal coordination among the institutions and activities concerned with this process in Karnataka.

The Coordinating Committee, which, together with, AID, succeeded in bringing together leaders in government, industry, academia, banking and research, included senior officials from:

- o The Government of Karnataka
- o Karnataka State Financial Corporation (KSFC)
- o Karnataka State Industrial Investment and Development Corporation (KSIIDC)
- o Indian Institute of Sciences (IISc)
- o Confederation of Engineering Industries (CEI)

This Committee and the participants in the Workshop represent an excellent resource pool for establishing the leadership and coordination activity called for in the model.

B. TECHNOLOGY BASE

The second Rao Report (referred to above) catalogs many of the elements included in the technology base. It does not, however, cover the extent to which these elements exist in the private sector and it does not make a critical assessment of where the weaknesses are. Based on what we learned at the Workshop from knowledgeable people from Karnataka and elsewhere in the world and our own observations, interviews and discussions, however, we can make the following comments about the current technology base:

- o A remarkably large pool of technical facilities, trained personnel and scientific knowledge exists in Karnataka and is concentrated in the Bangalore area;

- o Key linkages, such as those between university and industry, are missing or not formalized;

- Basic research is carried out in laboratories and research institutes, but it is should be tied more closely to the needs of industry;

- Testing facilities, scaling-up laboratories and quality control capabilities are not available to the small and medium-scale industry sector;

- The capability to do market research on untested products or technology is not well developed; and

- National laboratories have very good facilities and capabilities, but many could do more to assist private industry.

C. INFORMATION BASE

The information base in Karnataka has several gaps and deficiencies:

- Access to existing information is limited. Researchers and businessmen who need information often find that it exists in Karnataka but they cannot get it;

- Information concerning technical activities and assets in the region is not centralized. This means that the synergism from all the activities in Karnataka is lost; and

- Information to support effective market studies and evaluations of new technologies is not available.

D. CAPITAL BASE

There does not seem to be a shortage of low-cost capital for new businesses. However, the mechanisms and incentives in place are not conducive to financing all the stages of technology development. The system is heavily skewed toward financing projects in proven markets.

Specifically, the gaps and deficiencies in this area appear to include the following:

- Capital for the commercialization of new projects based on technology that is untested in the market place (and is therefore high risk) is not available. This absence of venture capital acts as an impediment, particularly for small-scale industries;

- Capital for the development phase of new technology (i.e., after basic research and prior to commercialization) is not readily available;

- There is little or new incentive for an entrepreneur to invest his own capital in a high-risk new technology project;

- Financial institutions do not have the capability to evaluate projects in new technology areas (i.e. both technical and market assessments);

- Easy access to risk capital for projects in more traditional technologies and markets leads to a high failure rate; and

- Seed capital is needed for the conceptualization/applied research phase of technology development.

E. HUMAN RESOURCE BASE

The human resource base required for successful technology transfer consists of people with a wide variety of skills. It includes scientists, engineers, technicians, educators, businessmen, managers and many others. Karnataka is well known for having an unusually high percentage of professionals in these areas. Nevertheless, there are certain issues and weaknesses in this resource base that must be addressed. These include the following:

- There appears to be a need for trained technical personnel with both generic skills for technology-based employment and skills specific to particular jobs; and

- There is a shortage of persons with training in managing the R&D process and innovation.

F. ATTITUDES

The attitudes of the necessary participants in this process appear positive and the general environment in which to bring about the required changes is favorable. As evidenced by the enthusiasm in the planning and participation of the Workshop, there is a strong awareness of the importance of technology development and willingness to do something to encourage the process. Nevertheless, there are some issues that must be addressed:

- The current system of economic incentives and the lack of coordination of efforts leads to attitudes which, although positive, are counter productive. For example, entrepreneurs often choose to start a new business rather than expand their existing one. Entrepreneurs choose lower risk projects in traditional industries over high risk projects in new technology industries.

- Researchers conducting basic research have little interest in doing research related to specific industry problems.

IV. PROGRAM FOR STRENGTHENING TECHNOLOGY DEVELOPMENT IN KARNATAKA

INTRODUCTION

From the discussion above we see that the prerequisites for a potentially successful program -- aimed at strengthening technology development in Karnataka -- are in place:

- There is a concept, which relates technology development to national goals and which argues for a regional thrust in technology development. This concept has been tested in other parts of the world where results have been favorable. There is good reason to expect that the concept applies to India.

- There is a model, which identifies the components that are required for successful technology development -- whether national, regional, sectorwide, or company specific. In Karnataka these components exists to a sufficient extent to allow us to expect that a program, aimed, at correcting the principal deficiencies, would create the critical mass of activities which is essential to a self-sustained technology development process.

- An effort to create such a program has been started and has some momentum. This effort includes initiatives by CEI, the State Government of Karnataka, various government institutions in the State, and USAID. The recent Workshop in Bangalore gave the movement added momentum.

The program, described below, does not cover all the projects and actions that can or should be taken to enhance technology development in Karnataka. It does, however, describe and address important elements of that program. Creating the proper framework within which technology development will thrive is a long and continuous process.

Thus, some of the actions recommended below are in the form of studies or pre-project activities which will eventually lead to projects.

A. PROPOSED PROJECTS AND ACTIONS

1. Establish a Leadership and Coordinating Body

a. Create a Technology Development Board of Karnataka

The very first step in the program to enhance technology development in Karnataka should be to create the centralized leadership force that will take a broader view than any of the participants and see to it that the process works.

The Board should consist of a small group of leaders representing the private sector, the scientific community, the financial sector, academia and government. They should have influence at the highest levels of their fields and be able to "make things happen."

The Board should be independent and autonomous but it should be appointed by the Government of Karnataka.

Its agenda should consist of at least the following set of responsibilities:

- Prepare near-term (e.g. one year) and long-term (e.g. four to seven year) technology development plans for Karnataka. These plans should identify where the State wants to emphasize development, set targets, identify gaps that need to be filled and present action programs. The programs might include the projects and actions described below.

- See to it that the projects and actions identified below (i.e. Sections 2-6), if appropriate, are executed, either by the Board and its secretariat or by other appropriate agencies.

- Advise government, both State and National on policy matters that affect technology development.

- Promote Karnataka as he leading technology center in India.

- Carry on dialogue with foreign advisors and development agencies such as USAID.

b. <u>Appoint a Full-Time Secretariat to the Board</u>

To carry out its agenda, the Board will require a full-time secretariat. This body must be highly professional, energetic, imaginative and multidisciplined. At first, it may consist only of a director, one or two professional staff and some support staff.

The director should be equally at ease with senior people in industry, government, the scientific community and academia. Even if he is recruited from the public sector, he should not be employed in the role of director as a civil service employee. He and his staff should be good analysts and be able to draft material that can be presented to high level officials on behalf of the Board.

The tasks of the Secretariat should include at least the following:

- Carry out or supervise the assignments associated with the Board's agenda. Some of the Board's agenda items (for instance, some of the proposals listed in Sections 2-6, below) may require contracting with outside consultants. In these cases the Secretariat might be asked to draft the scope of work and supervise the contract.

- Familiarize themselves with the technology development model, as carried out in other parts of the world, and use this construct to identify additional projects and actions required in Karnataka.

- o Advise the Board on all matters concerning its responsibilities.

c. <u>Set up Advisory Committees for Priority Technology Sectors</u>

The third component of the central leadership and coordinating body is made up of Advisory Committees representing each of the priority technology sectors. The Workshop Coordinating Committee identified these sectors as: informatics, telecommunications, food technology, materials sciences and biotechnology.

Participants on each of the Advisory Committees should be drawn from among the sector leaders in industry, academia, scientific institutions and government. They should meet regularly to discuss opportunities, problems and issues concerning these sectors. In addition, they should plan periodic forums or workshops in which other people in the sector are invited to participate. It may also be desirable, on occasion, to invite international experts to attend the forums.

Specific tasks of the Advisory Committees should include:

- o Prepare plans for their sectors. During the Workshop, group discussions were held in each of the priority sectors and a number of issues and project proposals were prepared for each. These proposals need to be studied more carefully and refined before they can be turned into action programs.

- o Advise the Board on matters dealing with their sectors.

- o Coordinate appropriate sectorwide activities, including basic research, workshops, resource development and information development.

Figure IV-1 shows the recommended organization of the leadership and coordinating body.

END

OF

4 1

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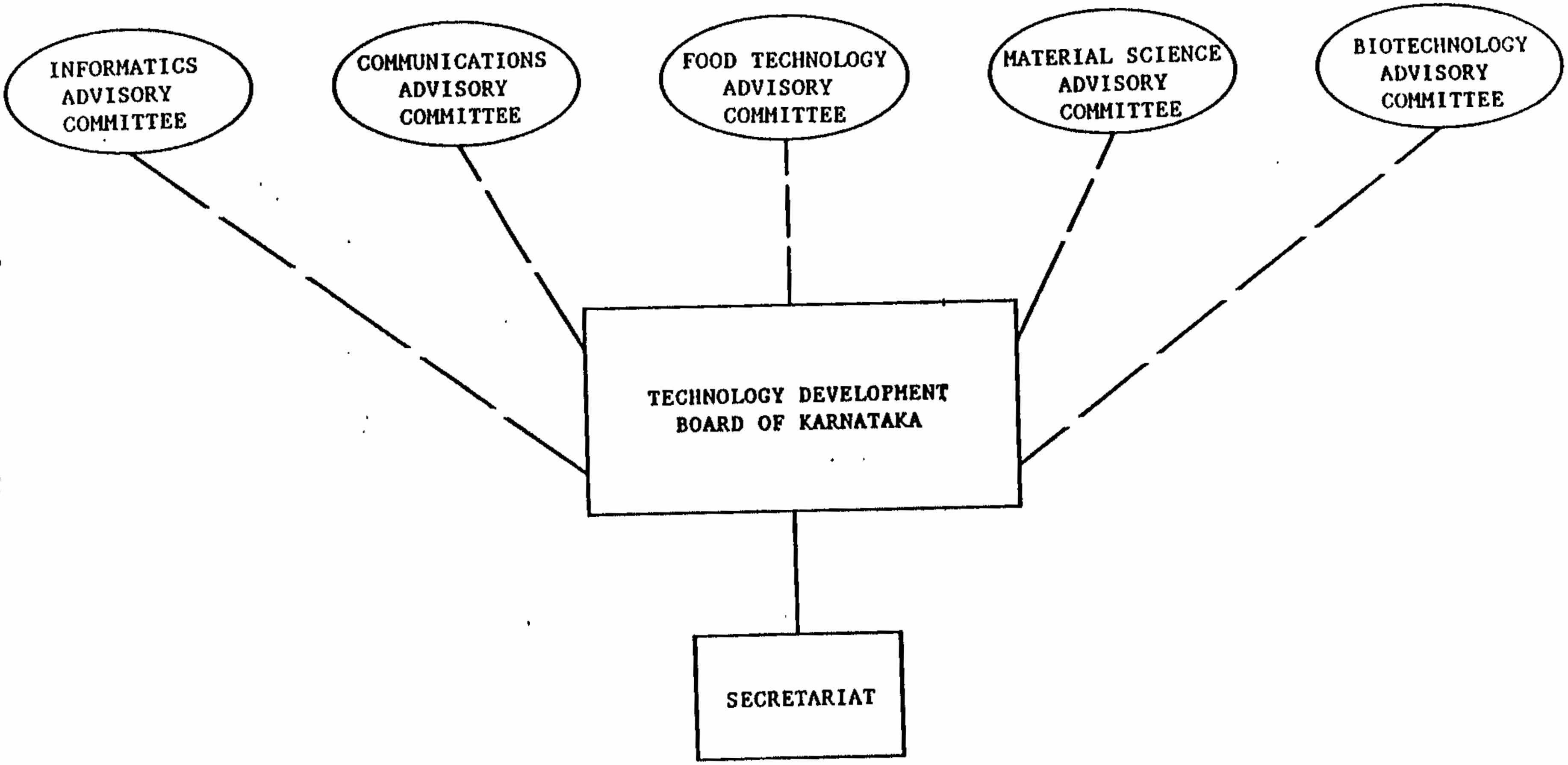

FIGURE IV - 1 ORGANIZATION OF LEADERSHIP/COORDINATING BODY

2. Strengthen Karnataka's Technology Base

a. Conduct Assessments of Technology Bases for Priority Technology Sectors

Assessments of the scientific and technical assets in the state for each of the priority technology sectors should be conducted in coordination with the Sector Advisory Committees, before any major projects are approved. These assessments should include: an inventory and evaluation of the facilities and technical capabilities available in each sector in Karnataka. The assessments should be based on relevant international standards in order to determine where Karnataka stands in relation to its competitors and to identify particular strengths and weaknesses. The assessments should be carried out by competent consultants or specialists in the sectors. The results should suggest directions for development and steps for filling gaps or correcting problems.

b. Support International Transfer of Knowledge

International transfer of knowledge through direct contact between Indians and foreign experts in their fields, is an important element in creating a stronger technical base. This can occur through several sets of activities. It is recommended that support for these activities be given, through the Board, in the form of assistance in identifying and arranging for such activities and funding, when appropriate. Examples of various types of proposed technical exchange efforts are listed below.

(1) Visits Overseas by Indians

Several situations have been found in which visits to the United States and elsewhere would be highly beneficial. Such visits would allow leaders involved in the process of technology development to experience directly what their counterparts, who have succeeded in creating high growth technology development centers elsewhere, have done. For example, the director of the Secretariat and members of the Board should visit comparable or related agencies in the United States, Korea and Taiwan; members of the Priority Technology Advisory Committees should visit relevant university-industry centers in the United States.

(2) Visits to Karnataka by Overseas Specialists

In addition to visits abroad by the Indian leaders, Karnataka could benefit from outside experts seeing the situation in Karnataka. This would also expose more people to the overseas experts than if the exchange takes place overseas.

Some examples might include: visiting lectureships and seminars at IISc and IIM on subjects vital to the process of technology development, e.g. Computer Aided Design and Manufacturing, managing R&D, and strategic planning; inviting Non-Resident Indians to visit Karnataka to provide their special insights in their fields, whether technical, managerial or entrepreneurial; visits to specific companies for periods of three to six months by retired U.S. executives (IESC) who have had successful careers in related technical development fields.

(3) Forums

Another useful dialogue could be fostered by specific seminars or workshops on particular sectors or problems. As suggested earlier, the priority technology Advisory Committees should arrange for such workshops periodically and invite international specialists to them.

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c. Expand University-Industry Linkages

Universities create new knowledge, much of which is of value to business. Mechanisms should be put in place to link universities and industry closer and to increase the flow of technology from research into the industrial sector. Some of the mechanisms which should be evaluated and considered are identified below.

(1) Joint Centers for Collaborative Research

There are at least two variations of these Centers:

- o National Science Foundation-type centers (U.S. model), in which industries with common research interests collectively fund research at a university with capabilities in those areas; and

- o University multi-disciplinary centers, which are problem-oriented rather than discipline-based.

(2) University-Industrial Liaison Programs

In these programs, industrial members may have wide or divergent research interests. Fees vary widely and might be in the range of Rs. 25,000 to Rs. 100,000 per year. Members attend seminars/briefings, have access to university faculty and graduate students, and may receive a few days free consulting.

(3) Matching Grant Program for Joint Research

Some states in the United States have created R&D funds which provide matching grants for industry-sponsored research at universities. These should be considered in Karnataka on a pilot basis. If the school can generate industrial support for a project at or above a certain level, the fund will provide some matching amount, generally up to 50 percent. The grants should be awarded on a competitive basis with evaluation by a joint committee with established, documented criteria for making choices among applicants.

(4) Contract Research

In the United States, the primary interaction between industry and the research institutions is through contract research. Contracts between industry and a particular individual or group of researchers are usually aimed at specific industry needs, but they can also give the firm a look at generic research which can then be used in product development by the contracting industry. Contract research can be increased by university policies which promote it and by more contacts between faculty and private firms at seminars and conferences. The proposal by several computer companies in Bangalore to jointly contract with IISc for research on a common standard for computer communication is a good example of a useful collaboration of this kind.

d. Support Private Sector Initiatives to Develop Technical Support Services

Industry, particularly small industry, frequently does not have sufficient capital or other resources to provide internal technical, professional, and management support functions. These include such essentials as data resources, computing capability, accounting and financial systems, legal help, testing facilities, and general management assistance.

In the United States and other industrialized countries, these support functions are usually provided by a variety of for-profit institutions or, in the case of small emerging businesses, by a limited number of public or quasi-public (public university) supported organizations. The private for-profit enterprises include technical consulting firms, applied research laboratories, management consultants, data processing companies, testing laboratories, business service organizations, and, of course, attorneys and accountants.

Some of these services are well developed in India, while others, particularly those which provide technical services, are less available. In Karnataka, many small businessmen have difficulty finding testing support and technology evaluation expertise. They also do not have the economies of scale to justify major expenditures in computers or even business systems. In at least one case, they have formed an association and propose to create a collaborative support service with its own facility and staff to fill this need. The Board should assist these groups in funding expertise and/or financial support for developing testing and other joint services.

e. Strengthen Industry Support Services at Existing Research Institutions

(1) University Consultancy

Research institutions in Karnataka presently have a variety of ways, other than formal research programs, in which they support technology-based industries. One method is to provide a window into the university through which industry scientists or managers can learn more about the type and location of expertise at the institution, and can identify individuals or groups who have the ability and inclination to work on their problems.

An example is the Consultancy Center at IISc, which acts as a link between companies with a problem or technical issue and the relevant technical talent on the faculty. Other universities have similar, although less well organized, mechanisms. While the institutions feel that they are serving industry well, industrial clients complain that response time by faculty is often slow and that the process lacks a sense of urgency and priority.

The industry service concept is most effective if the university commits adequate resources to it, is more aggressive in seeking industrial clients, and promotes more and better connections between industry and the university. Such a program should include full-time staff for industry relations, a database on university scientific and technical activities, and seminars/workshops. These actions can be accomplished without violating the basic purpose of the university or the intellectual freedom of the faculty, both of which are important concerns.

(2) <u>Technical Outreach Or Extension Service</u>

Universities and/or government agencies in a number of states in the United States have created technology extension services modeled on the agricultural extension service. These organizations are staffed with technically qualified individuals and serve as information gathering and problem solving centers for business, primarily small to medium-size firms. They are usually governed by a board drawn from industry and provide services ranging from a search of the technical literature to direct consultation on the factory floor. Examples in the United States include the Pennsylvania Technical Assistance Program (PENNTAP) and the Ohio Technology Transfer Program (OTTO).

f. <u>Encourage Universities to Engage in Applied Research and to Promote Faculty Entrepreneurship</u>

The Board should work with university presidents and research directors to explore internal policies which may adversely affect commercialization of research and innovative ideas. Proper university policies and procedures can move new ideas toward commercialization by motivating and supporting faculty who want to develop these ideas further. Programs which support faculty entrepreneurship include those which assist in patents and licensing, share royalties with faculty, give tenure and promotion credit for applied research and innovation, and give the researcher some share of ownership in intellectual properties which he helped create.

University personnel should visit universities in other countries where applied research and industrial consultancy are well supported.

g. Study the Feasibility of Several Major Facilities-Based Projects

Within a two-three year time frame, the Karnataka leadership could develop one or more major initiatives to support expansion of the state's technology base. Any of these efforts might require a large commitment of time, funds and personnel to start and to operate. Consequently, we recommend that the Board analyze the feasibility and desirability of these proposals prior to including of them in any action plan.

The analysis should be conducted under the auspices of the Board, although the amount of work required is substantial and would probably require the assistance of outside experts. The analysis should focus on three aspects of each concept: the technical and organizational feasibility, including some measure of need; the costs and benefits of such an initiative; and a general business plan. Some possible projects include:

(1) Technology Development Centers (TDC)

This concept has not been widely applied in the United States, but there are several examples in the United Kingdom and Europe. Most often, a TDC is an organization whose major function is to do applied research and product development based on the concepts developed elsewhere. The TDC usually has a facility with laboratories and qualified technical staff. It may also provide some follow-on services in product feasibility, market testing and final product design. TDCs may be affiliated with a university or consortium of universities, or they may be established by state or local governments. They differ from the technical consultants in that they are generally not-for-profit and do not have functions unrelated to technology-based

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research and development. The TDC model is evolving, but there are some road blocks to a cost-effective concept at this time, and it, therefore, should be closely examined before proceeding.

(2) <u>Science Parks and Incubators</u>

A number of science, research or technology parks have been established at or near universities and other research institutions in the more industrialized countries. Some of these parks are simply real estate projects, while others include infrastructure, support services and incubator facilities. In general, they have proved attractive to technology-based enterprises, since they provide a community of like interests; they often provide access to a university, and, in the case of incubators, they can provide shelter for new/emerging industries which could not easily survive under open market conditions.

The cost of establishing a science park is high, as they require ongoing provision of the services. Also, there is often a false presumption by tenants that they will have ready access to university personnel and facilities. Nevertheless, if properly organized, promoted and managed, science parks can be effective magnets for new or expanding firms in technology-based industries.

h. <u>Encourage In-House Research in Industry</u>

In the United States, the bulk of research and development occurs not in universities and other research centers, but in industrial laboratories. In India, as noted earlier, there are economic disincentives to innovation and, consequently, industrial research is not a major activity -- despite the support and incentives introduced through tax policy and subsidized services.

Industrial collaboration on non-proprietary research of mutual interest offers one possibility for increased activity. The Microelectronics and Computer Technology Corporation at Austin, Texas is a model for such an effort. There, a number of firms have formed a joint venture to develop improved microprocessors and other devices common to computers and other electronic products. The collaboration gives each member a much larger research program than any one of them could afford alone.

This model might work well in India's present economic structure, since the elements of competition are not as great a concern. BHEL, for example, is creating an enhanced R&D capability at its Electro-Porcelain Division with a focus on ceramics. The Board might consider initiating discussions with BHEL and other firms with materials interests to explore the possibility of a membership-based cooperative effort using the new facility as a nucleus. The center could become a model for collaborations in other industries and other locations. Assistance with the organization and development of the research program might be available from U.S. participants in similar ventures.

i. <u>Encourage Transfer of Technology from National Laboratories to Industry</u>

The national laboratories in India are substantial research organizations with well qualified scientists and excellent facilities. In the last five years, the United States has developed a program for identifying and transferring technology from the extensive federal laboratory system to the commercial sector. In India, ISRO has in place a strong technology transfer component with good ties to industry. This could be a model for further activity.

In support of this, the Board could take the initiative to:

- Organize and support a consortium of national laboratories in Karnataka for cooperation in technology transfer;

- Encourage ISRO to conduct training sessions for technology transfer/industry support agents at other laboratories; and

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- Invite and encourage national laboratories to participate in joint seminars, workshops and forums, and, where possible, to join in university-industry research efforts.

3. <u>Build Up the Science and Technology Information Base</u>

a. <u>Conduct An Inventory of All Data Resources in the State</u>

This would be a beginning for an information center which could direct inquiries for data to the appropriate library or other collection points in the state. The inventory should be done by people with technical library skills and expertise in some of the major scientific disciplines. In part, this inventory could be tied in with the assessment of the high priority sectors suggested in Section 2-a, above.

b. <u>Collect and Disseminate Information on Technical Activities in Karnataka</u>

The Board should oversee the development of a database on all science and technical activities in the state. This would be an ongoing effort which can be built incrementally as resources to gather the information are developed.

c. <u>Establish a Central Information Clearinghouse</u>

The clearinghouse would serve a number of functions, including housing and maintaining the inventory developed above, brokering information services, and overseeing the development of data about technical activities in Karnataka.

4. Broaden the Scope of Karnataka's Capital Base

a. Support Financial Institutions in Funding New Technology

As efforts by the Government of India to build a source of venture capital move ahead, there will be increasing need to strengthen the capabilities of financial institutions to evaluate R&D projects.

KSFC, for example, is planning to begin financing R&D projects. However, they feel unable to perform an adequate appraisal of such projects. In order to assist them and other financial institutions, a program should be set up to train loan officers to appraise R&D projects.

Specifically, at KFSC about ten loan officers would require such training. The requirements of other institutions in Karnataka would also have to be determined. In conjunction with training courses, field visits to appropriate financial institutions in the United States and elsewhere might also be considered.

The financial institutions might also require support in the form of access to R&D testing facilities and information centers.

b. Consider a PACT Window for Karnataka

Initially, USAID could undertake a program to promote PACT (and other USAID technology programs) in Karnataka. If sufficient demand resulted, a PACT window could be opened in Bangalore. It would have the capacity to do initial review of proposals and provide counseling for applicants. It might be operated by KFSC under a delegation from ICICI, and could be supported by earmarking some part of the present PACT funds for Karnataka, or by obligating additional funds specifically for this purpose.

c. Funding for Product Development

The funding spectrum from pure research to commercial production can, somewhat simplistically, be divided into three stages. The first stage is funding for research to prove the feasibility of a technical concept. Major funding is available for this purpose in India, although it is heavily, perhaps too heavily, concentrated in government laboratories. There is also substantial credit available, through development and commercial banks, for production investments, although the ability of the system to support high risk investments remains to be tested. Additional sources of venture capital for this purpose may need to be developed.

Some financial institutions are considering opening loan windows for new product development, but at present these loans place all the risk on the entrepreneur and will probably have limited appeal. The PACT project attempts to fill this gap for U.S.-India joint ventures by providing grants where repayment is conditioned on success. But there is a limit to the opportunities for joint ventures, and there is a clear need for a similar funding mechanism to support product development by wholly Indian ventures.

5. Enhance the Human Resource Base in Karnataka

a. Assess the Human Resource Development Capabilities in Karnataka

Karnataka has a strong human resource base, including a large skilled-labor work force and effective training/educational institutions. In order to utilize those resources effectively in expanding the technical base, it is necessary to determine where the capabilities for providing human resources are strongest, and where they need improvement. The Board, with assistance from outside experts, should undertake such an assessment before deciding on what needs to be done. In conjunction with the assessment, a survey of industry leaders should be conducted to determine which human resource areas are most critical.

b. Provide Good Management for Technological Change

A trained work force is only as good as its management. Technology development requires managers who know science and technology, understand its applications in industry, will use technology to improve their competitive position, can manage creative people, and know how to innovate.

The development of such people requires strong pre-service and continuing education programs, emphasizing basic technology management and the new concepts like technology forecasting, strategic management of technology, and evaluation of new technologies. These subjects should be taught on graduate level programs with faculty who have both academic and hands-on experience. A two-week seminar on some of these topics is planned at the IIM of Bangalore for April, 1987. This program should be an intensive experience for managers who are currently involved in technology companies, or who plan to be in the near future. Ultimately, the course should probably be somewhat longer and include several faculty with complementary skills and experience.

c. Encourage the Private Sector to Establish Industry-Based Training Programs and Facilities

Training is a function of the technical training institutes, but much of it is job-specific and can best be performed by a company or a group of companies in a cooperative venture. In-house training programs have already been established by a number of large and medium-sized companies in Bangalore, e.g., BHEL and Amalgamated. The Board should build on this base by organizing and supporting links between training institutes and industry for on-site worker training.

They should also consider a public fund which could provide matching grants to industry for such training.

d. Make the Educational Program in the Technical Schools and Institutes Relevant to Current Industry Needs

While technical schools cannot be at the leading edge of technology in every area, institutions must graduate students who are conversant with the needs of industry and who can be of use in the shop and factory. This requires instructors, who have regular contact with the industries where their students are most likely to be employed, and some testing of programs and curricula by industrial managers and supervisors.

One method which has proved effective elsewhere is to tie industry more closely to the technical institution through advisory or visiting committees which review or even approve curricula, inspect facilities and courses periodically and generally assist the school in keeping current.

6. Encourage Attitudes Which are Supportive of Technology Development Throughout Karnataka

Finally, it is important that all elements of this program give explicit attention to the attitudinal environment. Many of the proposals put forth above will, if implemented, help to strengthen and sustain the positive attitudes that already exist in Karnataka.

B. RELATION BETWEEN DEFICIENCIES AND PROGRAM ELEMENTS

Chapter II prescribed certain preconditions necessary for the model for achieving faster technology development to work. In Chapter III, we gave a general evaluation of Karnataka, according to these preconditions. The program projects and actions, just described, address themselves to the deficiencies, as summarized in Figure IV-2.

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1
- o Visits abroad
- o Visits to Karnataka
- o Forums

2
- o U-I Joint Centers
- o U-I liaison programs
- o Grants for joint research
- o Contract research

3
- o Testing facilities
- o Databases
- o Management services

4
- o Technology Development Centers
- o Science parks
- o Incubators

FIGURE IV-2

DEFICIENCIES AND PROPOSED PROGRAM

AREAS IN NEED OF STRENGTHENING / ACTIONS OR PROJECTS	Tech. Developm. Board	Secretariat	Sector Adv. Committees	Priority sector assessm.	Int'l. transfer of knowledge[1]	University-industry linkages[2]	Private sector initiatives[3]	Services in institutions	Applied R&D at univ.	Special projects[4]	In-house industry research	Tech from national labs	Central info. clearinghouse	Karnataka tech. database	Info dissemination	Institutional support	Indigenous PACT-type progs.	Funding for product develop.	"Mgmt. of Technology" courses	R&D management trng program	Industry tech. training centers
Leadership/Coordination																					
Coordination of leaders	X	X	X																		
Ongoing coordinating mechanisms	X	X	X																		
Focus and plans	X	X	X																		
Advocacy and dialogue	X	X	X		X	X															
Technology Base																					
Linkages between industry and research institutes	X	X	X	X	X	X	X		X		X	X									
Capacity and willingness to do in-house research in industry			X			X	X				X						X	X			
Mechanisms for conducting independent research	X	X	X			X	X		X		X										
Facilities for applied R&D			X	X			X		X	X	X	X								X	
Support services for technology-based industries	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X	X		
Facilities for small scale industry testing				X			X	X		X											
Information Base																					
Accessibility	X	X											X	X	X						
Coverage of local activities	X	X	X	X	X				X				X	X	X						
Evaluation of new technology					X			X					X	X	X					X	
Capital Base																					
Capital for all phases of R&D	X	X							X							X	X	X			
Ability to evaluate R&D new tech					X			X					X	X	X	X	X		X	X	
Human Resource Base																					
Adequate technical base	X	X	X	X	X				X			X					X			X	X
Appropriate management	X	X			X			X											X	X	X

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V. A POTENTIAL ACTION PROGRAM FOR AID

INTRODUCTION

AID has taken an active interest in technology development and enterprise in India with the PACT and PACER programs, followed by the recent workshop in Bangalore. The success of these actions has presented AID with the opportunity to participate in, and have an impact on, an important part of India's new economic challenge. In finding an appropriate role for itself in this process, AID should:

- Find immediate ways to support the process in Karnataka;
- Develop longer term projects or activities which will systematically continue that support; and
- Work with the Karnataka leadership without co-opting or preempting their initiative and control.

A. PROJECT CRITERIA

To support technology development in Karnataka, AID should look for opportunities where its contribution can have maximum impact by leveraging other local and national resources. Activities should meet the following criteria:

- Be part of, or consonant with, a locally agreed upon technical development strategy or plan;
- Be technically sound in terms of experience in the United States and elsewhere in area technology development, e.g., the model described in Section II above;
- Contain the maximum local management and control;

- Be developed primarily in areas where the United States has particular experience or expertise;

- Be activities where USAID's support is essential or important to the activity's success;

- Be sustainable, either from internal revenues, or committed local support (U.S. training or observation tours and consultant visits would be an exception to this);

- Take maximum advantage of existing USAID projects and technical development activities; and

- Be manageable in terms of the Mission's limited staff resources.

B. POTENTIAL PROJECT ACTIVITIES

1. A Process And A Project

The Karnataka seminar has launched what promises to be a growing, evolutionary process. What is needed is a parallel USAID process that supports, stimulates, and draws on the process in Karnataka. The ultimate objective of the USAID process is to develop a finite USAID State Technology Development and Enterprise project for Karnataka. In the short term, USAID activities should be designed to maintain the momentum in Karnataka and to provide the basis for a more formal project development process.

Project development -- going from a PID to a Project Paper -- will be the next stage, and it should begin as soon as possible. The process should include more support activities than would normally be a part of project development, and if the Karnataka effort proceeds as well as expected, it is difficult to see how USAID can provide adequate support over a longer period through ad hoc arrangements. One alternative for funding short term pre-project activities could be a grant to the Technology Development Board, based on a set of objectives which the Board expects to achieve through as yet undefined actions.

2. Possible Short Term Activities

We have identified a series of short term (i.e, over the next 12 months) activities to maintain the momentum, to support the components of the technical development process in Karnataka, and to provide the basis for project development. These activities are as follows:

a. Provide Support for the Proposed Technology Development Board and its Secretariat

As the apex institution for technology development in Karnataka, the Board will be the first step in the process. It will be supported by a small (probably two or three person) Secretariat. But the Board will be responsible for initiating, stimulating, coordinating or carrying out all of the activities essential to achieving a critical mass for technical development. The secretariat will need additional resources to accomplish these tasks.

Possible USAID support for the Board and Secretariat could include:

- Observation tours for the Board and Secretariat to observe successful state or area technology development programs in the United States.

- Deputation to the Secretariat, for one or two years, of a young American with experience in technology development programs in the United States. This individual should not be on the level of an advisor to the Secretary, but rather someone who will serve as, and will be perceived as, a member of the Secretary's staff.

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- Consultancy services, U.S. and Indian, to: assist in the preparation of near-term and long-term technology development plans for Karnataka; prepare feasibility studies for potential projects, such as a Technology Development Center, a science park, and an incubator facility; conduct an assessment and inventory of technical data sources in Karnataka; and conduct other studies.

- Interim direct support for the Secretariat if local sources are inadequate.

b. <u>Support for the Sector Advisory Committees</u>

These committees will be vital elements in the technology development process in Karnataka. They will have a substantial workload and no full-time staff resources. Possible USAID support for the committees could include:

- Observation tours similar to these above, but geared to the technical field of each committee -- e.g., informatics.

- Consultancy services, U.S. and Indian, to: assist in the development of sector technological development plans; conduct an assessment of the technology base in each sector; and conduct other studies and analyses.

- Follow-on seminars in three to six months. These would be training cum working seminars in each sector and would require the participation of a U.S. expert (or experts) in the respective technical field.

c. <u>Short Term Training for KSFC Staff</u>

This training would help prepare a nucleus KSFC staff to manage a new R&D loan window. It would include training in such areas as the analysis of high risk investments and review of technical feasibility

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proposals. The Mission is already exploring possible avenues for such training.

d. Support for a Testing Center at Peenya Industrial Park

Peenya is the largest industrial park in India, with some 1200 small and medium-scale businesses. These entrepreneurs have established and registered the Indian Institute of Small Business Management, an organization intended to develop common services which are beyond the means of any one business. They have begun a technical library and arranged their first management course. They are currently conducting a survey to identify the testing needs of members to enable them to maintain high quality control. The intent is to build and equip a common testing facility. USAID support for the effort could include:

- o Consulting assistance (probably Indian) to translate the survey-determined requirements into the configuration, equipment and staff requirements of a common testing facility; and

- o Funds for the import of testing equipment not produced in India.

e. Emphasize Existing USAID Projects

A quick, and relatively inexpensive way to begin now to stimulate technology development in Karnataka would be to try to increase the use of available USAID projects, such as PACT, PACER, the International Executive Service Corps, and the pending CEI/Batelle collaboration. This could be done by contracting with a local firm to establish an office or store-front reference center to provide information on these projects -- what they offer, whom to contact, how to apply, etc. The contractor would also be charged with publicizing the projects widely among the business community in Karnataka.

f. Build an Information Base

The following activities will assist Karnataka in creating a technical information resource available to all interested parties:

- Provide support for the technical information clearing house. This activity was identified as a high priority by the recent Bangalore Workshop;

- Establish a grant fund and rapid procurement mechanism to secure technical information from abroad; and

- Offer grants to procure specialized data bases relevant to the priority sectors. These could be dispersed to appropriate locations based on their technical interests and expertise.

3. Possible Longer Term Activities

Possible longer term activities are ones which could potentially form part of a larger full State Technology Development and Enterprise project. Development of these potential activities should not begin until after the proposed technology development plan for Karnataka is prepared, in order to ensure that they will be consonant with it.

a. Possible Project Development Activities

These are activities, for which there is sufficient need apparent now to warrant beginning project development or pre-development work, include:

- Begin discussions with a potential grantee. KSFC is a leading candidate. It is in the government budget, has aggressive modernist leadership, and is very interested in performing this role.

- Set up a grant fund for contract research for small and medium-scale business. Patterned after the U.S. small business R&D grant program, this fund would make small (up to say $10,000) grants to enable small and medium-scale private firms to contract with a university or research laboratory to determine the feasibility of a potentially commercially exploitable technical concept. It would enable small entrepreneurs to accomplish research they could not do themselves, stimulating industry interest in research and development and helping forge industry -- university or laboratory links.

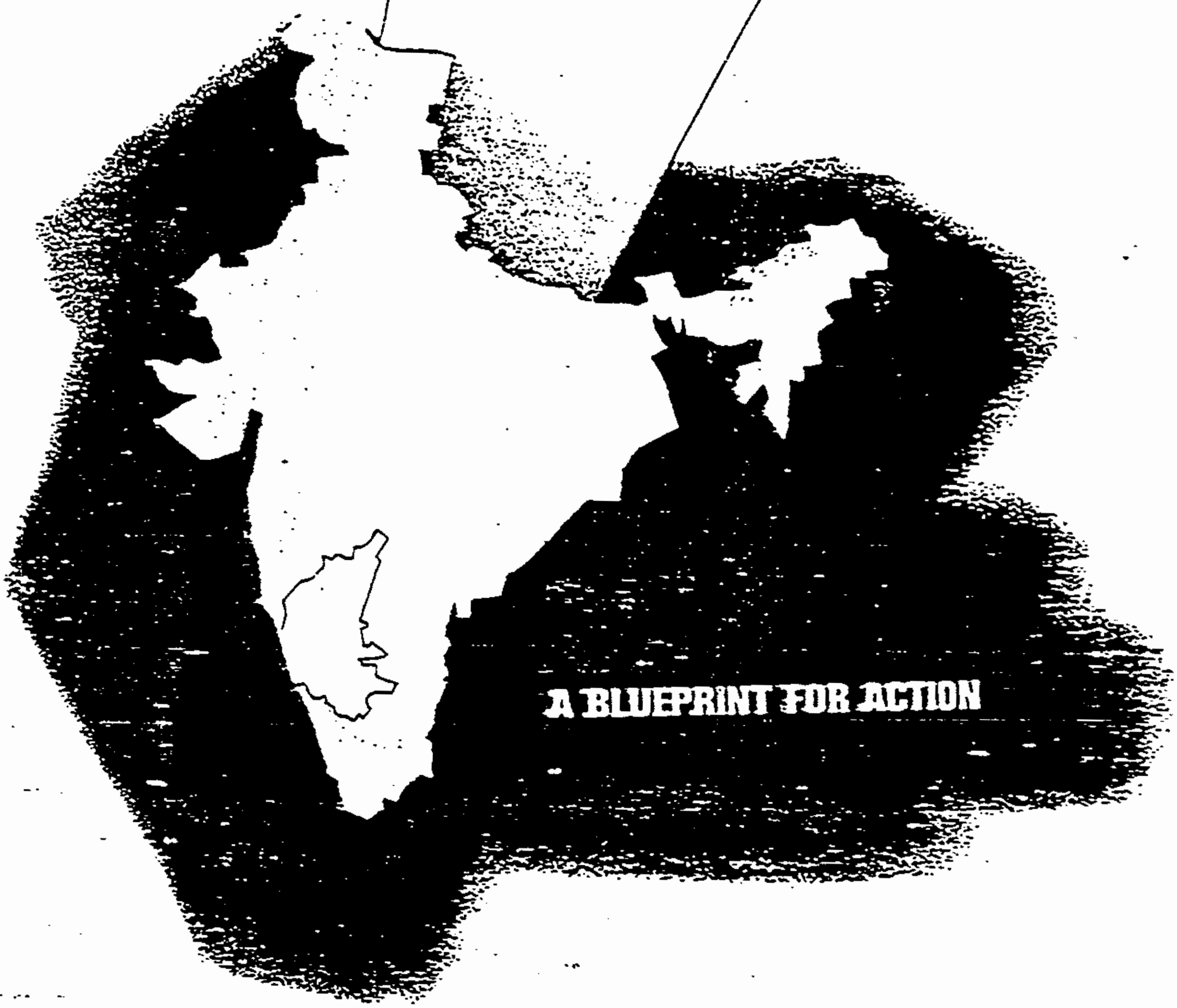
- Set up a PACT-type program to support research and development by small and medium-scale enterprises in Karnataka. It would be modelled directly on PACT, except for PACT's joint venture requirement. Like PACT, it would provide conditional grants for work at the development end of the R&D spectrum by private small and medium-scale firms. On a cost sharing basis, grants of up to $250,000 would fund work from the technical feasibility stage up to pilot scale production, including such activities as prototype development and market testing.

b. <u>Other Potential Areas for Long Term USAID Support</u>

Almost any one of the recommended projects and actions discussed in Section IV.A, above, may create a need or opportunity for USAID assistance. For example, the development of an effective Technology Management program might require the services of consultants experienced in designing and running such programs. There is substantial U.S. experience in this field and a relative absence of Indian expertise. However, it is not meaningful to speculate at this time as to when any of these projects and actions will mature, and which will be appropriate for AID assistance. USAID should continue the dialogue with the Karnataka leadership so that together they can identify which projects are consistent with the programs of Karnataka, India and AID.

ANNEX "P"

KARNATAKA
IN TRANSFORMATION



A BLUEPRINT FOR ACTION

Discussion Draft

SRI International

Prepared for:

U.S. Agency for International Development
New Delhi, India

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KARNATAKA IN TRANSFORMATION

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November 1987

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New Delhi, India

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ABOUT THIS REPORT

The state of Karnataka has been pursuing programs and policies to support the development and enhancement of industry, particularly those industries active in the technology product markets. Both public and private actors in Karnataka have taken a role in promoting technology development in the state. The U.S. Agency for International Development (USAID) has joined in supporting Karnataka's goal of technology development. Among other activities, USAID supported a recent workshop, "Technology Development, Finance, and Human Resources in Karnataka," held in Bangalore in March 1987.

This study, also funded by USAID, is designed to build on the process begun at the workshop. This report assesses the match between Karnataka's current policies, programs, and institutional capabilities for technology development and the changing needs of the state's existing and emerging industries. This study examines the existing capacity and adaptability of Karnataka's economic infrastructure to meet the needs and changing dynamics of the state's industrial base.

The focus of the study is specifically on the technological, human resource, and financial needs of Karnataka's industries. Although the constraints of Karnataka's physical infrastructure, especially the shortage of electrical power, are recognized, this report does not explicitly address these problems because USAID has funded another study for this purpose.

The study is designed to bring to Karnataka SRI's experience in:

- Developing a framework for understanding the important new elements that make up the economic infrastructure.
- Assessing industry dynamics and their requirements for the new and changing economic infrastructure.
- Evaluating the public and private economic infrastructure that supports the development and adaptation of enterprise.
- Development of new public policies and public-private initiatives to improve the responsiveness of the economic infrastructure to the needs of emerging, expanding, and transforming enterprise.

An Executive Summary has been prepared, drawing together key points in the report for the reader desiring a quick review. Following the summary are five sections. The first describes the analytical framework used to analyze Karnataka's industrial sectors and to assess the state's economic infrastructure. Section II carefully examines the changing dynamics and needs of Karnataka's emerging, expanding, and transforming industries. For each, the needs for technology, human resources, and financial capital are assessed. Section III analyzes Karnataka's economic infrastructure and assesses the strengths and weaknesses of its technology, human resource, and financial infrastructures in responding to industry needs. Appropriate examples drawing from U.S. experience and innovation that apply to Karnataka's economic infrastructure are also examined. Section IV develops a "Blueprint for Action" recommending specific actions to enhance the state's economic infrastructure within specific time frames. Finally, Section V presents a detailed work program for beginning the implementation of high-priority Blueprint elements.

With this report, key participants in the development of Karnataka have, at a minimum, a point of departure for a wide-ranging discussion on priorities for the state, but also a detailed blueprint for launching a systematic program to put Karnataka on India's new industrial frontier.

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EXECUTIVE SUMMARY

Karnataka at the Crossroads

India, since independence, has become a major force in the world economy. In recent years India has established itself particularly as an emerging world leader in science and technology. Through the application of science and technology, both developed locally and transferred from abroad, the nation has taken steps toward building the economic capacity needed to become a major world force in industrial technology and innovation.

The state of Karnataka, and Bangalore in particular, has emerged as one of the most important centers of technology-driven enterprise in the country. The concentration of higher education institutions, national research laboratories, technical centers, public initiatives for high-technology utilization, and technological talent have led many to suggest that Bangalore is the "Silicon Valley" of India.

However, despite the existing concentration of technology-related activities, this report concludes that much remains to be done to enhance Karnataka's capacity for technology-driven development. Not only does Karnataka's existing technology network need to be made to work better, new economic foundations—in technology, human resources, and finance—are needed to strengthen Karnataka's existing and emerging industries. The main report presents in detail SRI's recommendations of specific steps required to enhance Karnataka's new economic foundations. The highest-priority recommendation for immediate action is development of a technology infrastructure that responds to the increasingly market-driven R&D needs of Karnataka's industry. Two high-priority actions are recommended to accomplish this goal:

- Create an applied research and development center that directly responds to the technology needs of industry in Karnataka.
- Develop a buyer–supplier development initiative that focuses on the technology and human resource needs of Karnataka's emerging new industries.

The need for concerted, strategic action is at hand. If efforts are not mobilized, Karnataka's development could remain slowed by a lagging physical infrastructure, a technology and educational network not especially responsive to industrial needs, an oppressive bureaucracy, and a regulatory environment that stifles indigenous industrial innovation. On the other hand, Karnataka is at the threshold of a new era of technology-driven industrialization and could help lead India into the new global economy.

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Karnataka's Industries and Their Needs

Karnataka today is one of the foremost industrial states in India. It has a broad range of industries, from steel to software and telecommunications. The state is well endowed with natural resources and has an extensive infrastructure of public and private educational and research institutions. However, Karnataka's companies, like many others in India, have for a long time been sheltered from international competition and have rarely competed in global markets. Today, Karnataka's companies are not only experiencing greater competition from overseas but many of those in newer industry sectors, such as software, have to expand overseas in order to grow. It is clear that Karnataka's industries have to become internationally competitive to succeed in the long run and bring greater prosperity to the state.

The needs of Karnataka's companies in three critical areas of the state's "economic infrastructure"—technology, human resources, and capital—vary depending on a particular industry's stage of development. Industries from all three stages of the "industrial life cycle"—emerging, expanding, and transforming—are currently represented in Karnataka.

Companies in emerging sectors need resources to conduct R&D and bring new technologies to market; they require access to risk capital and entrepreneurial management skills. Expanding-sector firms need access to management and engineering talent as well as financial capital to adapt their operations for the mass market and large-scale production. The infrastructural needs of companies in transforming sectors, in turn, center around availability of technological, financial, and human resources to change to new markets or production methods.

Emerging-Sector Industries and Their Needs

Emerging industries typically enjoy a high degree of technological innovation and change. These companies work in new technological areas, and their ability to develop new products, come up with next generations of products, and successfully commercialize the results of R&D are vital to their success. They require access to state-of-the-art laboratory equipment, instruments, and design and testing facilities in order to support their R&D efforts.

In Karnataka, as in the United States, emerging industries are represented by small entrepreneurial start-up companies (e.g., Biocon) as well as by divisions or groups of larger diversified companies (e.g., Kirloskar Computer Services Ltd.). The emerging sector includes the following industries, among others:

- Software
- Telecommunications
- Computers
- Biotechnology.

Since these companies are heavily technology driven, their infrastructural requirements center around the availability of resources to perform R&D and transfer the results of R&D into commercializable products.

In the area of technology, this sector especially needs medium-term, problem-focused, product-development-oriented

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research. Such research typically focuses on technical issues that are narrower and more practical that national laboratories are used to doing. A software company, for example, might need research on artificial intelligence applications to industrial processes. An electronics firm might need research on very large scale integrated circuits or microprocessor architecture for computer workstations. A biotechnology company (typically a subsidiary of a pharmaceutical or chemical firm) may need research on fermentation technology for specific chemical production, or on monoclonal antibodies and DNA probes for medical diagnostic applications.

In the area of human resources, emerging industries in Karnataka require a combination of entrepreneurial, technical, and management skills allowing them not only to take necessary risks and stay on the leading edge of technology, but also to tailor their research to market needs. Companies in emerging industries require flexibility from their personnel to be able to respond to frequent technology and market changes. Flexibility on the part of the company and its personnel is probably one of the key factors for these companies' success.

Capital for financing R&D, especially in the early stages of product development, is critical to success in emerging sectors. Karnataka's smaller start-up companies need better access to such venture and risk financing. Provision of risk capital, however, should be combined with management support. It is also necessary to create better mechanisms for funding and writing off R&D expenditures of emerging companies (R&D limited partnerships, corporate investments, etc.).

Expanding-Sector Industries and Their Needs

In expanding industries, product categories and markets are well established, products are standardized and can be manufactured in large volumes, and there are many well-established competitors in the market. Competition in expanding sectors centers around companies' ability to grow with the market – i.e., preserve their market share, expand their product lines, and introduce new products and next generations of existing products. The need to grow often takes companies into international markets, and it is at this stage that many companies establish international operations.

Whereas manufacturing and marketing are of marginal importance in emerging sectors, in expanding sectors these two functions assume primary importance. Because the volume of production is larger and products are standardized, companies begin to differentiate products on the basis of cost and quality. The better and the more efficient are the company's manufacturing and production facilities, the lower are its costs per unit. Thus, companies in expanding sectors need to invest in the latest manufacturing technologies (computer-integrated manufacturing, robotics, etc.).

Among the major industries of the expanding sector in Karnataka are the following:

- Pharmaceuticals
- Automotives
- Electrical equipment
- Processed foods.

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The infrastructural needs of these companies center around the availability of resources to sustain growth and engage in efficient production and manufacturing.

An important area of concern for Karnataka's companies is inadequacy of their manufacturing and production technologies. This area is neglected by Karnataka's universities and colleges. It is often impossible to find qualified personnel in specific areas – e.g., production control, production scale-up. Very few companies use the latest manufacturing technologies, including computer numeric control, flexible manufacturing, and computer-aided manufacturing.

Expanding-sector firms are likely to need services on moderately sophisticated R&D issues in the future. In the medium to long term, they will be mainstream R&D customers in Karnataka for research in new materials and processes, as well as for production technology innovation from a variety of sources in Karnataka, if they can respond. These industries need help to recognize that they have R&D needs that can be met by technology suppliers.

The ability of companies to hire enough qualified personnel to support growth is a key to success in the expanding sector. At present Karnataka's companies do not have difficulty hiring sufficient numbers of scientists, engineers, and marketing professionals. There is concern, however, that if expansion continues, it may become harder to fill needed positions.

Financing is typically not a problem for companies in the expanding sector because their growth generates enough revenues to support R&D, acquisition of needed technology, and hiring of new personnel. Although expanding industries usually do not have difficulty finding capital in Karnataka, long-term efforts could be directed toward increasing the efficiency and reducing the cost of obtaining capital.

Transforming-Sector Industries and Their Needs

The transforming sector includes industries in which both the product and the production methods are changing or have changed radically. There are several reasons for industry transformation. The most common one is the emergence of new technologies that have a significant impact on existing industry products or production methods.

When industry handles transformation properly, the majority of companies within the industry, after a sometimes painful restructuring process, will evolve to a new form. If a transforming sector does not adapt to the forces at work, the industry is likely to be reconfigured significantly anyway as either emerging sectors encroach on existing markets through product substitution (e.g., plastics and ceramics replacing steel) or as new production techniques permit other industries to enter into current markets (e.g., electronics and smaller-scale telecommunication firms offering satellite and cellular telephones versus larger telephone companies offering traditional local and long-distance services).

Among the industries of the transforming sector in Karnataka are the following:

- Chemicals
- Machine tools
- Materials.

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Overall, companies in the transforming sector in Karnataka require access to resources that can help them carve out new market niches or decrease production costs.

The R&D needs of the transforming sector in Karnataka are very basic and less complex than those of emerging-sector or expanding-sector firms. For the most part, this sector has waited too long to explore how R&D and technology could make its businesses more adaptive and productive.

The transforming sector's greatest need is to prevent the increase of existing lags in production technology, particularly manufacturing automation. Karnataka has possibly the best foundation for this element of the medium-term technology infrastructure in India, but it needs to expand its development systematically and induce lethargic industries to accept and pursue new activities in this area.

The main human resource issue for transforming companies is the mismatch between the current skills of their workers and the skills required by new products and production methods. Karnataka's educational and training institutions cannot at present successfully meet transforming companies' retraining needs and respond to them in a timely and flexible manner.

Transforming companies need to invest heavily in R&D, capital plant modernization, and retraining. However, many of Karnataka's companies have not seen a need to transform while their revenues are high and financing is not a major problem. Thus, the problem is not in financing but in sensing market signals early and developing timely corporate strategies.

Table 1 summarizes the needs of Karnataka's emerging, expanding, and transforming industries for technology, human resources, and finance.

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KARNATAKA'S ECONOMIC INFRASTRUCTURE NEEDS

Industry	Technology	Human Resources	Finance
Emerging			
• Software	In the long run will require greater investments in artificial intelligence, while in the near and medium terms, companies need better access to satellite and telecommunications equipment.	More engineering graduates with applied skills and specifically trained in software engineering. In the near term, need personnel skilled in R&D management and technology forecasting.	Capital to finance R&D and overseas marketing.
• Telecommunications	Indigenous suppliers of quality semiconductor components.	Engineers with applied skills in circuit design, software engineering and materials research, as well as those with specialized technical skills in manufacturing and installation of telecommunications systems.	Better access to capital for smaller suppliers to finance product enhancements and equipment upgrading
• Computers	Indigenize manufacture of components and parts. Develop engineering workstations for CAD/CAE. Develop on-line process control systems.	Develop strong R&D with IIT/IISc graduates. Work with vocational schools to train electronic technicians.	Better access to risk capital.
• Biotechnology	Development of capabilities in a broad range of technologies, from recombinant DNA to tissue culture. Better access to technologies for downstream production and production scale-up.	Scientific personnel interested in applied biotechnology work.	Risk capital for small start up firms.
Expanding			
• Pharmaceuticals	Greater internal investments in basic research. Improve commercial viability of technologies coming out of research labs and universities in Karnataka.	More personnel with skills in specific areas: quality assurance, material handling. More scientific personnel interested in applied work in biochemistry and pharmacology.	Incentives for equipment replacement.
• Automotive	Apply modern methods of manufacturing to improve quality.	Train production people in manufacturing methods such as SQC, quality circles. Educate designers in the use of new materials.	
• Food processing	Access to packing and food preparation technologies as well as techniques that allow for extension of shelf life of products. Capabilities to monitor technological developments overseas.	Development of personnel in market research and development; better quality control and engineering personnel; R&D management, planning and monitoring capabilities.	Capital for equipment upgrading.
Transforming			
• Chemicals	Development of indigenous equipment suppliers. Expansion of internal R&D efforts in chemicals and fertilizers.	Continuing education for scientific staff, training to enable technical and semiskilled workers to operate new production equipment.	Capital for modernization of plant and equipment
• Machine tools	Develop flexible manufacturing systems. Improve quality, on-time delivery. Indigenize CNC equipment design.	Create a mnaufacturing center of excellence. Retrain designers for CNC equipment. Develop systems engineers.	Allow greater depreciation allowance to encourage R&D investment.
• Steel and concrete	Encourage energy conservation. Implement modern mini steel plants and mini cement plants.	Reeducate steel executive to think globally and foster innovation.	

A central premise of this report is that, although global and national "external" forces undoubtedly will influence Karnataka's economic development, actions taken at the state level by committed and dynamic public and private leaders can play a major role in shaping Karnataka's economic future. SRI's research on economic development has shown that traditional components of comparative advantage—once land, low-cost labor, and natural resources—are not as important as they were only a few years ago. The components of comparative advantage in the world are changing: to be competitive in today's economy, Karnataka's key industries require a new kind of economic infrastructure. The new components of comparative advantage are:

- Access to technology
- Skilled and adaptable human resources
- Accessible capital.

Karnataka can directly influence the competitiveness of its industries by building a new comparative advantage in these areas.

Access to Technology

In today's economy, technology is a critical factor for every industry. The technology infrastructure of a state includes those public and private sources of information and materials that enable industry to innovate in both product development and production methods. Karnataka has one of the better-endowed technology infrastructures in India. Yet, as good as it is, it is unable to perform the roles it must if the Karnataka economy is to thrive and grow in the future because some key elements essential to a vital and adaptive technology infrastructure are absent, or at least underdeveloped.

Technology infrastructure is a broad continuum of development and supply capabilities. The technology infrastructure in Karnataka (as well as in the United States) includes these elements:

- *Long-Term*—Universities, primarily those with advanced science and education programs that provide both academic discovery and graduates with advanced degrees who enable technology transfer when they enter industry.

- *Medium-Term*—Technology centers or laboratories that perform research for business and government on applied science issues, whether avionics, communications, food, or industrial automation.

- *Near-Term*—Technical assistance and consulting organizations that provide short-turn-around services to business and industry, helping companies identify, evaluate, and implement technologies.

Karnataka has a reasonably well-developed long-term technology infrastructure. Its major source for long-term basic science and technology is the Indian Institute of Science (IISc). However, other long-term technology infrastructure is limited. Although Karnataka has an array of national laboratories and institutes, they do more medium-term applied work than long-term basic science.

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Overall, Karnataka's long-term technology infrastructure could benefit from expansion to other academic institutions in the state. Thus, Bangalore University, Mysore University, and some of the research centers should be encouraged to improve their academic credentials and participate more aggressively in world science development.

Karnataka has a more highly developed medium-term technology infrastructure than most Indian states, and even than many states in America. However, this infrastructure, despite claims to the contrary, does not appear to be as responsive to industry R&D needs as is desirable, particularly for those firms in the emerging stage of the life cycle.

Of the three time frames in which technological development, application, and use take place, the near term is the most fundamental. The near-term technology infrastructure consists of those sources of "first-generation" technology – already available through the market – that make firms more innovative or productive. However, first-generation technologies that might appear available in principle may not be available or accessible in practice.

Karnataka is fortunate to have a moderately well-developed near-term technology infrastructure serving both the emerging and the transforming segments of the economy. The national laboratories and institutes that are part of Karnataka's technology infrastructure are all mandated to try both to provide technical assistance to industry and to license technology as technology transfer. Many of these technology centers have a strong past record of assistance to industry. All of them can enhance their efforts to assist industry directly beyond trying to commercialize technology.

Other than these laboratories and institutes, the IISc Centre for Scientific and Industry Consultancy (CSIC) is the only major independent scientifically oriented near-term source of technology in Karnataka. CSIC is an example of recent efforts by the IISc to improve relationships with industry and expand the flow of industry support to faculty and facilities. However, the IISc's CSIC is a fairly restricted technology resource for industry in Karnataka. IISc staff will do selected near- to medium-term research, but, like university researchers, they want topics that relate to their interests and are not too close to the marketplace to lose their scientific value for inquiry. CSIC wants to attract more industry clients, but industry still views CSIC more as an avenue for exploring issues, not for addressing important near- to medium-term technological problems.

Skilled and Adaptable Human Resources

As Karnataka has moved toward a more knowledge-intensive, technology- and information-based economy, human capital – the set of skills and knowledge that people bring to their jobs – has become a critical foundation for economic development. In this regard, Karnataka's industry today requires a higher-quality, adaptable work force.

Karnataka's human resource requirements have grown as the economy has expanded over the past decades. The state has developed a strong set of educational

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institutions – including the Indian Institute of Science, the Indian Institute of Management, Bangalore and Mysore Universities, and its over 50 engineering colleges. 150 polytechnic colleges, and technical training schools. For the most skilled human resources, Karnataka can draw on the excellent resources of the IISc, IITs, and IIMs to meet its long-term scientific, technical, and managerial needs. However, closer linkages between these institutions and the state's industries must be developed through the efforts of both. The IISc, in particular, has a special mission to perform relevant research and provide teaching and consulting for the emerging sector, which includes high-technology companies.

At the college graduate level, the IITs and the state's engineering colleges provide industry with a vast supply of engineers. However, SRI's interviews with Karnataka's industries revealed that the graduates of engineering are not equipped with up-to-date knowledge and skills that are easily applicable in industrial settings. The highly centralized structure of both the engineering colleges and the polytechnic schools has constrained the ability of faculties and individual colleges to adapt their curriculum to respond to changing technologies and the changing human resource needs of industries.

Although Karnataka has a variety of excellent technical training centers, such as the Government Tool Room and Training Center and the Foreman Training Institute, the demand for skilled technicians from these centers by industries within the state, and elsewhere in India, far exceeds the number of graduates. It is important to find ways to increase the training capacities of these centers.

Availability of Finance

Capital availability – or the ability of a variety of financial institutions to meet the financing needs of industries at different stages of their life cycle – is a third factor increasingly important to Karnataka's industries as they seek to adapt to changing economic conditions. Capital is critical not only to finance the start-up of new businesses, but to finance the development of new products, use of new processes, retraining of workers, and development of new marketing strategies that are required in the current economic environment. Karnataka's financial infrastructure is well developed, both in its first-rate public development banks and its fast-growing commercial banks. However, good as it is in meeting traditional financial needs, the emerging financial needs of Karnataka's dynamic economy require new and innovative mechanisms, especially in financing higher-risk activities.

Industry in Karnataka and nationally depend predominantly on the public financial institutions to meet their capital needs: much of industry's investment capital comes from the state sector. Without the pressures of a highly competitive financial marketplace, the introduction of new instruments and mechanisms has lagged considerably behind changing industry financial needs. Increasingly, however, state financial institutions are developing innovative financial schemes. The growth of sources of equity financing through capital markets in recent years has greatly enhanced the financial options of Indian industry.

Despite the introduction of several new financing schemes by the development banks. Karnataka's long-term finance infrastructure—its ability to finance R&D, product commercialization and testing, and production scale-up—is limited. A variety of new schemes for financing innovations and emerging industry start-ups have recently been established; however, both public and private financial institutions are moving ahead very slowly and cautiously. Yet, if Karnataka is to become competitive, the state will have to broaden and deepen its capacity to finance the R&D and start-up ventures of the state's entrepreneurs.

There appears to be general agreement on the need for venture capital in Karnataka, corresponding to the kind available in the United States for the formation and start-up of small firms specializing in new ideas or new technologies. The virtual absence of private-sector venture capital in India is due largely to various regulatory provisions, and in part to the prevailing business environment and opportunities. Although several private-sector nonbanking financial companies have recently launched venture capital funds, considerable further regulatory changes are needed to remove existing disincentives for private capital to invest in high-risk ventures.

Karnataka's capacity to provide the long-term funds required for setting up projects on a commercial scale—whether new projects or for major expansion or diversification—is well developed. SRI's interviews with Karnataka's industries revealed that there is adequate access to sources of both long-term debt and equity capital. In Karnataka, both the Karnataka State Industrial Investment and Development Corporation (KSIIDC) and the Karnataka State Financial Corporation (KSFC) are state-level agencies that provide investment loans to industry and also perform a major role in the promotion and assistance of projects. Similarly, the Karnataka State Electronics Development Corporation (KEONICS) has been instrumental in promoting and assisting projects in the electronics industry, including entering into joint ventures for this purpose.

The major gaps in Karnataka's financial infrastructure lie in two main areas. First, there is difficulty in financing R&D and the early commercialization stage of a project. Second, it remains difficult to raise equity with which to leverage institutional debt for start-ups across all industries, whatever their stage in the industry life cycle.

A Blueprint for Building Karnataka's Economic Infrastructure

If India is to participate in the world economy, Karnataka and several other states represent India's best chances. However, for Karnataka to compete globally, its economic infrastructure must be world class. To build such an infrastructure, Karnataka faces the challenge of selecting and implementing the most effective public- and private-sector actions needed to support its development. This section provides some insights into the priorities for action that build on and reinforce the concern for change and commitment to action already expressed by Karnataka's business and government leaders.

Karnataka needs to focus its energy on attainable goals that will reinforce continued growth and adaptation in the state economy. Based on its analysis of the economic infrastructure and the broader set of recommendations presented in each infrastructure discussion in the main report, SRI recommends that Karnataka develop a "Blueprint for Action" that concentrates on specific areas of its industries' technology, human resource, and finance needs within specific time frames.

The highest-level priorities identified in this study are actions focusing on medium-term outcomes. These should be supported by easier-to-accomplish, less complex, near-term actions, as well as by a longer-term program of broader reforms and capacity-building initiatives. The set of proposed actions presented here reflects the importance of building an economic infrastructure that maximizes the synergies between economic sectors and institutions and captures the benefits of adaptation and growth in the Karnataka economy.

Priority Agenda

The primary focus for a priority infrastructure agenda should be improved technology access, with human resource development stressing technology skills and financial strategies supporting emerging-sector business development. The reason for the emphasis on technology is that being competitive in domestic as well as international markets requires incorporating appropriate technology more aggressively at all stages of business activity.

Four key findings from the SRI research drive an agenda for action focusing on improving technology access in the medium term:

- First, although technology capabilities are highly concentrated in Karnataka, they do not work well for the economy. The reason is that technology resource providers in Karnataka are not market driven and do not respond to the economic requirements of industries at different stages of development.

- Second, Karnataka's technology resources are not sufficiently sensitive to different types of industry needs, and therefore do not offer the specialized research and development capabilities that different sectors (e.g., software, automotives, food processing) might require at important stages of product development (e.g., product R&D, manufacturing R&D).

- Third, technology supply institutions in Karnataka are also not very adaptive to the immediate environment. Because they are primarily national laboratories and institutes, they are slow to change or take the initiative in reaching out to the Karnataka marketplace.

- Fourth, although they may desire to serve industry better, their limited financial resources and dependency on Government of India programs for this support tend to drive out the incentive among technology centers to respond to needs that would require nontraditional financial and contractual arrangements.

In sum, because existing technology institutions (national laboratories and institutes) are themselves evolving through their own life cycle, and in many cases have

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not evolved as rapidly as the economic sectors they are chartered to assist, there is a need for a new configuration of technology suppliers.

Thus, the highest priority for action for Karnataka is development of a technology infrastructure that responds to the increasingly market-driven R&D needs of sectors at each stage of the life cycle. Two priority actions are recommended to achieve this goal:

- Create an applied research and development center that directly responds to the technology needs of industry in Karnataka.
- Develop a buyer–supplier development initiative that focuses on emerging-sector technology and human resource needs.

Create Applied Research Center—This analysis suggests that no one technology center is responding adequately to the needs of the economy, although some have more or different capabilities than others or are more willing to help than others. No one center has the set of resources needed to address the technology needs so important to the economy.

A central part of the solution to the medium-term action agenda, therefore, is developing a market-driven applied R&D capacity in Karnataka. This center would be new in organization and operation, reflecting Karnataka's movement toward a market-sensitive economy.

The applied research center would stress identification of industry needs as the basis for organizing its research and staffing structure. Research capacity should be oriented to the marketplace and would cover key aspects of at least four major areas of capability: manufacturing automation, advanced materials, biotechnology, and computer sciences. It would be designed to produce timely results that are responsive to business needs.

This research center would not necessarily represent any one organization. The provider could be an existing institution, but the center could be privately operated and managed, with its own staff as well as staff from universities and other centers. It would make extensive use of existing Karnataka science and technology resources (e.g., IISc, NAL, ISRO, CFTRI, CMTI) through direct and indirect staffing agreements.

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STEPS FOR DEVELOPING AN APPLIED TECHNOLOGY INSTITUTE

The work program for creating an applied research institute involves a developmental process that begins with defining the mission and scope of the institute and continues through to actual organization and start-up of the institutional setting.

The first step in developing an appropriate research institution, therefore, is to carry out a mission and scope study that provides a detailed analysis of what types of capabilities are needed and what types of organizational settings would be best able to supply them. A mission and scope study would provide the detailed work plan for implementing the applied research institution. There are two parts to a mission and scope study: the evaluation and specification of mission and the development of detailed organization parameters.

Evaluate Mission – Define the basic purposes for which the applied research institutional capacity would be created. This means answering the following questions:

- *Life Cycle Focus* – Which life cycle stage should R&D capacity be oriented toward: emerging, expanding, or transforming stages? Should the applied research institute favor those who are best able to make use of its capacity, such as the informatics sector? Should it be structured to reach out to industries with rapidly evolving needs, such as food processing or manufacturing? Can these needs be differentiated in an institution's mission?

- *Technology Generation* – What stage of research should be emphasized, if any? Third generation (science), second generation (emerging technology), first generation (applications of existing technology)?

- *Technology Capture vs. Technology Development* – What types of research activity should be emphasized? Should "technology capture" be stressed, with its focus on making existing technology work for each sector? Or should the focus be technology development, with a focus on innovation?

- *Technology Fields* – What fields of technology should be provided to Karnataka industry? Advanced materials (composite materials, powdered metallurgy, ceramics); automated manufacturing (small- and large-scale computer-aided design, engineering, manufacturing systems development and integration); informatics (computer systems and software); biotechnology (industrial chemicals and agronomic applications)? Should the institution start with one area (such as informatics) and expand over time? Most emerging-sector firms are in the informatics sector, yet, as competitiveness becomes more central to the Karnataka economy, expanding and transforming sectors will increasingly require R&D assistance in fields such as chemicals and materials.

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Development Options – The richness of the Karnataka technology infrastructure and the seriousness of the mismatch between sectors suggests that the design of a potential applied research institution be carefully examined. The following questions need to be answered:

- *Sponsors* – Who should develop and sponsor the applied research institution? Should a public–private consortium be formed to provide balanced oversight to the development of this institution? Should business or the government of Karnataka play the lead role? What about organizations such as USAID?

- *Design* – Who should design the organizational structure? Should it be designed by a committee or panel of experts? Should design be assigned by consensus to one institution, such as the Indian Institute of Science (IISc), Tata Consultancy, SRI?

- *Structure* – Should the institution be independent and free-standing (e.g., a new institution), developed within an existing organization as improved services, or developed as a subsidiary? Should the applied research capacity be operated as a research brokerage service that is chartered to acquire needed research from the most appropriate source?

- *Operators* – Who should be designated as the operators of a possible applied research institution? Should the operators be selected by competitive bid, open to all qualified institutions in Karnataka, including CFTRI, CMTI, CPRI, ISRO, NAL, IISc, and so on? Should there be one or more centers, possibly specializing in different fields?

- *Initial Capitalization* – How should the applied research institution be initially capitalized? Should initial funding come from Karnataka industry, declining as revenues from contracts increase? Should funding come from the state of Karnataka initially, declining over time, as well? Should there be matching seed capital from the Government of India or USAID? One scenario might show a 25% initial capitalization by each of these four groups.

- *Financing* – How should the applied research institution be financed once established? How should this evolve over time (from initial founding to mature operation)? Should it operate on the basis of revenues generated from contract research, charging fees for services rendered? Should support come from state and Government of India contracts and grants as well? Should the institution accept contracts from industry outside of Karnataka? From outside of India (e.g., overseas-sponsored R&D)? One scenario might be a transitional financial structure in which the applied R&D institution moves from initial funding by business and government to complete support from contract research over a 5-year period.

The completion of a mission and scope study that examines all these issues will have established the groundwork for creation of appropriate applied technology capabilities to serve the Karnataka economy. The information from this analysis will, in essence, constitute a feasibility analysis and can be used to guide implementation steps from that point forward.

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Develop Buyer–Supplier Initiative – Development of a buyer–supplier initiative represents an important complement to development of an applied research center. This need arises from two observations.

First and foremost, U.S. and Indian history has proven that the development of suppliers, subcontractors, ancillaries, subsidiaries, and all forms of smaller-scale enterprise related to larger industrial sectors is a primary means of stimulating and capturing the benefits of economic growth. Efforts to expedite and enhance indigenization for economically logical reasons help create the synergies essential for the positive economic feedback that has characterized all major industrial centers, whether it was Detroit in the 1960s, Silicon Valley in the 1970s, or the Highway 128 corridor in Boston in the 1980s. India, too, has always placed indigenization high on its agenda for economic development.

Second, the need for suppliers and ancillaries with higher technical competency and capability is fast rising in Karnataka, but the development of ancillaries with suitable capabilities has proven to be difficult. This problem reduces the local growth of business in emerging sectors.

If Karnataka is to become active in the global economy, it stands to gain substantially by energizing the development of small enterprises that can supply increasingly complex products, ranging from semiconductors to avionics systems. Karnataka needs world class suppliers that can become, in some cases, world class companies. To this end, creation of a buyer–supplier initiative could provide some of the technology equipment, production techniques, and management skills required by existing or new suppliers. This initiative would facilitate efforts by one or more companies to identify and assist the formation of suppliers needed for strategic purposes by industry. Thus, when one or more firms need better suppliers of a standard, high-quality component, their efforts can be pooled to set up one or more firms that the organization established by the initiative then assists in meeting quality and production needs.

Unfortunately, there are few specific models for use in enhancing buyer–supplier relations in the United States. Most states and localities have depended primarily on major firms to take care of these issues. Programs for small businesses emphasize capitalization, and sometimes technology information. But what U.S. firms and governments are now realizing is that improving the linkage between different buyers and suppliers in the areas of technology and production is essential to the broader competitiveness of all parties. This awareness is giving rise to new efforts by industry and government to work with suppliers. The majority of efforts focus on improving technology utilization by small-scale enterprise, often focusing specifically on suppliers as a group. This activity is clearly needed in Karnataka.

STEPS TO DEVELOP A BUYER–SUPPLIER INITIATIVE

Developing a buyer–supplier initiative will involve two main steps: assessment of the supplier structure and organizational development.

Assess Supplier Structure – Karnataka's public and private sectors need to examine the structure of the state's supplier system to determine which types of suppliers exist for different industrial segments of the Karnataka economy. This analysis should examine the following issues:

- *Supplier Life Cycle/Sector Characteristics* – Karnataka's business and government groups need to know the configuration of suppliers by both stage of life cycle and sector. There may be areas where there are more suppliers than others, particularly in the transforming sector. This imbalance might suggest a mismatch between the needs of buyers in other stages of development, or possible underutilization of suppliers. Karnataka needs to know enough about its supplier sectors to orient the next steps in a buyer–supplier initiative.

- *Review Changing Buyer Requirements* – An analysis of changing buyer requirements should be carried out. This analysis should determine, by stage of life cycle and sector, what major technological changes in product materials and production are coming on line. In Karnataka, as in the United States, changing market conditions and new technology developments are placing greater pressure on companies to emphasize quality and efficiency, as well as innovation. Knowing these trends will help in a buyer–supplier initiative.

- *Evaluate Supplier Capabilities* – An analysis of a sample of suppliers in terms of their ability to utilize technologies and meet quality standards of major buyers should be carried out. This will establish the range of technical assistance requirements for Karnataka suppliers.

- *Identify Technology Assistance Opportunities* – Based on the size and structure of the supplier system, the changing requirements of major buyers, and the capabilities of current suppliers, Karnataka needs to identify technology services needed by suppliers.

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Organizational Development – To develop a buyer–supplier initiative, possible sponsors need to be identified, as well as alternative organizational structures.

- *Sponsors* – Who should sponsor a buyer–supplier initiative? Should the government of Karnataka be the overall sponsor? Should the sponsors be a set of industries with shared concerns, such as the informatics sector? Which industries are most likely to agree to participate in a buyer–supplier initiative that requires provision of information on technical standards and quality assurance requirements? Perhaps some type of partnership in which government serves as intermediary to businesses who reach out to suppliers would be most appropriate.

- *Organizational Structure* – A medium-term initiative to improve buyer–supplier relations can be carried out in a number of ways. Karnataka's business and government sectors need to explore different approaches to reaching out, both to suppliers and to buyers, giving them common ground for working collaboratively. In addition, specific roles for staff of existing technology centers in Karnataka also need to be explored. Since most of the National Laboratories in Karnataka claim to be working with local industry, particularly ISRO (on aerospace parts and components), there may be a need to evaluate their potential contributions more systematically. Companies, technology centers, and the state of Karnataka may have the makings of a critical mass of resources needed to enhance buyer–supplier relations. If so, they have not been brought together in the best combination yet.

- *Design* – A specific organizational structure that provides different opportunities for buyer–supplier interaction is important. Individual subprogram activities may also be very critical. At the simplest level, a program might involve loaning calibration equipment and providing quality review on a neutral basis to suppliers. On a more sophisticated level might be an effort to develop production standards for suppliers based on a series of meetings between major buyers of parts and components. Perhaps most important might be an industrial extension service that reaches out to suppliers, helping them to evaluate their needs relative to buyer requirements (rather than only the suppliers' best judgment).

- *Finance Options* – Once Karnataka's business and governmental sectors have decided whether a buyer–supplier initiative needs extensive infrastructure, such as measurement equipment and pools of loanable or leasable technical equipment, or whether it will emphasize human resources for appraisal of supplier capabilities and technical needs, the cost of a buyer–supplier initiative can be estimated. Even if the initiative is capital intensive, many of the resources could be provided in-kind by companies or by other technology centers in Karnataka. Between core staff and in-kind corporate participation, the buyer–supplier initiative could become a viable public–private initiative that could grow and change with the needs of both sets of participants.

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Other Actions Needed

Near-Term Actions—Concurrently with initiation of the medium-term priorities, Karnataka should undertake the more direct, near-term actions that will respond to the immediate needs of industry. These actions include:

- Develop a Technology Deployment Service to reach out to smaller industries and help them plan their technology requirements.
- Create an international technology network to provide local companies with easier access to current information on product development and marketing.
- Develop international technology work sessions, bringing state-of-the-art professionals in key fields or industries to Karnataka to lead work sessions with industry leaders and technologists in the state.
- Strengthen polytechnics by establishing demonstration sites at selected polytechnics and vocational institutes and enhancing their capability to respond quickly to industry training needs.
- Provide entrepreneurship and R&D management training.
- Facilitate training in investment banking and business plan evaluation.

Long-Term Actions—Finally, beginning now but following the progress of the medium-term priorities, Karnataka should act on the initiatives that are critical to its long-term evolution as a leading center for technology development:

- Expand Karnataka's world class science capability—expand the ability of more universities to perform first-rate science research.
- Develop interdisciplinary university centers—Karnataka universities should be encouraged (and sponsored by both public and private sources) to develop more interdisciplinary research programs that represent emerging scientific disciplines, such as biotechnology, advanced materials, automated manufacturing, and computer science.

In addition, Karnataka industry and government should continue to develop a shared agenda for larger, all-India-level reforms that will enable the economic infrastructure to adapt more effectively and thus help to bring about a world class economy in Karnataka.

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As this report shows, Karnataka already possesses many of the essential building blocks to develop a strong and technologically sophisticated economy. The state has a well-educated work force, talented large and small companies, and first-rate educational and research institutions. Following the recommendations of this report will fill important gaps in Karnataka's economic infrastructure and provide necessary support to the emerging technology-driven economy of the state.

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I TECHNOLOGY DEVELOPMENT IN KARNATAKA: A FRAMEWORK FOR ANALYSIS

This report presents a set of findings and recommendations relating to how the state of Karnataka can create the economic infrastructure required to sustain technological development in the state. The recommendations in the report are based on an examination of the existing capacity and adaptability of the state's economic infrastructure to meet the changing needs of its industries. The capabilities and responsiveness of Karnataka's infrastructure are reviewed in light of U.S. experience and innovation in these areas. The recommendations identify new policy and program directions that might be developed in Karnataka to support its emerging technology-driven economy and suggest possible models from U.S. experience that might be adapted to meet Karnataka's needs. This first section introduces the analytical framework used in this assessment of Karnataka's economic infrastructure.

Karnataka's Role in India's Expanding Economy

The Indian economy, since independence, has become a major force in the world economy. Recently, India has established itself particularly as an emerging world leader in science and technology. By applying science and technology, both developed locally and transferred from abroad, the nation has taken steps toward building the economic capacity needed to become a major world force in industrial technology and innovation.

The state of Karnataka, and Bangalore in particular, has emerged as one of the most important centers of technology-driven enterprise in the country. The concentration of higher education institutions, national research laboratories, technical centers, public initiatives for high-technology utilization, and technological talent have led many to suggest that Bangalore is the "Silicon Valley" of India.

However, despite the existing concentration of technology-related activities, this report concludes that much remains to be done to enhance Karnataka's capacity for technology-driven development. Not only does Karnataka's existing technology network need to be made to work better, new economic foundations – in technology, human resources, and finance – are needed to strengthen Karnataka's existing and emerging industries. Karnataka's development could remain slowed by a lagging physical infrastructure, a technology and educational network not especially responsive to industrial needs, an oppressive bureaucracy, and a regulatory environment that stifles indigenous industrial innovation. On the other hand, Karnataka is at the threshold of a new era of technology-driven industrialization that could help lead India into the new global economy.

Changing Factors of Comparative Advantage

A central premise of this report is that, although global and national "external" forces undoubtedly will influence Karnataka's economic development, actions taken at the state level by committed and dynamic public and private leaders can play a major role in shaping Karnataka's economic future. SRI's research on economic development has shown that traditional components of comparative advantage – once land, low-cost labor, and natural resources – are not as important as they were only a few years ago. The components of comparative advantage in the world are changing: to be competitive in today's economy, Karnataka's key industries require a new kind of economic infrastructure. The new components of comparative advantage are access to technology, skilled and adaptable human resources, and accessible capital. Although cost remains an important consideration of comparative advantage, quality is now paramount. Karnataka can directly influence the competitiveness of its industries by building a new comparative advantage.

There is little doubt that Karnataka has been working purposefully to create a supportive environment for economic development. The state has been active in pursuing programs and policies to support the development and enhancement of industry, particularly those industries active in technology product markets. However, in an environment of rapid economic change, the development of policies and programs to maximize the development, expansion, and adaptation of industry require continued assessment and enhancement of this economic infrastructure.

SRI International, over the past 6 years, has developed a framework for understanding overall economic infrastructure that stresses the importance of these new components of comparative advantage in addition to the more traditional factors (including also physical infrastructure – roads, water, power, communication). The importance of these components is discussed below.

Access to Technology

Access to technology pertains to the sources of technology that directly reach industry in the near, medium, and long term. These sources include university research programs, laboratories, research centers, technology institutes, and technical assistance programs that supply technology by a variety of means: developing basic science information through published research and forums, conducting applied research projects responsive to industry-group concerns, and providing group and individual technical assistance. These sources also include parent corporations, intermediate buyers and suppliers, and distributors who transfer technology through the marketplace.

The technological infrastructure in the Karnataka region is far from complete. For example, although the Indian Institute of Science (IISc) in Bangalore is a leading center for basic research and 44 engineering colleges and 122 polytechnics are established in Karnataka, there is a shortage of facilities that provide the bridge between basic research and skilled technicians – specifically, facilities for product

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and process innovation. In developing strategies to improve the technology infrastructure, states must consider how the marketplace satisfies these needs and how well the institutions in the public infrastructure are able to respond to short-term market inefficiencies as well as longer-term development needs.

Human Resources Development

The human resource system of an economy encompasses the entire range of education and training institutions. Typically, these encompass primary education, secondary education, technical and occupational training schools and programs, professional schools, community colleges (2-year academic and training institutions), and colleges and universities (4-year professional and graduate education institutions). Private institutions for training, as well as internal corporate training (apprenticeships, skill training programs, etc.) and training by product vendors are also increasingly essential to meeting the human resources needs of industry. Moreover, in an economy oriented toward new business formation, expansion of existing industry, and adaptation of mature industry, the capacity of institutions to respond to rapidly changing and often very specific needs has become increasingly important, but this capacity is often inadequately matched to the dynamics of the economy. Karnataka may have some of the best-developed human resource capabilities in the nation. Despite this fact, there is some mismatch between what institutions are doing and the current and future needs of the state economy. These issues are worth examining.

Capital Finance

Every state has a system of banks, finance companies, investment banking houses, insurance companies, private investors, and buyers or sellers who finance business activities. These are frequently complemented by a range of public finance programs, ranging from direct loans and loan guarantees to grants and other subsidies. All these elements of the capital finance infrastructure are frequently regulated by a set of banking, securities, insurance, and import and export regulations and policies that influence the dynamics of the capital finance marketplace. There is no doubt that no matter how much public money is used to support the growing activities of business, the level of funding available will be small relative to the total private capital in the domestic and international marketplace. As a result, a significant function of the public capital finance infrastructure is to increase the efficiency with which financing flows to points of need, rather than attempting to substitute for the marketplace itself. However, the risks and liabilities of industrial sectors, whether they are new or mature, technology driven or merely technology users, cause the process of financing to be a major obstacle to development and expansion.

Many states are now reviewing how public policies and programs affect the financing of research and development (R&D), product development, the purchase of new technology equipment and replacement of older equipment and facilities, the purchase of materials, and other aspects of production finance in their regions, and are considering policy changes that make possible a more effective flow of capital. Clearly, Karnataka needs to determine how well its capital finance infrastructure serves its unique and expanding economic community, and what policies and programs might be required to stimulate and support further development and adaptation.

Innovation in Use of Policy Tools

To continue to serve the growing needs of industry in the rapidly changing global economy, the public sector must play an active role as manager of the state's "portfolio" of economic infrastructure elements. This portfolio encompasses primarily those "investments" or "assets" *directly* controlled by the public sector, such as universities, science and technology research programs, and technical assistance and investment programs. However, the state's infrastructure portfolio is in actuality much broader than the programs and institutions it has responsibility for. In fact, the portfolio can extend to influencing the broader behavior of the national or state marketplace. This broader role is achieved through *purposeful* use of public policies to improve market efficiency (rather than encumber it).

States can influence the economic infrastructure by using their powers of regulation and deregulation, administrative reform and innovation, and taxation, as well as collaboration with the private sector. As we can see from the preceding discussion, states use their policy tools to:

- *Provide information* — Assembling information; or brokering relationships that improve entrepreneurship, business productivity, strategic alliances, and appropriate investments.
- *Enable markets* — When provision of information alone is not enough to overcome a problem, states can use regulatory reforms or modifications to enable new business relations to take shape; enable new buyers and suppliers to form alliances that enhance the flow of capital, knowledge, and export of goods; and generally simplify and enhance the set of ground rules that affect enterprise.
- *Provide incentives* — After information and regulatory changes have been made to address problems, tax incentives or indirect methods of assistance may be appropriate to stimulate innovation or help reduce the marginal cost to businesses of satisfying their infrastructure requirements in acquiring technology, skilled human resources, and financing.
- *Strategically subsidize* — Finally, when all efforts to use information, regulatory innovation, and marginal incentives have been tried, *and* the social cost of not addressing a problem is greater than the cost of acting directly, then carefully targeted programmatic strategies may be needed. These are typically used to build initial capacity where none exists in the marketplace or where, over time, there may be a clear public-sector role that will *continue* as an institutional strategy.

The challenge of building the economic infrastructure for Karnataka requires using a practical framework for strategically focusing public and private actions. Many times, business and government fail to recognize that businesses are not static enterprises but are dynamic, and as such are subject to a variety of external and internal economic forces. An economy is a dynamic, evolving ecology of enterprises, even where traditional market forces are to some degree constrained. Consequently, the economic infrastructure required must also be dynamic. The economic infrastructure must be able to assist the development and adaptation of industries as they move through time.

Because economies—in both the United States and India—are dynamic, there is a need for an effective framework to understand their movement over time as external and internal forces exert their effects.

The industrial "life cycle" concept provides a framework that helps plan policies for infrastructure development at the national, regional, and state levels. Industries, rather than individual firms, move through a life cycle that resembles a spiral of development in which industries emerge, expand, and then transform as their products and production methods are altered over time. The behavior of the firm as an individual unit within the larger movement of the industry can be adaptive or maladaptive. Thus, for example, individual companies in emerging or transforming industries in a particular state or regional economy may be either healthy or unhealthy.

Industrial Life Cycle Stages

This discussion provides a brief overview of the definitions of the three principal stages of the industry life cycle that can be applied to examining the economic infrastructure needs of Karnataka.

Emerging Stage

Emerging-stage industries are those in which the actual form of an industry is still taking shape. Here, there are fewer competitors than in more developed industries. The products being offered are not clearly defined, and consumer or industry standards are just beginning to take shape. In emerging industries, R&D is far higher in proportion to the total size and revenues of the individual companies that make up the sector. Employment has lower numbers of manufacturing workers and relatively more product design and development staff. The financing in this stage is primarily from high-risk-tolerant sources, pending scale-up of production. In fact, there is often the possibility that the sector may be acquired by other existing (transforming) sectors, or may not mature at all as it exists, without a long period of incubation. Although unique technologies are often central to emerging industries, many emerging industries, inasmuch as they represent new ways of doing business, are not technology driven and merely reflect a unique means of responding to a consumer or business need (such as computer-aided design, or home-delivered gourmet meals). Industries in this stage are also primarily consumers of existing supplier products, but are in the early stages of creating their own supply industry (as in the case of biotechnology companies stimulating development of producers of genetic engineering measurement instrumentation.

Expanding Stage

Expanding industries are those in which the product category is well established; there are accepted basic types of product, with variations obtained through improvement and specialization. At this stage, there are a larger number of companies in the sector, with more entering all the time, and considerable acquisition and merger activity. There are well- established, if not growing markets. This situation generates a level of revenues that permits supporting aggressive product-improvement-focused R&D and considerable emphasis on marketing. If resources are adequate for industries at this stage, they can diversify vertically and horizontally, giving the overall industry a strong role in other industrial life cycles. For example, the chemical industry has become actively involved with "downstream" production of consumer products, such as plastic wrap, as well as with plastics fabrication technology necessary for utilization of advanced materials (such as reinforced reaction injection molding technology). Although technology is important to expanding-sector industries, marketing and product modification are most central to success.

Transforming Stage

Industries move through their life cycle at different rates. An industry has reached the transforming stage when *both* the product and the production methods are changing or have changed radically. The result, in such cases, is that the industry is no longer the same. If industries handle movement through this stage well, the majority of companies within the industry will evolve to a new form. For example, in banking, the shift in U.S. statutes has enabled a variety of new institutions to enter into the financial services business, causing the structure of the financial services sector to broaden dramatically in terms of ownership structure, products and services offered, and technology (shifting from tellers to automated teller machines, mixing credit cards and insurance). If a transforming sector does not adapt to the forces at work, the industry is likely to be reconfigured significantly as either emerging sectors encroach on existing markets (plastics and ceramics replacing steel) through product substitution, or as new production techniques permit other industries to enter into current markets (satellite and cellular telephones offered by electronics and smaller-scale telecommunications firms versus traditional local and long-distance lines controlled by the larger telephone companies). The machine tool industry, for example, has not adapted to the transformation of its sector structure in the United States. As a result, it is rapidly disappearing, being replaced by an advanced-manufacturing equipment sector that incorporates computer numeric controlled equipment, sensors, and mechanical systems together. In some cases, the transformation has a dramatic impact up and down the economic chain. For example, the development of automated manufacturing equipment, from robotic arms and vision inspection systems to automated materials handling systems has slowly started a shift in the procurement of manufacturers away from traditional metal forming and shaping equipment. Moreover, a third wave may occur as the shift toward flow process materials (composite plastics) takes place. Thus, the force of industrial life cycle movement requires strong and continuous adaptive strategies recognizing both product and production technologies. Without these, at least in competitive markets, less adaptive industries, will experience a high failure rate among member firms or, in the case of a managed economy, sick and nonproductive firms.

The utility of the life cycle framework is that it permits the targeting of a state's infrastructure elements, such as technology supply, human resource needs, or financial requirements, to a broad set of businesses, recognizing that their resource requirements may change as the industries move forward. Thus, whereas basic technologies and capital plant investments may once have been the important inputs to the development of the consumer products or food processing industry, today the requirements may need to emphasize formulations for advanced products (rather than basic ones) and more efficient production equipment and new packaging techniques.

Experience in the United States suggests that industrial policies and industry-oriented institutions, whatever sector they serve, also need to reflect the life cycle dynamics of the industries they serve. Unfortunately, many specific industry-dominated institutions (e.g., a steel research institute) often fail to recognize life cycle changes in their sponsor or client industries, often becoming wedded to definitions of industrial products or production techniques that become obsolete as the industry evolves. Thus, the American Steel Institute, while performing good research on steel, failed to anticipate the larger technological and market forces that have transformed the industry from a traditional basic and finished steel industry dominated by large mills, to a transformed advanced-materials sector comprising new producers of steel (mini mills) and substitute materials (plastics). Moreover, competitive concerns in many industries often force down the level of innovation in industry-focused centers since few firms eagerly share their innovations with competitors. Although traditional industry-sponsored research programs may have worked well for companies in the past, the consensus in the United States today is that they have not been effective in enabling their sponsors to gain needed technical and organizational advantages essential to adaptation during the industry life cycle.

Fortunately, there have been some important changes in industry views, toward recognizing life cycle perspectives in their collaborative work. For example, a number of new industry-sponsored R&D centers for precompetitive research have been formed in the United States in the past 5 years. Precompetitive research has been accepted as a necessary area for industries with shared concerns about future technologies to pursue. Such activities enable large companies to gain insights into the foundation of the emerging-stage industries they could build or acquire. Moreover, many firms have used participation in such activities to gain entry into new markets. The Microelectronics and Computer Technology Corporation (MCC) and the Semiconductor Advanced Technology Corporation (Sematec) are two examples of these cooperative efforts. Even these new centers have had to overcome problems of patent and licensing rights, as well as the reluctance of companies to participate actively participate in this research.

In general, the industry life cycle framework encourages a broader perspective on the economic infrastructure, with greater specificity within strategic elements. For state governments, the life cycle framework is an important acknowledgment of the fact that industries evolve, in a Darwinian manner, rather than exist as fixed institutions. For industry, the life cycle framework helps corporations view their business more flexibly. For example, a company that makes machine tools would, in using this perspective, be able to see itself as being in the automated manufacturing business, and a steel firm as being in the emerging materials sector.

To understand Karnataka's economic infrastructure needs, three steps are required. The first is development of an understanding of the different requirements of the industry by stage of life cycle. In Section II, the technology, human resource, and capital finance needs of Karnataka's emerging, expanding, and transforming industries are examined and evaluated in view of the worldwide and U.S. trends in each industry. Second is the characterization of the existing sources of economic infrastructure in Karnataka. Section III provides a review of the technology, human resources, and financial infrastructure in Karnataka and highlights relevant U.S. economic infrastructure innovations and programs. Third, having examined both of these supply and demand dimensions of the Karnataka economy, decisions about what infrastructure gaps will be addressed, how, and by whom must be made. Strategies for public and private action to enhance economic infrastructure are articulated in Sections IV and V.

Economic Benefits of Agglomeration: Karnataka's Industrial Synergies

Another important analytical concept that has great bearing on Karnataka's development relates to the concentration of activities giving rise to economic benefits from agglomeration (or clustering). Karnataka attracts industries not only because of its good climate, its relatively low wage rate, and so on, but also because there is an agglomeration of firms. These agglomerations confer substantial productivity advantages to firms because of buyer–supplier linkages and savings in the costs of communications, transportation, and support services. In sum, those represent elements of a spontaneous economic infrastructure—one that emerges from the cumulative and mutually reinforcing decisions of individual firms, often in connection with concerted public actions. Karnataka, since the 1950s, has been developing a clustering of technology-intensive activities, including public enterprises such as Hindustan Machine Tools, Bharat Electronics Ltd., and Hindustan Air, and national research and testing laboratories, such as the Central Food Technology Research Institute and the Central Machine Tool Institute.

The relationships between buyers and suppliers, for instance, represent an important "horizontal" linkage that tends to facilitate the flow of technology. The close proximity of these producers and suppliers can facilitate important dynamics that can lead to new technological development. In addition, the buyer–supplier connections can become vertical. Vertical linkages may be within one large firm that has units simultaneously engaged in science, R&D, and applied product commercialization.

In addition, productivity gains of agglomeration are associated with access to other specialized inputs, such as human resources, finance, support services, and materials, and to interaction among and between industries.

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Time Frame for Change

An organizing principle for this report is to explore each infrastructure area according to the time frame—near, medium, and long term—for change. There are elements in Karnataka's technology, human resource, and financial infrastructure that cannot be influenced in the near term but rather require a long time to change, even if they are perceived as a high-priority concern. For instance, the time frames in which technologies evolve vary considerably. In reviewing technology impacts on industries, this report uses the concept of technology "generation":

- *First-generation technologies*—Technologies that are available to industry through distributors and vendors in the marketplace, and are considered to be accepted business tools by industry.

- *Second-generation technologies*—Newer applied technologies that are just reaching the market and are not in very wide use, for which there are only emerging standards for performance and use, and for which training and support by vendors are important and specialized.

- *Third-generation technologies*—New concepts in technology that are reaching the application stage, may be in limited use as experimental prototypes, and have no defined market or supplier system.

Similarly, it takes years, even decades, to create a new human resource capability for producing Ph.D.-level researchers in a specific field. Thus, in this report, the time frame for the human resource infrastructure is organized in terms of the long-, medium-, and near-term dimensions:

- Long-term human resource infrastructure relates to the training of Ph.D. and master's level graduates.

- Medium-term human resource infrastructure involves the 4-year college and university graduates.

- Near-term human resource infrastructure refers to graduates of technical training institutes and 2-year polytechnic schools.

For the financial infrastructure, the organizing concept is less related to the time frame for change than to the financial needs of industries at various stages of the industry life cycle.

- *Emerging industry*—The financial needs of early-development-stage industry and business are for high-risk venture and seed capital.

- *Expanding industry*—Industries in the growth stage require "mezzanine" finance and capital for production scale-up.

- *Transforming industry*—Transforming industries that are adapting to changing conditions require a variety of financial mechanisms, including term loans, capital replacement, acquisition, merger, and leveraged buyout.

Objectives of This Report

Using the economic infrastructure concept, the industry life cycle framework, the important notion of "agglomeration synergies," and the time frame for change, this report examines Karnataka's economic infrastructure in terms of its responsiveness to the needs and changing dynamics of Karnataka's industrial base.

U.S. experiences and innovations in these areas are reviewed, and specific U.S. examples are offered for comparison. Finally, this report identifies new policy and program directions that might be developed by the state to support the emerging technology-driven economy of Karnataka.

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II KARNATAKA'S INDUSTRIAL DYNAMICS: A LIFE CYCLE PERSPECTIVE

Introduction

Karnataka today is one of the foremost industrial states in India. It has a broad range of industries, from steel to software and telecommunications. The state is well endowed with natural resources and has an extensive infrastructure of public and private educational and research institutions. However, Karnataka's companies, like many others in India, have long been sheltered from international competition and have rarely competed in global markets. Today, not only are Karnataka's companies experiencing greater competition from overseas, but many of those in newer industry sectors, such as software, have to expand overseas in order to grow.

The needs of Karnataka's companies in the three economic infrastructural areas—technology, human resources, capital—vary with their industry's stage of development. Companies in emerging sectors need resources to conduct R&D and bring new technologies to market; they require access to risk capital and entrepreneurial management skills. The infrastructural needs of companies in transforming sectors, at the other end of the spectrum, center around the availability of technological, financial, and human resources to enable them to change to new markets or production methods.

The rest of this section presents a detailed analysis of the the emerging, expanding, and transforming industries and a tabulated summary of their infrastructure needs.

Emerging-Sector Industries and Their Needs

Emerging industries typically enjoy a high degree of technological innovation and change. Revenues of companies in these industries are usually low because markets for new products are initially small; in some cases, companies in emerging industries have to *create* markets for their products. An example is the personal computer industry, where no mass market for personal computers existed before the introduction of the Apple computer.

Whereas revenues of companies in emerging industries are low, their R&D and capital expenditures are high. These companies work in new technological areas, and their ability to develop new products, come up with next generations of products, and successfully commercialize the results of R&D are vital to their success. They require access to state-of-the-art laboratory equipment, instruments, and design and testing facilities to support their R&D efforts.

Companies in emerging industries have high growth potential but also high risks. A new technology or product may not be accepted by the marketplace; a company may fail to bring the product to market; a competitor may introduce a better or cheaper product, making a company's product obsolete. Because of the high growth potential of emerging industries, however, competition in these sectors is high and many new entrants are attracted to the market. Thus, companies must always be alert to new competitors and, more importantly, have flexibility to shift resources and strategies quickly to new products and markets.

Emerging-sector companies often cluster around a university or a research institute, which serves as a source of not only technology but also management and scientific personnel for companies. In the United States, there are several areas (e.g., Silicon Valley around Stanford, Route 128 around MIT) characterized by an agglomeration of small technology companies. Such agglomerations encourage diffusion of information between companies and great personnel mobility, thus promoting competition and growth in the sector.

Emerging industries, however, do not and cannot exist in isolation from the other sectors of the economy. In the United States, state efforts have too often been directed toward development of "high-tech" industry in an area, not realizing that it is the older sectors that are the main contributors to the economy. It is these older manufacturing sectors that will become the ultimate users of technology and will "pull" the development of emerging sectors. Only the presence of both older and newer industries in the area, and cooperation and sharing of resources between the two, will lead to a balanced economic development.

In Karnataka, as in the United States, emerging industries are represented by small, entrepreneurial start-up companies (e.g., Biocon) as well as divisions or groups of larger, diversified companies (e.g., Kirloskar Computer Services Ltd.). They include the following industries:

- Software
- Telecommunications
- Computers
- Biotechnology.

Since these companies are heavily technology driven, their infrastructural requirements center around availability of resources to perform R&D and transfer results of R&D into commercializable products.

The analysis of the dynamics of the emerging-sector companies in Karnataka points to a set of common long-, medium-, and near-term infrastructural needs in technology, human resources, and finance, as discussed in the following pages.

Emerging-Sector Needs for Technology

Many of Karnataka's emerging-sector companies are more integrated into overseas markets than into Karnataka's economy. They often depend on either foreign markets or foreign technologies. For example, since office automation is limited in India, major markets for Karnataka's software industries are overseas, particularly in the United States. The majority of Karnataka's software companies work more closely with foreign partners than with users in the state. Both computer and nascent biotechnology industries in Karnataka rely on foreign partners for the latest technologies. In the telecommunications area, although much technology is still imported, progress has been made in designing indigenous products, particularly in rural automatic exchanges (RAXs) and private branch exchanges (PBXs).

At present, connections between emerging industries and other sectors, which are potential users of technology, are limited. Although the practice of creating ancillaries is widespread in Karnataka, the latter are usually in lower technological areas and often do not have independence and resources to compete with the parent or push technological development in the sector. Hardware companies, for example, develop most of the software for their needs internally, although this can be done more efficiently by independent software companies. Chemical and pharmaceutical companies rarely do joint work with independent small biotech companies, like Biocon. This lack of interaction prevents development of synergies between different industries in the state and does not allow Karnataka to fully capitalize on the resources of its existing industries. Efforts to better link emerging-sector companies with the needs of Karnataka's economy and its existing companies (e.g., encourage biotechnology production to increase productivity of Karnataka's agriculture and pharmaceutical companies) can yield major benefits to the state.

Internal R&D expenditures of Karnataka's emerging-sector companies are higher than the industry average but low in comparison with the same industries in the United States (3% of sales, compared with 10% in the United States). Thus, R&D resources of Karnataka's universities and research labs will play a major role in ensuring the technological competitiveness of these companies. Emerging-sector companies are the greatest potential users of university and laboratory research, not only because the technical needs of these companies are great but also because their personnel often come from university/research backgrounds and are open to working with these institutions.

Karnataka's emerging industrial sector faces needs for medium-term problem-focused and product-development-oriented research. This problem-focused research is typically on technical issues that are narrower and more practical than national laboratories are used to doing. A software company, for example, might want research on artificial intelligence applications to industrial processes. An electronics firm might want research on very large scale integrated circuits or microprocessor architecture for computer workstations. A biotechnology company (typically a subsidiary of a pharmaceutical or chemical firm) may want research on fermentation technology for specific chemical production, or development of monoclonal antibodies and DNA probes for medical diagnostic applications.

Emerging-sector firms have a high degree of respect for the personnel of the leading Karnataka technology institutions, whether ISRO, NAL, or IISc. The common complaint among emerging-sector firms is lack of a market-sensitive R&D capability that can provide a critical mass of technical research support to a number of firms. Karnataka firms want R&D resources that represent international levels of capability in fields such as software engineering, computer systems, and advanced materials. Karnataka firms, inother words, want R&D institutions outside their own walls that they can call on at need but do not have to support on a continual basis.

Karnataka firms believe that these respected technology institutions are more eager to do studies in the fields preferred by their staff than in areas related to the requirements of the emerging sector. This belief could easily be true and is quite understandable, given the history of the development of national laboratories and technology centers. They were organized to supply technology developments to an economy that was not very sophisticated and did not have extensive competitiveness. As competition in national and international markets has increased in the emerging sector, the need for more sophisticated and more focused research has grown.

In sum, emerging-sector firms believe that there is not so much a lack of skills overall as there is a lack of concentration of skills in the delivery of R&D services responding to key areas in which Karnataka's industries are growing. Emerging-sector industries want services that will help them become competitive internationally, not only at the national level. These companies want a "window" on world technology. Attaining the desired level of focus and response to industry needs may very well require either changes in the organization of existing R&D institutions or possibly creation of a new R&D enterprise for the future.

Emerging-Sector Needs for Human Resources

Emerging industries in Karnataka require a combination of entrepreneurial, technical, and management skills allowing them to not only take necessary risks and stay on the leading edge of technology, but also tailor their research to market needs. Companies in emerging industries require flexibility from their personnel to be able to respond to frequent technology and market changes. Flexibility on the part of the company and its personnel is probably one of the key factors for these companies' success.

Karnataka's companies are generally satisfied with their ability to hire scientists/engineers from local colleges and universities. Most companies, however, believe that the training provided by colleges and universities is too abstract and does not qualify graduates for immediate applied work. For example, there are few engineering software schools in India. Many schools teach traditional systems engineering and programming, but not enough institutions focus on bachelor's and master's level engineering and computer science courses.

Many emerging-sector industries have internal training programs for their new hires lasting from 6 months to a year. Tata Consultancy Services (TCS), for example, has a sophisticated year-long training program, combining instruction with actual work experience. The program is so successful that TCS is planning to market it to other firms.

To perform research in many emerging sectors today requires multidisciplinary skills that Indian graduates often lack. Biotechnology research, for example, requires a combination of chemical and biological expertise; computer science requires knowledge of mathematics and engineering, as well as skills in modeling, simulation, and analysis. Karnataka's companies believe that there is a scarcity of graduates with such multidisciplinary skills in the state and overall in India.

Although emerging-sector companies in Karnataka do more technology planning and monitoring than their counterparts in expanding and transforming industries, they also feel the need for more personnel with R&D management and technology forecasting skills. Such personnel are needed to plan, execute, and evaluate the progress of R&D activities. R&D managers should combine technical training with commercial acumen to assure that a firm's R&D activities match the needs and opportunities in the marketplace.

Emerging-Sector Needs for Finance

Capital for financing R&D, especially in the early stages of product development, is one of the critical factors for success in emerging sectors. The financing requirements of Karnataka's companies differ significantly between smaller start-up companies and divisions of large established corporations operating in emerging sectors. The latter usually have access to the resources of the larger company. The former, however, need better access to venture and risk financing in early stages of development. The provision of risk capital should also be combined with management support for the start-up. In addition, it is necessary to create better mechanisms for funding and writing off R&D expenditures of emerging companies – i.e., R&D limited partnerships, corporate investments, etc.

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EMERGING INDUSTRIES

Software Industry

The software industry is one of the fastest-growing industries in Karnataka and worldwide. It is closely linked with the development of electronic hardware equipment and growth of office and production automation in the economy. The industry currently consists of four major segments:

- Custom software and contract programming (consulting sector).
- Packaged software for specific applications (banking, airlines, apparel, etc.).
- Integrated systems for production planning, control, and engineering.
- Systems and utilities software, including operating systems, compilers, data base management systems, and software productivity tools.

In the United States, approximately 31% of about 4,300 independent software companies provide professional services and contract programming; 43% provide software packages, and 26% provide integrated systems. Although hardware companies previously performed software design internally, in recent years, the number of independent software companies has grown significantly, as have the number of arm's-length cooperative agreements between hardware and software manufacturers.

Traditionally, software manufacturers have been differentiated by the type of system for which they designed software, i.e., those designing software for large-scale computer systems, medium-scale systems (minicomputers), and personal computers. Currently, these three systems are converging. As personal computers become more powerful, divisions between companies in the three segments are blurring, with many software companies having to produce an integrated range of products.

Karnataka is viewed by both foreigners and Indians as a center of excellence for software design, with several well-known multinationals relying on Karnataka's companies for software design and services (e.g., Citicorp, American Express, Tektronix). Karnataka's software industry encompasses a broad range of products, representing all of the industry segments described above. Such products include packaged software for banking, medical diagnostics, and apparel manufacturing, and operating systems software for micro and mainframe computers.

Karnataka's comparative advantage in the software field stems from its high-quality labor force, available at a relatively low cost (on average, one-tenth to one-fifth of that in the United States). The productivity of Karnataka's design engineers is low, however, because of insufficient applied training in design and development and the absence of state-of-the-art design tools. This low productivity significantly narrows the cost differential for some software products. To design system software in India may cost only 30% less than to do the same task in the United States.

Software companies are drawn to Karnataka by its pleasant climate and supportive government policies, and by the proximity of universities and technical colleges. Many software start-ups are in the area, several started by Indians who have been educated and have worked in the United States. Company agglomeration promotes a dynamic and growing software industry, in many ways similar to California's Silicon Valley. The software designers/engineers are very mobile; various formal and informal channels for communication between professionals in different companies exist; the potential for spinning off new units is good. The

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agglomeration of software companies also promotes extensive transfer of technology between companies and spurs innovation and growth in the industry.

A special feature of Karnataka's software industry is its orientation toward foreign markets. Because office and production automation in India is not widespread, major markets for software products are not in India but overseas, particularly in the United States. Karnataka's software companies must therefore market in developed countries; however, their overseas marketing efforts are insufficient, largely because of insufficient funds. Most of Karnataka's software companies rely on foreign partners for marketing. As a result, projects undertaken by these firms generally involve sending professional teams to foreign customer sites for specific assignments and for fixed periods of time. Often, Karnataka's software firms have exported more people than actual programs. Thus, unlike the U.S. software industry, where most firms design and market packaged software and integrated systems, the majority of Karnataka's software industry is involved in the less profitable part of the business—software consulting and services.

The situation is likely to improve as Karnataka's companies learn more about U.S. and other developed countries' markets through tie-ups with foreign partners. Every software company in the state has a number of such cooperative agreements, which allow Indian companies to stay abreast of the latest overseas technologies (foreign partners regularly provide samples of the latest software products). Through these partnerships, Indian firms can also learn about the U.S. market, making it more feasible for them to establish independent operations in the future and to market to foreign companies in India. To do so, however, Karnataka's firms will need to spend significantly greater amounts on marketing. In the United States, a major part of the cost of software development is attributed to marketing efforts—test marketing, debugging, and adapting to specific customer needs.

In India, the growth of Karnataka's software companies will depend greatly on the development of the indigenous hardware industry, as well as the pace of computerization and automation in the Indian economy. Software for electronic publishing, for example, represents a huge potential market for Karnataka's companies since India has one of the largest publishing industries in the world.

An inhibiting factor in the development of independent software companies in Karnataka is the unwillingness of large hardware makers to subcontract software design to smaller outside companies. The practice of creating ancillaries, common in other Karnataka industries, is practically nonexistent in the software sector. In the United States, not only do hardware manufacturers spin off software companies, but they also spin off large numbers of independent start-ups. Lotus Development Corporation, for example, has spun off over 30 independent software houses.

Technology

The software industry is highly R&D intensive. Today, for example, software companies must invest more in artificial intelligence techniques (e.g., voice recognition, image processing), which make software easier to use. U.S. software companies have substantially increased their R&D investments in the last few years. Ashton-Tate, a medium-size U.S. software company, has nearly quadrupled its R&D budget in the past 2 years, and currently spends $19 million, or 15% of its sales, on R&D. By comparison, an average R&D budget of a Karnataka software firm is 3% of sales. This figure is higher than the Indian industry average (1% to 2%) but low by international standards, and is insufficient to keep Karnataka's firms on the forefront of technological developments in the sector. Thus, the capabilities of local universities/research institutes in the area of artificial intelligence are key to continued competitiveness of Karnataka's software companies. Although IISc has one of the most advanced artificial intelligence centers in India, it has few linkages or joint projects

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with Karnataka's companies. Most of the companies' technologies are either developed internally or in cooperation with overseas partners.

Indian software firms have designed some technologically very sophisticated software packages. Tata Consultancy is currently marketing a computer-aided software engineering (CASE) package in the United States. The software was developed in Hyderabad and allows for a substantial increase in productivity of software engineers and designers Developments in CASE and its increased use by U.S. software companies are likely to increase the productivity gap between U.S. and Indian software engineers, thus undermining India's present comparative advantage in the area. Access to the latest CASE software and workstations is necessary if Karnataka's companies are to preserve their competitiveness in the sector.

Karnataka software companies require access to telecommunications and satellite equipment, which can considerably improve their linkages with foreign partners, customers, suppliers, and information sources. In this regard, the existing telecommunications infrastructure is inadequate – there is a scarcity of telephone lines, available satellite connections (the current OCS link is slow), and facsimile and telex equipment. Establishing a private satellite link, as was done by Texas Instruments, is expensive and takes a long time. Several software companies are currently requesting aid in setting up a shared satellite link with the United States.

Human Resources

Software companies need to hire large numbers of engineering graduates at the bachelor's and master's levels. Although Karnataka has an adequate supply of qualified engineering graduates, they often do not have sufficient applied skills and require substantial training. Few engineering software schools exist in India overall and in Karnataka in particular. According to software industry representatives, many schools teach traditional systems engineering and programming, but not enough institutions focus on bachelor's and master's levels engineering and computer science.

Most software companies interviewed have internal training programs for their new hires, varying from 5 months to 1 year. Tata Consultancy Services (TCS) has a sophisticated 1-year-long training program, combining instruction with actual work experience. The program is so successful that TCS is planning to market it to other firms.

Software companies prefer to hire from IITs, but the best graduates are not available because most go abroad after graduation. IIT Kanpur is considered the best school for software training. The quality of second-tier graduates (e.g., Bangalore University) is often not as good, but they are often more interested and trained in applied work.

In general, Karnataka's software companies have no difficulty attracting graduates from all over India. Bangalore is a desirable place to live; most companies offer a challenging and informal work environment; and some give their key personnel stock ownership. The mobility of engineers between companies is also high – the average rate of turnover is 5% to 10%.

Karnataka software companies can also hire excellent marketing staff because many Indian engineers switch to marketing after graduation. This practice allows for a good combination of technical and marketing skills.

Like other Karnataka companies, software companies lack sufficient personnel with R&D management training. Some staff members can track technological developments overseas and prepare 3- to 5-year technology plans, but few are trained in technology planning, forecasting, R&D project management, etc. Sometimes software companies recruit consultants from universities. The results of such consulting projects are often not satisfactory (too academic and removed from actual industry needs according to one interviewee).

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Finance

Software companies have three types of capital needs:

- Venture or risk capital for spin-offs and other new software companies.
- Capital to finance R&D.
- Capital for overseas marketing and operations.

Venture capital is a new concept in the Indian environment, and very few existing financial institutions (e.g., Keonics and KSIIDC) provide financing for risky new ventures without a proven track record. However, because software has relatively low capital requirements, start-up companies can still be financed from personal savings and family funds. As the industry becomes more capital intensive, the lack of sufficient venture and risk capital could prove to be a considerable deterrent to the growth of new companies.

According to the GOI policy, software houses can use as much foreign exchange as they need for overseas marketing and equipment imports, as long as they undertake to bring home proportionately higher export earnings within a set time. The policy calls for firms to net back hard-currency earnings according to rigidly prescribed timetables within 4 years of the original outlay. The amount of obligation varies according to the origin of foreign exchange used: 150% for the promoter's own funds, 250% for borrowings from government development institutions, and 350% for Export-Import Bank credits. This export obligation places an undue burden on software companies, and many refuse to avail themselves of offered financing. The ability of companies to export products has little to do with the source of financing for hardware and overseas marketing.

PACT offers a good source of funding for joint research and development between Indian and U.S. companies. However, many companies have difficulty figuring out how to divide up funds because the cost differential between Indian and U.S. companies is great.

Telecommunications

Karnataka is the center of the telecommunications industry in India. The rapidly evolving industry consists of two major sectors, each with a number of additional specialized markets. The first sector, communication systems and equipment, includes radio and television equipment, facsimile equipment and antennas, broadcast equipment, alarm systems, detection, navigation, and guidance systems, as well as other specialized laser and ultrasonic communication equipment. The second segment is telephone and telegraph equipment, which includes switching and switchboard equipment, private branch exchanges (PBXs), and fiber optic equipment.

The telecommunications industry worldwide has been in a state of turmoil for the past 5 years. This turmoil is largely the result of deregulation of several national telecommunications markets, particularly in the United States, United Kingdom, and Japan; the globalization of competition and emergence of new competitors in the industry; and the merging of telecommunications and computer technologies. The outcome has been a tremendous proliferation of new telecommunications products and services worldwide.

The existing telecommunications infrastructure in India is inadequate and technologically outdated, greatly impeding the overall productivity of the Indian economy. India today has only 0.3 telephones per 100 persons, one of the lowest per capita numbers in the world. Upgrading the telecommunications infrastructure has been given priority by the government; in the next decade the industry is expected to grow an average of 15% a year. Growth will

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result not only from building new telephone lines but also from replacing existing technologies. The available exchanges are often a mix of mechanical, electromechanical, and electronic technologies. These devices come from different sources and create great maintenance problems.

Two public-sector giants – Bharat Electronics Limited (BEL) and Indian Telephone Industries – are operating in the state. The Bangalore operation of BEL accounts for about 60% of the total production. BEL manufactures defense communication, broadcasting, and other telecommunications equipment. Indian Telephone Industries is the premier organization in the country in telecommunications, manufacturing telephone exchanges, telephone instruments, transmission equipment, microwave equipment, and telemetry and telecontrol systems.

The Center for Development of Telematics (C-DOT) is another of Karnataka's assets. This organization is developing indigenous telephone exchanges suitable for Indian needs.

Private-sector companies are also active in Karnataka's telecommunications sector. Tata Electronics manufactures video mappers and tactical display units/consoles. Larson and Tubro has set up a plant in Mysore to manufacture electronic private branch exchange (EPABX). Bharat Heavy Electricals, Hindustan Brown Boveri Limited (Mysore), and others will manufacture EPABX developed by C-DOT.

With the technical support from major public organizations, several small-scale industries have grown in the state. C-DOT has created a large number of ancillaries, which provide the company with electrical, mechanical, and semiconductor components. BEL's Bangalore complex has 19 ancillaries in the state. With the help of KSIIDC, it has started 20 new industrial buildings that were relegated to ancillary status. ITI has over 30 ancillaries in the state.

Keonics has also been instrumental in the development of the state's telecommunications industry. In a joint venture with Swede Ericsson of Sweden, it has started a plant to manufacture telephone instruments. Keonics also manufactures VHF wireless communications equipment in collaboration with Marconi of the United Kingdom.

Several major government labs and research organizations are developing telecommunications technologies in Karnataka. Electronics and Radar Development Establishment (ERDE), the premier institute in the field of radar development, is located in the area. Research, development, and production of satellites, including communication satellites, are carried out at the Indian Space Research Organisation (ISRO) in Bangalore.

Technology

The telecommunications industry is rapidly advancing in both the products and processes it encompasses. Product niches are broadening to include information systems and voice, data, and graphics transfer systems. Fiber optics technology is revolutionizing the industry, allowing greater volumes of information to be transmitted over hair-width lines. High-speed, large-capacity, and multimedia functions continue to be the focus of technology efforts in the industry. Karnataka's telecommunication companies must invest in these technologies to be competitive.

Until recently, Karnataka's telecommunications equipment suppliers relied on foreign sources for technology. In some areas, however, successful indigenization of product development (e.g., telephone exchanges) is now taking place. C-DOT has developed a 128-line rural automatic exchange (RAX) and its 128-line electronic PABX is ready for field trials. ITI has developed an indigenous EPABX and recently a sophisticated integrated local and trunk exchange (ILT) utilizing state-of-the-art techniques for operation and maintenance. However, foreign companies still serve an important role in transferring switch technology to

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Karnataka's companies. In the private sector, technology from GTE Belgium, Jeumont Schneider of France, and Oki of Japan has been given to 15 companies for manufacturing switch equipment.

For telephone equipment, many of Karnataka's companies are relying on foreign technology—Swede (India) Teletronics Limited will manufacture electronic push-button phones with Swedish collaboration; another company is setting up a plant in Mysore for the manufacture of telephone instruments with Siemens technology. The ITI-BEL consortium is negotiating with Nippon Electronics of Japan for the manufacture of digital microwave systems. The license for manufacture of optical fiber links to be undertaken by ITI is likely to come either from NKT, Denmark, or STC Telecom.

More technology has been transferred from government research labs to industry in telecommunications than in other sectors. However, the transfer is usually between a government organization and a large public (sometimes private) Indian company, rarely to smaller private firms. With the assistance of ISRO, for example, ITI has begun to manufacture terminal equipment, including earth stations, required for satellite communication links. Tata Electronics manufactures video mappers and display consoles for radar using technology from the Electronics and Radar Development Establishment (ERDE). Although some technology transfer exists, the volume can be expanded to include more small and medium-size companies.

One of the greatest bottlenecks for Karnataka's telecommunication companies is a lack of sufficient high-quality suppliers of semiconductor components. Because Karnataka has no large-scale manufacturers, the quality and cost of semiconductor products greatly lag behind what is available on world markets. Small-scale ancillaries set up by ITI and C-DOT usually produce low volumes and cannot afford the latest equipment and materials to ensure high quality.

Human Resources

The industry requires a high degree of engineering skills, ranging from the most sophisticated levels of R&D in circuit design, software engineering, and materials research to the specialized technical skills needed for manufacturing and installation of systems, as well as marketing and management skills. Although Karnataka's companies are able to hire sufficient numbers of qualified engineering graduates, these people often lack applied training, and telecommunication companies have to invest considerable amounts in training. Like firms in other emerging sectors, telecommunication companies lack sufficient R&D management, technology forecasting, and modeling skills.

Finance

The telecommunication industry is becoming increasingly R&D and capital intensive. R&D spending by Karnataka's larger public and private companies is relatively high (between 3% and 4% of sales). Smaller suppliers, however, do not have sufficient funds for R&D and product enhancement—a fact that often result in poor-quality and high-priced products. Ancillaries rely largely on parents for the latest technology and do not engage in sufficient independent R&D. Better access to financial resources for smaller units can alleviate the situation.

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Computers

Karnataka is a leader in the rapidly growing Indian computer industry, and firms within the state produce mini- and microcomputers, as well as peripherals such as disk drives, storage devices, modems and printers. The electronics industry in Karnataka accounts for 30% of India's electronic goods production. The state has even created an "Electronics City" near Bangalore where many electronics manufacturers are concentrated.

The global computer industry has witnessed major technological changes that have resulted in dramatic improvements in the price/performance ratios of computers. Today, personal computers have the raw processing speed of mainframe computers of a decade ago. At the same time, rapid advances in integrated-circuit technology and drastic decreases in the price of memory chips have led to sharp declines in the prices of computers. The personal computer is now a commodity, and the main differentiating factors between various manufacturers are brand-name recognition, manufacturing prowess, marketing, distribution channels, and price. New developments in the personal computer industry include IBM's new line of personal computers that will be more difficult to clone than the previous models, and the use of Intel's 80386 microprocessor that makes the high-end personal computer a very powerful and versatile machine.

Engineering workstations and supercomputers form the emerging sector within the global computer industry. The former are designed primarily for use by engineers, while the latter, which can process hundreds of millions of instructions per second, are needed for weather forecasting, nuclear research, and complex simulations. The sale of supercomputers in the international market is a politically sensitive issue, with the United States aiming to qualify the buying nation as well as the intended application before authorizing the sale.

Engineering workstations are expected to proliferate substantially with the growing use of CAD. Companies like Apollo and Sun Microsystems have an early lead in this field, but computer makers like Digital Equipment Corporation, Hewlett-Packard, COMPAQ, and others are expected to make a strong bid for dominance in this market. Engineering workstations will also face competition from high-end personal computers based on Intel's 80386 or Motorola's 68020 and 68030 microprocessors.

Other emerging fields within the computer industry include advanced computer architectures such as parallel processing and neural networks. The field of peripherals has also seen many changes in storage technology; vector and raster plotters; thermal, ink-jet, and laser printers; and scanners. A key global trend in electronics manufacturing is the increasing use of surface mount components, hybrid components, and multilayer and flexible printed circuit boards. These developments will further miniaturize designs.

Technology

The computer industry within India is an emerging sector driven primarily by imported technology, including value-added components for Indian brand computers and foreign brands sold by local firms. Most research and development within Indian computer firms focuses on emulating existing products, developing enhancements to existing products, and in some cases combining software to develop effective turnkey systems. Many of the electronic components are imported but are becoming increasingly available within India. Government rules require companies to offset the cost of imports by exporting computer hardware. The United States is regulating the outflow of state-of-the-art computer technology for national security reasons, however.

The emerging computer industry in Karnataka will need to develop many capabilities over the next few years. Karnataka will need to progressively indigenize the manufacture of computer components such as memory chips, as well as develop engineering workstations for

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CAD, perhaps using the Intel 80386 microprocessor. Karnataka also needs to produce drafting plotters for use with CAD systems. These plotters could use pens and grit-wheel technology to produce engineering drawings. Karnataka's computer peripherals industry must keep pace with advances in storage device technologies such as optical disks. Developments in surface mount technology components and placement equipment also need to be monitored and assimilated in a few years. A major application area for computers in India is process control. Computer hardware and software need to be designed for on-line process control applications in a variety of industries to improve process efficiencies, reduce energy consumption, gather process data, maintain control, and promote safety.

One way to indigenize the development of computer hardware is to attract nonresident Indians working in U.S. computer firms back to India to work on product development in Karnataka's computer companies. Also, the graduates of various IITs, particularly at Kanpur, and IISc are excellent candidates for creating strong research and development functions. The computer components sector can be gradually indigenized through the planned establishment of plants to produce semiconductor devices, integrated circuits, printed circuit boards, and plastic and stamped metal parts.

Human Resources

The state's computer industry hires graduates from the IITs, IISc, and engineering colleges. Although the availability of good employees is not considered a problem, their training requirement is. Wipro has a formal 9-month training program in computer systems and corporate values. Hinditron Computers sometimes sends high-caliber recruits to the United States for training. The state's computer industry maintains close links with the educational institutions that supply bachelor's and master's degree holders in electrical engineering and computer science. The industry is characterized by the high mobility of its professional work force, akin to Silicon Valley in the United States.

To keep abreast of rapid technological changes in the global computer industry and do research and development work, the computer industry in Karnataka needs to attract the very best electrical engineers and computer scientists. Because of the relatively high job mobility of technical professionals in the industry, companies also need to devise ways to retain employees and reduce turnover. An important source of technical talent for the industry would be nonresident Indians wishing to return and work in India after completing education and acquiring relevant work experience in the U.S. computer industry. Also needed will be electronic technicians for testing, repair, and laboratory work. The state's polytechnics and vocational training institutes should be relied on to produce printed circuit board layout designers and electronic technicians.

Capital

Many of the technologies are capital intensive, and for an emerging industry in India like computers and peripherals, the sources of capital would typically be the parent company (if the parent is an established large company that is diversifying), the state government and its agencies, and foreign equity partners. The venture capital industry is not developed enough to be a source of risk capital for new ventures in high technology.

Biotechnology

Although Karnataka does not have a biotechnology industry as such, it has a number of institutions and companies that can serve as a basis for its future development in the state. Despite much excitement about the promises of biotechnology, the industry is still in an embryonic stage with very few companies able to introduce commercial products. This situation is due largely to the long-term nature of biotechnology research and a lengthy process of regulatory approval for new drugs and processes in many countries. At present, the biotechnology industry is divided into four main sectors, each with a different profitability record:

- *Human diagnostics* — This sector encompasses innovative diagnostic testing devices. Currently, this market segment is the most profitable, largely because development of diagnostic products (e.g., pregnancy detection kits, blood pressure tests) does not require high R&D investments and long lead times.
- *Human therapeutics* — This sector includes complex pharmaceutical products produced using new genetic engineering techniques. Companies in this sector spend more on R&D, require longer time frames to bring products to market, and face higher regulatory barriers. At present, therapeutic firms are highly science and research driven, with very few products reaching the market and enjoying commercial success. In the long run, biotechnology firms in human therapeutics will have to compete with established pharmaceutical firms. Many pharmaceutical firms, in fact, have started internal biotechnology programs; almost every existing pharmaceutical firm has a number of joint research and cross-licensing agreements with smaller biotech companies.
- *Agri-tech* — The sector encompasses products to treat plant and animal diseases, strengthen resistance to environmental factors, and improve seeds and productivity of livestock. As with human therapeutics, companies in this sector are blazing new scientific trails, with few products reaching commercial success yet.
- *Biotechnology suppliers* — The industry includes companies producing biologic feedstock, nutrients, equipment, and instrumentation for internal marketing to the industry. Development of this industry segment is linked to the development and demands of the other three biotechnology sectors.

Overall, the biotechnology industry is extremely R&D intensive. R&D expenses as a percentage of total costs average around 30% per company. Thus, one of the major issues for smaller companies is having sufficient capital to fund R&D. Often such funds come from larger pharmaceutical, chemical, or food companies in the form of joint ventures, R&D limited partnerships, and other forms of alliances with biotech firms. Virtually every biotech firm in the United States has 5 to 10 cooperative agreements with larger firms. The benefits of such arrangements are evident to both partners: smaller companies get needed funds to continue research and gain access to the larger firm's marketing and distribution network; larger firms gain knowledge of technologies that can be applied to their product lines or used for diversification.

The majority of the 400 biotechnology companies in the United States face a dilemma: the need to invest in long-term R&D projects with greater future payoff versus the need to show current profits, particularly for public companies. Most biotechnology companies, while investing in glamorous research areas (like recombinant DNA), also continue to work in less glamorous biotech applications (like tissue culture).

Karnataka does not truly have a biotechnology industry yet. A few pharmaceutical firms are starting to work on biotechnology applications (e.g., Astra-IDL). These firms have good science capabilities and, through joint ventures with overseas biotech companies, may serve as the basis for a future biotechnology industry in the state. A few small biotechnology firms (e.g., Biocon) are focusing on production of enzymes and feedstocks for chemical production. These are generally considered less technologically advanced and less profitable sectors of biotechnology.

As with other emerging industries, biotechnology cannot develop in isolation from other related industry sectors in the state — chemicals, pharmaceuticals, food processing, agriculture, etc. The application of biotechnology techniques by these firms, combined with their willingness to invest in new products, will ultimately drive the development of the biotechnology industry in the state. At present, Karnataka's pharmaceutical and chemical companies are not actively looking at applications of new fermentation technologies for production; most are not yet using current processing technologies (e.g., few have computer process controls). Greater interaction between existing biotechnology and established chemical, food processing, and pharmaceutical companies may be important in encouraging biotechnology growth.

In addition to synergisms between biotechnology companies and larger established firms, two other factors have been crucial in the development of the industry in the United States. First, the availability of venture capital led to the growth of start-up biotechnology companies. Second, most biotechnology breakthroughs came from universities (e.g., Stanford's genetic engineering techniques), and many companies were founded by academics who combined scientific and entrepreneurial skills (one of the founders of Cetus, for example, was a University of California, Berkeley, professor).

The interactions between companies and universities also play an important role in industry development. Every biotechnology company has working relationships with four to five universities, ranging from consulting arrangements to joint development work. Although the biotechnology industry in India may develop differently, all three – linkages with established companies, strong capabilities of local universities, availability of financing – are necessary elements of Karnataka's infrastructure for the industry.

Technology

Depending on the specific biotechnology sector, companies need access to a broad range of technologies, ranging from recombinant DNA to plant and animal tissue culture. Companies engaged in manufacturing biotechnology products also require knowledge of biochemical engineering and processing.

At present, those Karnataka companies interested in biotechnology applications are looking to foreign companies for technology (Astra and Farmacia of Sweden, Genentech of the United States). Some firms are also attempting to develop technology indigenously. United Breweries Group, for example, has founded the Vittal Mallya Scientific Research Foundation in Bangalore with the purpose of engaging in biotechnology research. IISc Bangalore can also serve as a base for future activity in the sector. IISc has an excellent animal research lab and one of the most advanced facilities for oligonucleotide synthesis, which plays an important role in molecular biology and genetic engineering. At present, however, there is little interaction between the academic labs and Karnataka's industry.

The areas in which biotechnology companies in Karnataka are lacking expertise include process technology for downstream production and production scale-up. In addition, they report difficulty monitoring technological developments worldwide and getting access to recent research data.

Human Resources

Biotechnology is a multidisciplinary area, which requires a range of human resource skills, including molecular biology, chemistry, physics, and pharmacology. Because the industry is extremely science driven, companies need to hire graduates at master's and doctoral levels in these areas. The Indian Institute of Science, Bangalore, is one of the few centers in the country in which the Department of Biotechnology has launched an innovative program for the teaching of biotechnology. The students for the program are selected nationally and are provided with scholarships from the Department of Biotechnology.

Existing biotechnology companies report no difficulties in finding the needed research talent from either IISc or the Institute of Biotechnology, New Delhi. However, as the biotechnology industry in the state grows, it might become harder to find qualified people.

Finance

Financing does not represent a problem for large chemical or pharmaceutical companies planning to engage in biotechnology activities. Small biotech companies in Karnataka, however, have trouble obtaining needed financing, especially for production scale-up and purchase of the latest laboratory and production equipment. One of the major sources of finance for U.S. biotech companies – R&D limited partnerships – is not available in India because of regulatory restrictions.

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Expanding-Sector Industries and Their Needs

In expanding industries, product categories and markets are well established, products are standardized and can be manufactured in large volumes, and there are many well-established competitors in the market. Competition in expanding sectors centers around companies' ability to grow with the market, i.e., preserve their market share, expand their product lines, and introduce new products and next generations of existing products. The need to grow often takes companies into international markets, and it is at this stage that many companies establish international operations.

Companies in expanding industries may also expand into adjacent product lines and services to integrate their products into a system. This strategy allows companies to offer customers significant added value and provides customer loyalty. An example of this strategy is IBM, a computer manufacturer, joining with CBS and Sears to offer customers various data services on IBM computers.

Whereas manufacturing and marketing are of marginal importance in emerging sectors, in expanding sectors these two functions assume primary importance. Because the volume of production is larger and products are standardized, companies begin product differentiation on the basis of cost and quality. The better and the more efficient are the company's manufacturing and production facilities, the lower are its costs per unit.Thus, companies in expanding sectors need to invest in the latest manufacturing technologies—CIM, robotics, etc.

Among the major industries of the expanding sector in Karnataka are the following:

- Pharmaceuticals
- Automotives
- Processed foods.

The infrastructural needs of these companies center around availability of resources to sustain growth and engage in efficient production and manufacturing.

Expanding-Sector Needs for Technology

Karnataka's expanding-sector firms make use of a variety of technology resources. Not unlike expanding sectors in the United States, expanding sectors in India typically have more resources than the emerging or transforming sector to bring to bear on competing in the marketplace. However, also like U.S. expanding-sector firms, these firms spend less on applied research and more on end-stage product development and marketing. The larger expanding-sector firms, in automotives, specialty chemicals, and processed food, each have their own technology sources within their companies. Most of these firms have not focused extensively on R&D before and invest very little in it today. (Firms in pharmaceuticals, however, apply far more resources than those in specialty chemicals or food processing in India.) As a result of this tradition, expanding-sector firms will continue to grow with low expenditures on applied research as long as there are few competitors.

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The modest level of technology used in expanding industries and the lack of competition allow them greater leeway in planning their technology development activities. Most take the tried and true route, whether it means using the same formula for detergent and soap used for years or copying products made by overseas producers and selling them into regional markets. Product R&D fluctuates with annual budgets, and there is little emphasis on research that is not designed to improve products or production.

An important area of concern for Karnataka's companies is inadequacy of their manufacturing and production technologies. This area is neglected by Karnataka's universities and colleges. It is often impossible to find qualified personnel in specific areas—e.g., production control, production scale-up. Very few companies use the latest manufacturing technologies, including CNC, flexible manufacturing, and CAM.

As a result, some expanding industries are customers of the research institutes and labs in Karnataka. In fact, these industries were the ones these centers were originally designed to serve when initially formed. Key institutions for the expanding sector have been the Central Machine Tool Institute, the Central Power Research Institute, and, in some cases, the Central Food Technology Research Institute.

These centers' skills and service structure were, and perhaps still are, well suited to the types of organizations they have served. However, even those firms that the technology centers have served are finding, as their businesses mature, that the technology centers are either not interested in their problems or are not able to respond their specific needs. In fact, many expanding-sector firms have a specific need for more sophisticated technology capabilities in planning the deployment of automation in a plant to improve productivity or to conduct product upgrading and development of new products. Thus, as expanding-sector firms mature in India and the markets they operate in become less protected, they too will need increasingly sophisticated R&D and technical assistance to modernize and compete in domestic and overseas markets.

The scope of needs for new R&D assistance appears to be related to the corporate structure of the expanding firm. Many expanding firms in Karnataka, for example, are joint ventures with European companies. These relationships provided technology equipment and skills to companies early in their development. Today, most joint ventures have far more limited relationships with their partners, necessitating that the Indian company expand its R&D capacity. Because they have faced little competition in the past, the drive to build capacity in R&D has often been limited to narrowly defined and practical fields. In most cases, technological advances have focused not on developing breakthroughs in the industry, but on modifications that suit the needs of customers in the Indian marketplace. Joint-venture companies are likely to have a reasonable organizational capability that can be built on to expand R&D in the future or to do new work with R&D institutions.

Large public companies, on the whole, have better-structured R&D activities than their counterparts in the private sector. They also engage in more technological and strategic planning. Companies like

BHEL and HMT are major buyers of R&D from government research labs and universities. Relationships between large public companies and research institutions in Karnataka are often the result of mobility of top-level management personnel between these institutions and personal relationships between them. The transfer of R&D between public companies and government research labs is also encouraged by the government. However, some of the larger private holding companies, such as Tata, have actually recognized the potential for developing private R&D and consulting practices for Indian industry. These larger companies will, over time, probably be a growing consumer of R&D services, like the emerging-sector firms, if India's industries enter international markets.

Overall, expanding-sector companies believe that technologies coming out of research labs and universities are "paper technologies"; i.e., they will require 3 to 5 years to result in commercially viable products. There is a general perception that research organizations are not interested in this late stage of development and often do not have capabilities for it.

Karnataka's expanding-sector companies at present do not have sufficient capabilities to monitor technologies worldwide, particularly in adjacent areas that might affect their products in the long run. This inability may lead to delays in investments needed to stave off maturity and obsolescence.

In sum, expanding-sector firms are likely to be a major source of demand for R&D service around moderately sophisticated issues in the future. These industries need to be helped to recognize that they have R&D needs that can be met by technology suppliers. In the medium to long term, they will be mainstream R&D customers in Karnataka for research in new materials and processes, as well as for production technology innovation from a variety of sources in Karnataka – from NAL to CMTI – if they can respond.

Expanding-Sector Needs for Human Resources

The ability of companies to hire sufficient numbers of qualified personnel to support growth is a key to success in expanding sectors. At present, Karnataka's companies do not have difficulty hiring sufficient numbers of scientists, engineers, and marketing professionals. There is concern, however, that if expansion continues, it may become harder to fill needed positions. As with emerging sectors, these companies lack skills in R&D management and technology forecasting. In addition, they are not getting qualified manufacturing and production personnel. At the same time, it is particularly important to organize R&D activities in expanding sectors in close coordination with manufacturing and marketing staff.

Emerging-Sector Needs for Finance

Financing is typically not a problem for companies in expanding sectors because their growth generates enough revenues to support R&D, acquisition of needed technology, and hiring of new personnel. However, the depth of surrounding financial institutions – i.e., their ability to offer a variety of debt instruments and financing mechanisms – determines companies' ability to hedge their borrowing risks and

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costs of borrowing capital. Overall, India has an overwhelmingly loan-based system of corporate finance, which favors existing companies. The stock market is fairly underdeveloped despite increased activity over the past 2 years. Long-term loan liabilities still predominate over stock issues and securities trading as a major source of business capital. Although new financing mechanisms – debentures and equipment leasing – are becoming increasingly popular, many other innovative financing mechanisms currently used in the West are not available for Karnataka's expanding industries. The use of bond and equity financing by development banks is limited and there is no secondary securities market. Although expanding industries usually have no difficulty finding capital in Karnataka, long-term efforts could be directed toward increasing the efficiency and reducing the cost of obtaining capital.

EXPANDING INDUSTRIES

Pharmaceuticals

Pharmaceuticals is a growing industry in Karnataka, with several well-known companies located in the state (e.g., Eskayef Ltd., ASTRA-IDL, Karnataka Antibiotics Public Limited, Cipla). Several other Indian companies have pharmaceutical units in the area (e.g., Reckitt-Coleman, United Breweries).

While the market for modern pharmaceuticals is expanding rapidly in India (currently, modern medicine only has 25% of the market), in developed countries growth rates of pharmaceutical companies have fallen. In the 1980s growth rates in the industry equalled 5% a year compared to 15% in the 1970s. Drug companies have increasingly come to realize that only a new wave of innovation, bringing significant medical advances, will offer the chance of renewed growth. They have turned to biotechnology for new products and methods of drug design and testing.

A recent regulatory change in the United States has caused an upheaval in the pharmaceuticals sector. In 1984, Congress passed a bill removing regulatory obstacles to the manufacture of drugs on which patents had expired. By the end of 1986, 120 of 1983's 200 top-selling products were out of patent, presenting the opportunity for generic firms to make cheap copies. Generics found a ready market in the United States, and their sales now account for more than one-fifth of the American drug market by value, compared with 10% in 1983. The generics industry will cast an increasingly large shadow over the big pharmaceutical companies. Sales of off-patent drugs are expected to increase by 20% to 25% each year to reach over $8 billion in 1990.

Generic competition and price erosion will spur companies toward developing new drugs. In the long term, industry experts foresee the emergence of three classes of drug companies: the discoverers, producing new drugs that expand the market in new directions; the acolytes, surviving on manufacturing drugs licensed from the discoverers; and a multitude of imitators dominating the bottom of the market with cheap versions of off-patent products.

In Karnataka, as with the rest of India, this market structure has been in existence for a long time. There are virtually no "discoverers"; most firms are either acolytes or imitators, primarily because of the overall regulatory environment, which gives little incentive to innovation. Patent rules in the pharmaceutical sector do not accord sufficient protection – only processes, not actual products, can be patented. Patent enforcement is lax and imitators are rarely fined; price controls do not allow innovators to recoup their initial investments in R&D. Thus, Karnataka companies' R&D expenditures are low compared with those of their U.S. counterparts (3% versus 5% to 10% in the United States).

The growth of Karnataka's drug companies has been based on manufacturing products originally introduced by multinationals or imitating their products. Since multinationals usually do not introduce their latest products into India because of insufficient protection, the current range of drugs produced by Karnataka's companies is 5 to 10 years behind what is available on world markets.

Although indigenous drug companies can capitalize on lower labor costs, fewer pollution controls, and fewer regulatory restrictions, their costs of production are much higher than the international prices. In percentage terms, the range of Indian prices is equivalent to 109% to 423% of the international prices for manufacture of antibiotics, vitamins, and hormones.

Karnataka's drug companies, however, have produced innovations in certain areas of homeopathic treatments, based on medicinal plants native to the area. Cipla, Bangalore, for example, has produced a drug for cancer based on a locally grown vinca plant; ASTRA-IDL is working on new ayurvedic medicines.

Technology

Karnataka's pharmaceutical companies obtain technology in three ways;

- Adapt existing products (most common).
- License from overseas.
- Buy from research institutes (e.g., National Chemical Laboratory, Central Drug Research Institute, Lucknow, IISc).

Most drug companies do not have the resources to do basic research or to sponsor it at universities or government research labs. Although new products have come out of these institutions (e.g., a drug to reduce blood pressure was developed at CDRI), company personnel interviewed agree that most products that come out are "paper technology": 3 to 5 years are required to make them commercially viable and to develop appropriate production methods. Existing processing and production techniques in the pharmaceuticals sector are inadequate and lag far behind world standards.

Drug company staff believe that the infrastructure of industries supplying the drug sector is inadequate. For example, the packaging and materials-handling technologies are very primitive. Existing machines have low output; more sophisticated, higher-output machines exist, but they cannot work with Indian materials.

Most pharmaceutical companies have numerous ancillaries in the state, ranging from raw-materials suppliers to producers of certain drug formulations. The ancillaries usually operate in lower technology areas or produce products that a drug company itself decided to phase out.

Human Resources

Karnataka's pharmaceutical companies have trouble hiring skilled personnel in specific areas—quality assurance and material handling, in particular. Most believe that university education is too general and does not prepare graduates for specific industry tasks. Substantial on-the-job training (2 to 3 years) is required.

Company staff also believe that the research personnel they hire are often too academic, and they have to work hard to interest them in applied work. Sources of recruitment include the University of Bangalore, IISc (limited), and IITs.

Finance

The pharmaceutical industry has no special finance needs; however, removal of restrictions on import of machinery and incentives for equipment replacement are necessary.

Automotive

The automotive industry in Karnataka includes makers of vehicles such as scooters, mopeds, motorcycles, autorickshaws, and passenger cars; automobile parts such as tires, batteries, pistons and piston rings, engine valves, spark plugs, distributors, starter motors, ignition coils, and fuel injection equipment; and instruments and gauges such as speedometers, oil gauges, and temperature gauges.

Worldwide, the automobile industry is being transformed because of changes in technology and manufacturing methods. Here, too, the Japanese have been a major factor because of their exceptional competence in manufacturing. The major inroads made by Japanese firms into other markets, particularly the United States, created the strong interest in Japanese manufacturing and management methods. Now the three major automobile companies in the United States are adopting many of those practices, such as just-in-time manufacturing, total quality control, factory automation including use of robots, close customer-supplier relations, fewer suppliers, and employee involvement programs. The large number of companies that supply automotive parts to these three major U.S. automakers are also, in turn, implementing the same practices because they are expected to supply 100% quality parts, on time, and in small lot sizes to their customers. The suppliers are also being expected to respond rapidly to requests for tooling and prototypes.

There have also been many innovations in the designs of automobiles. These include microprocessor-based controls to regulate and monitor engine performance, emissions, and brakes to ensure fuel efficiency and safety. The trend is toward more electronics and sensors in cars to provide the driver with timely information about the performance of the car, as well as to improve safety and fuel efficiency. Other innovations include such features as variable-stiffness suspensions, 4-wheel steering, anti-lock brakes, and twin-cam engines. Plastic parts are also being increasingly used.

Besides changes in technology and manufacturing methods, the global automobile industry includes new producers from Korea, Yugoslavia, and Brazil to join the many automakers from the United States, Japan, and Europe. Thus, the international market is fiercely competitive, and customers expect high reliability and quality, attractive options and styling, and competitive prices.

The automotive market in India was long protected from foreign competition. Recently, the Indian market has opened to foreign auto companies, some of whom have entered into joint ventures with Indian firms. This change should revitalize and expand the Indian auto industry, which for a long time was characterized by poor quality and lack of innovation. Also, with a growing middle class, India's automotive market is poised for considerable expansion.

Technology

The auto industry of Karnataka obtains technology from in-house development as well as from foreign sources. For example, MICO, which makes spark plugs and fuel injection equipment, is partly owned by Bosch, a West German company, and its R&D chief is a German national. Vikrant Tyres imports technology from abroad and tailors it to Indian conditions. Amco produces batteries based on both indigenous designs and imported technology. It is obtaining technology from France to produce nickel-cadmium batteries. The company is the nation's largest exporter of batteries, primarily to the USSR.

By exploring new technologies for existing and new products, the auto companies of Karnataka can take advantage of the expanding Indian auto market. These include producing radial tires, car air conditioners, electronic horns, headlamp assemblies, clutch plates and assemblies, brake linings, and clutch facings. In producing these parts, the state's auto companies need to incorporate some Japanese manufacturing methods and thereby achieve high quality. The prospects for exporting auto parts exist, but doing so will be challenging because of the global auto industry trend toward fewer and closer suppliers.

The new technologies could be obtained in the short run through joint ventures or licensing arrangements with suitable foreign companies. The participation of several foreign auto

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makers, particularly the Japanese, in joint ventures with Indian firms could lead to the availability of many new technologies and to more stringent quality requirements. In the long run, however, Karnataka's auto industry should rely on in-house research and development to indigenize and improve imported technologies.

Human Resources

The availability of employees with the required skills does not appear to be a major issue for the state's auto industry. Occasionally, however, people with certain skills cannot be found. For instance, Amco needed an expert in glass fiber technology but could not find one. The company sometimes sends employees to the Battelle Institute in Columbus, Ohio, for R&D training.

As new technologies are pursued and product quality requirements become more stringent, auto companies will need highly competent design and manufacturing engineers. The latter typically will be mechanical or industrial engineers trained in process design, plant layout, material-handling equipment design, quality-control techniques, etc. Increasingly, the design engineers will need to be knowledgeable about new materials such as plastics, and the manufacturing engineers should be familiar with the methods and concepts of modern manufacturing. As the electronic content of automobiles increases, the need for electrical and control engineers will increase. Also, the managements of these firms should be exposed to global trends in manufacturing and be aware of Japanese management techniques. The management will need to inculcate in workers a new quality ethic and give them the training and the tools necessary to use statistical quality control and problem-solving methods.

The management education needs of current and future auto executives can be met by working closely with the IIMs to develop suitable courses. The state's technical sources, such as the engineering colleges and polytechnics, are capable of supporting the auto industry well in most areas. Training in modern manufacturing techniques, such as statistical quality control, may be arranged with the Foreman Training Institute, which offers courses tailored for manufacturing supervisors.

Finance

The availability of capital is not a major issue for the state's auto industry. In general, most ventures will be well within the means of the private sector through equity and loan financing.

Processed Food

Demographic changes and changes in life styles are affecting consumer food preferences in the United States. In response to new consumer trends, food companies are revamping their strategies and developing new products, packaging technologies, and distribution channels. Among the demographic changes driving these developments are growing numbers of working women with less time for food preparation; decrease in household size, requiring smaller quantities of purchased food; rise in the elderly population with special dietary needs; and increased concern with the quality and health benefits of food. Consumers are increasingly looking for quality, convenience, and nutritional value in food purchasing.

The processed foods industry in the United States has changed from a staid, low-technology business to an innovative, dynamic growth sector of the economy. A variety of new products have been introduced in response to consumer needs – General Mills has expanded its food service offerings by 50% to 150 products over the past 5 years, and Quaker Oats has quintupled its offerings to 500. Several companies have established research institutes to investigate the latest food technologies: Campbell Soup has formed the Campbell Microwave Institute to resolve technical issues relating to microwave foods and to convert all Campbell's products to microwavable formulations and packaging within 5 years; CPC International has established a worldwide research network designed to investigate the demands of local customers.

Sales of prepared foods are cutting into the sales of processed foods. Food processors in the United States have responded in two ways: first, by developing processed foods that are able to compete with freshly prepared takeout meals; second, by acquiring food service suppliers.

Similar demographic changes and changes in life styles are taking place in India, although on a different scale. There are a growing number of nuclear families instead of traditional extended ones, often with both spouses working; the life expectancy has gone up with a concomitant growth in the elderly population; interest in healthful foods is growing; large numbers of westernized young people are attracted to western-style fast food. Convenience, quality, packaging, and distribution are becoming important considerations for large numbers of Indian consumers. These include 35 million middle-class consumers in urban areas and 40 million affluent households in rural areas.

The potential of the processed foods industry in India is great. Out of about 55 million tons of fruit and vegetable production, an estimated 25% to 30% is wasted or not utilized economically because it cannot be processed quickly enough. In fact, the food processing industry in India uses only 0.5% of the total production of fruits and vegetables, compared with 50% in developed countries. In the past 4 to 5 years, India has been increasing its manufacture of convenient ready-to-cook and ready-to-serve products. These products have a high value-added content. It is expected that in the next 12 years, the value addition may increase from the present 85% level to more than 150%.

Karnataka's food processing industry at present is limited. It is based on several crops grown in the state – rice, corn, sugar, wheat, coconut, coffee, etc. Food processing companies include millers, distillers, feedstock producers, brewers, edible-oil manufacturers, and snack food and spice makers. One of the largest liquor/food companies in India – United Breweries (UB) – operates in Karnataka. However, because of government restrictions on industrial expansion, UB subcontracts production of many varieties of food products and brewing additives to small units. Most of the existing food processing companies in the state are small. The largest flour mill, for example, produces only 300 tons a day. Karnataka's small food processing units operate with obsolete equipment and technology, leading to inefficiency and high cost. Consumers often do not trust small manufacturers, especially those in an unorganized sector, to supply good-quality food.

The Central Food Technology Research Institute (CFTRI) operates quite independently from industry in the state. Although there are a few cases of technology transfer from CFTRI to small private companies, on the whole the industry considers CFTRI unable to engage in applied research and to develop products to the commercialization stage. CFTRI, however, has stimulated growth of small agricultural and food processing companies in the Mysore area. Thus, it has a good potential for serving as a focal point for the development of the food processing industry in the state in the future.

Technology

To be internationally competitive, Karnataka's food-processing companies need access to three areas of technology: packaging, food preparation, and techniques that allow for extension of the shelf life of products. Currently, Karnataka's companies are not taking advantage of a wide variety of new packaging materials and technologies: plastics, controlled-atmosphere packaging, aseptic packages, self-heating cans, etc. Vacuum-packed, self-stable, and refrigerated meals are new developments that can have a great market potential in India and

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can be capitalized on by Karnataka's companies. Self-stable products do not require refrigeration and last for a long time. The lack of need for freezing these products makes them particularly suitable for the Indian market.

Karnataka's food processing companies do not have sufficient information about the latest developments in food technology, either in India or overseas. Most do not have sufficient resources internally for technology monitoring and planning. Many of Karnataka's food processing companies do not have sufficient capital for equipment upgrading. Also, adequate food processing equipment and machinery are often unavailable. As a result, most food production is inefficient and costly.

Human Resources

Karnataka's food processing companies currently lack sufficient numbers of people in the following three categories:

- *Marketing*—Research, evaluation, testing, market development, consumer research, marketing strategy development.
- *Production*—Quality control and engineering, production engineering.
- *Technical*—Planning, monitoring, strategy development, R&D management, food technology.

Finance

The greatest gap for Karnataka's food processors today is a lack of sufficient capital for equipment upgrading. Because most of the food processing companies are small, they lack sufficient internal resources and often cannot obtain outside funding to fill these needs.

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The transforming-sector includes industries in which both the product and the production methods are changing or have changed radically. The result is that the industry is no longer the same.

There are several reasons for industry transformation. The most common one is the emergence of new technologies that significantly affect existing industry products or production methods. In the U.S. automobile industry, for example, the introduction of flexible manufacturing techniques has resulted in a drastic reorganization of production. At the same time, the advent of electronics and new materials has started a shift in the nature of the automobile: instead of an electromechanically based product, it is becoming an electronic one. Another driving force behind transformation may be deregulation, allowing companies to move into new product/service areas. In banking, for example, the change in U.S. statutes has enabled a variety of new institutions – such as retailers and insurance companies – to enter the financial services sector. As a result, the structure of the financial services sector has broadened in terms of ownership and range of products/services offered (e.g., mixing credit cards and insurance).

When an industry handles transformation properly, the majority of companies within the industry, after a sometimes painful restructuring process, will evolve to a new form. If a transforming sector does not adapt to the forces at work, the industry is likely to be reconfigured significantly anyway as emerging sectors encroach on existing markets through product substitution (plastics and ceramics replacing steel), or as new production techniques permit other industries to enter into current markets (electronics and smaller-scale telecommunications firms offering satellite and cellular telephones versus larger telephone companies offering traditional local and long-distance services).

Companies that fail to transform their products and production methods reach maturity – their revenues decline, markets for their products shrink, and their costs rise compared with their competitors'. The machine tool industry in the United States is an example: the industry is rapidlydisappearing and being replaced by an advanced manufacturing equipment sector, which incorporates computer numeric controlled equipment, sensors, and mechanical systems together.

In some cases, the transformation has a dramatic impact on all stages of production. For example, the development of automated manufacturing equipment, from robotic arms and vision inspection systems to automated materials handling, has slowly started a shift in the procurement of manufacturers away from traditional metal forming and shaping equipment. Moreover, another transformation may occur as the shift toward flow process materials (composite plastics) takes place.

The protected nature of the Indian economy tends to keep Indian industries from having to transform at the same speed and to the same degree that industries transform in the United States. The inability of companies to go out of business, in particular, leads to a proliferation of mature companies that are considered "sick,"

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i.e., effectively bankrupt. These companies serve as a drain on the overall economy, crowding out investments in newer industries and reinforcing a vicious cycle: companies fail to invest in new technologies and products leading to sickness; sickness, in turn, demands increased government investments, drawing resources away from newer industries. Instead of a positive economic chain reaction, sickness reinforces a negative chain reaction. Thus, encouraging transformation in appropriate Karnataka industries will benefit the state economy overall.

Among the industries of the transforming sector in Karnataka are the following:

- Chemicals
- Machine tools
- Materials.

Overall, companies in the transforming sector in Karnataka require access to resources that can help them carve out new market niches or decrease production costs.

Transforming-Sector Needs for Technology

The R&D needs of the transforming sector in Karnataka are very basic and less complex than those of emerging-sector or expanding-sector firms. For the most part, this sector has waited too long to explore how R&D and technology could make its businesses more adaptive and productive. However, transforming-sector firms have not had the incentives to develop their own R&D capacity, even to the level of expanding-sector firms. As a result, these often "sick" industries are unable to respond to the changes that surround them. Some firms in the transforming sector are noted for their adaptiveness. Recognizing the forces at work, these firms have gone out of their way to plan modest but effective technology strategies.

The machine tool industry, for example, which is evolving into the automated manufacturing systems industry globally, is now slowly making its way in that direction in Karnataka. Large machine tool firms are introducing advanced computer numeric control machines into their product lines – some equipment being imported, other parts being built indigenously. Most of these companies are aware that the nature of the industry is changing and are trying to plan the introduction of new technologies.

Machine tool builders are in need of R&D to enable them to develop more advanced manufacturing systems as well as group technologies for advanced manufacturing. At present, they are not organized to move forward actively in these areas because the domestic market is not developed. Yet, since India exports substantial levels of machine tools, this sector needs to keep abreast of the rapid changes taking place in the industry. Machine tool builders in Karnataka are aware of these needs, and often make use of medium-term technology skills available at CMTI. Although CMTI (and the Government Tool Room) are important resources for this and other maturing industries, these industries believe that there is a need to take the nextsteps in developing advanced manufacturing technology R&D capacity in Karnataka.

In sum, the transforming sector's greatest need is to prevent the escalation of existing lags in production technology, particularly in manufacturing automation.

Karnataka has possibly the best foundation for this element of the medium-term technology infrastructure in India, but needs to systematically expand its development and induce more lethargic sectors to accept and pursue new activities in this area.

Transforming-Sector Needs for Human Resources

The main human resource issue for companies in the transforming sector is the mismatch between the current skills of their workers and the skills required by the products and production methods. In transforming sectors, displacement of workers and layoffs are common, while simultaneously companies need to hire large numbers of workers in new skill categories. At present, Karnataka's educational and training institutions cannot successfully meet transforming companies' retraining needs and respond to them in a timely and flexible manner.

Transforming-Sector Needs for Finance

Companies in the transforming sector need to invest in R&D, capital modernization, and retraining. Many companies in Karnataka cannot perceive the need to transform early, while their revenues are high and financing is not a major problem. Restructuring occurs late, only after revenues have been down for a considerable time and there is no real opportunity for revitalization unless drastic measures are taken. In this situation, companies rely on various types of financial rescues: sale of assets, government loan guarantees, subsidies, etc. The problem, however, is not in financing but in sensing market signals early and developing timely corporate strategies.

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TRANSFORMING INDUSTRIES

Chemicals

Karnataka only recently started developing a chemical industry. In 1966, Mangalore Chemicals and Fertilizers Ltd. was set up. Later, several chemical plants producing basic or intermediary chemicals sprang up around Bangalore, Mysore, and Nanjangud. The recently proposed oil refinery at Mangalore, with a capacity of 6 million tons, adds to the potential of the chemical industry in the state.

In general, the greatest future growth for the chemical industry is expected in developing countries such as China, India, and Brazil. This growth offers good opportunities for technology transfer and various collaborative agreements between Karnataka's companies and MNCs. In the United States, the chemical industry is just emerging from a period of restructuring precipitated by the growth in global competition, the decrease in inflation, and falling oil prices. Petrochemical companies have been hit particularly hard, and have shut down much excess capacity and rationed production. A number of petrochemical companies have chosen to concentrate on specialty grades and withdrawn from the commodities market (e.g., du Pont). Overall, the profitability of specialty chemicals companies has been high compared with other segments. Not surprisingly, the large chemical companies have become much more interested in specialty chemicals.

The fertilizer sector has the greatest potential in India. In the next 15 years total fertilizer demand is expected to increase 55%, with a large share of growth occurring in developing countries.

Major products of Karnataka's chemical and fertilizer companies at present include ammonia, urea, and phosphates. Considerable scope for development lies in the production of basic chemicals, cosmetics, insecticides, pesticides, man-made fibers, dyes, and dye intermediaries.

Technology

Most of the technology for the chemical/fertilizer industry in Karnataka is imported on a turnkey basis. Sources of technology include Great Britain (ICI for ammonia and urea manufacture) and Japan (for development of chemical and fertilizer plants). Foreign suppliers are also used to provide modern equipment. There is considerable scope for indigenization of production. Companies staff interviewed believe that the R&D capacity in India to develop chemical and fertilizer plants is lagging.

Fertilizer companies help conduct experiments in agricultural universities and transfer the results to farmers. Efforts in the field of agriculture are considered satisfactory, and work with universities has produced positive results.

Human Resources

Chemical companies provide internal training to new hires lasting from 6 months to a year. A major source of training is also foreign partners. Company personnel interviewed were particularly satisfied with their Japanese partners' willingness to train personnel and send experts to supervise plant construction. Whereas many trained engineers used to leave India to work in the Middle East, the end of the oil boom has made more engineers available for Karnataka's industry. As the industry grows, however, Indian universities might not be able to satisfy its human resources needs.

Machine Tools

Karnataka has long been one of the centers for the machine tool industry in India. Private and public companies such as Hindustan Machine Tools (HMT), Kirloskar, Bharat Fritz Werner, and Herbert India manufacture a variety of machine tools, including CNC machines. HMT has also spurred the growth of many anciliary machine tool companies. The Central Machine ToolInstitute (CMTI) in Bangalore does research and development work on machine tools, licenses other manufacturers to produce its designs, tests machines, provides training and consulting services, develops tools and accessories, and disseminates technical information. CMTI has also established a center to assist industry in all aspects of CNC machines.

Globally, the machine tool industry is a transforming industry experiencing intense competition among producers from several nations and undergoing major changes in technology and marketing. With the advent of modern manufacturing practices pioneered by the Japanese, the industry has had to respond with machines that require greatly reduced set-up times and allow for quick changeovers and small lot sizes (flexible manufacturing systems). The machines are also being increasingly used in cellular factory floor layouts (group technology) and feature CNC operation. Further, the trend is to link production machines directly with product design tools (CAD/CAM), thereby greatly reducing the lead time for prototyping designs. Even the marketing of machine tools is changing, with customers now beginning to expect integrated manufacturing systems instead of just individual machines. Customers also expect vastly improved equipment uptime, reliability, and service from the vendors. In this emerging environment, machine tool vendors will increasingly have to provide "total solutions" and guarantee results.

The machine tool industry also faces competition from other manufacturing processes, such as plastics injection molding, pressed powder metal, die-casting, and forging. As the precision of these competing processes improves, manufacturers will do less machining. The global automobile industry is a good example, because automobile design and manufacturing trends are to reduce machining and increase the use of plastic and pressed metal parts.

Some observers of the industry believe that there is excessive machine tool building capacity in the world and expect a shake-out among the producers.

The machine tool industry in India is also experiencing rapid changes because of the opening of the Indian market to foreign participants and loosening of government regulations. Several Indian companies now have collaborative arrangements with foreign partners for producing NC/CNC machines, programmable logic control systems, precision tooling, and accessories for a new generation of machine tools. The manufacturers have to import some critical components like bearings, clutches, DC motors, and electronic items. These imported components are charged high customs duty ranging from 85% to 181%, whereas the duty payable on fully imported machine tools varies from 35% to 85%. The machine tool industry wants this anomaly rectified.

The number of NC machines in India is estimated at 1,200, which represents 0.1% of the country's total machine tool population (1986 census). This number of NC machines will undoubtedly grow in the years ahead, although the rate of growth may be slowed by the capacity, in terms of capital and trained workers, of machine tool customers to absorb the new technologies. Currently, about 150 new NC/CNC machines are being added each year, and the annual growth of these machines is expected to be only about 400 by 1990. Even in the United States, NC machines represented only 3.5% of the country's machine tool population in 1983. The installation of NC machines, implementation of CAD/CAM, and full realization of the potential benefits involve a long learning and gestation period. Consequently, there will be continuing need for the more conventional machine tools.

Technology

Karnataka's machine tool industry currently makes CNC equipment by importing up to 50% of the components from foreign firms. But despite the joint ventures with foreign firms, interviews suggest some foreign suppliers are reluctant to share state-of-the-art CNC machine tool technology. The interviews also suggest that machine tool customers have greater confidence in foreign manufacturers for equipment reliability and on-time delivery than in domestic manufacturers. This problem is compounded by the anomaly of higher duties on CNC equipment components imported and assembledin India than on whole equipment imported from abroad. Besides importing technology from foreign firms, Karnataka's machine tool industry also conducts in-house research and development. For example, HMT has developed a six-station pallet and head changer, and expects to work on robotics. The company now has a new long-term planning process that will review worldwide technologies, examine staff perspectives, and develop new insights. HMT also collaborates with IISc on technology forecasting exercises. The resources of CMTI are available to the state's machine tool industry to test equipment, use the CAD system, etc. The question of expanding CMTI's resources to serve the state's industry more fully needs to be examined.

To cope with the national and global changes in the industry, the machine tool manufacturers of Karnataka will need to further develop the technologies necessary to make CNC machines and accessories that will fit into cellular, computer-integrated, flexible manufacturing systems. The goal must be to progressively reduce the import content of CNC machines through emphasizing in-house research and development. Also, in marketing the products globally, the machine tool makers must develop the capability to provide integrated systems that will directly meet the needs of the customers. Thus, a strong manufacturing systems engineering capability should be added to a strong machine tool building capability.

To rectify the image of inferior quality and delivery performance relative to imports, the machine tool makers of Karnataka must attract and motivate the best design engineers and make a determined effort to manufacture reliable machines on time, and thereby gradually establish an image of quality and timeliness that is on a par with that of foreign suppliers.

Human Resources

The state's machine tool industry recruits technical manpower from a variety of sources. Like most other industries, however, it has difficulty attracting graduates from the IITs, who typically go on to obtain advanced degrees in engineering and management in India or abroad. HMT does havea program for upgrading its engineering employees through a master's degree program at the IITs.

The new developments in CNC equipment and manufacturing systems engineering will require design engineers who are trained in the related disciplines. Therefore, the machine tool makers will need to retrain some of their design engineers in areas such as CAD/CAM, numerical controls, and manufacturing systems engineering to design machines for the emerging market. They will also need to hire new engineers with master's degrees in mechanical engineering, electrical engineering, and computer science who specialize in machine design, numerical controls, and computer-aided manufacturing to assimilate the new technologies and develop new machines. Further, the machine tool makers should be among the first to use CAD/CAM to design and prototype their own products because this experience will enable their designers to fully understand the new market for their products.

The retraining, continuing education, and new-hire needs of Karnataka's machine tool industry can be met through the resources of the IIT at Madras, CMTI, and perhaps the state's engineering colleges. HMT already has an exchange program with the IIT faculty.

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The creation of a design and manufacturing center of excellence at IIT Madras that will emphasize CAD/CAM, CNC equipment, manufacturing systems engineering, etc., will be very beneficial to Karnataka's machine tool industry.

Capital

A major concern of Karnataka's machine tool industry is the high cost of technology. The adoption or development of new technologies will require extensive capital investments. The sources of capital would include equity participation by foreign firms, bank loans, and company funds. The machine tool industry has been lobbying for a higher depreciation allowance to generate additional funds for investments in new technologies.

Materials: Steel and Cement

Karnataka is rich in limestone and has eight major cement factories producing over 6 million tons of cement per year. The largest-capacity plants are in Gulbarga district. The limestone reserves are large enough for the state to produce cement at the rate of 50 million tons per year for 100 years.

The state is also rich in iron ore and manganese, and has two steel plants, Bhoruka Steel and Visvesvaraya Iron and Steel, producing pig iron, low- and high-carbon steels, steel billets, ingots, rolled products, and castings, among other products.

The world steel industry has been transforming because of four factors: international competition, new technology, changing customer requirements, and competing materials. Japan has emerged as a dominant steel-producing and steel-exporting nation, while South Korea, Taiwan, and Brazil also have a strong presence in the global steel market. But the steel industry in the United States and Europe has been declining because of problems of overcapacity, outdated technology, and inefficient plants. The Japanese companies have used many new technologies, such as continuous casting, and combined various process steps, such as pickling, tandem and temper mill rolling, annealing, and automatic inspection, into 1-day (rather than 12-day) production. The mini-mill sector has acquired a significant market share at both lower- and higher-grade levels. Steel is also being replaced in many uses by plastics, ceramics, composites, and nonferrous metals.

In India, the steel industry was given high priority after independence, and a great future was envisioned for it. But now the industry is one of the main problem areas of the Indian economy, with the government-owned company, the Steel Authority of India Limited (SAIL), losing money heavily. The main problems of the Indian steel industry are antiquated plants, inadequate use of modern processes such as continuous casting, and inefficiency. The Indian steel industry uses twice as much energy per ton of steel as the Japanese industry. The government is now thinking in terms of smaller steel plantsowned and operated by the private sector rather than large, public-sector steel mills.

In the cement industry, a new technology suited for small cement plants has been developed by the National Council for Cement and Building Industries. This technology is appropriate for Indian conditions because it uses waste material such as coke waste from steel plants, and transportation costs are minimized by having a large number of mini cement plants.

Technology

The major issue for Karnataka's steel industry is an energy shortage. Because the state has a deficit in power-generating capacity, energy reduction programs are important to the industry. Also, the technology of mini-mills will be very important to enable the industry to

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move toward becoming competitive in world markets. Bhoruka Steel believes its technology is 15 years behind the state of the art, but has plans for acquiring the latest mini-mill technology by next year. The company has made impressive progress in reducing energy consumption per ton of steel produced.

The steel industry needs to consider acquiring technologies for high-value-added and special steels that will enable it to find niches in world markets, but obtaining the required raw materials appears to be a problem in the manufacturing technology for mass-scale production. The main source of imported technology is Europe, particularly West Germany.

For the cement industry, too, the power shortage is a problem, as is the price of inputs. Energy conservation programs have to be implemented to increase the energy efficiency of processes. The technology for mini cement plants also needs to be used more widely.

Human Resources

The availability of skilled people does not appear to be a problem for the state's steel industry. In general, steel companies require metallurgists and mechanical and electrical engineers. They also need management that is very aware of global trends in the steel industry and that fosters innovative research and development. The latter is the real problem, and the IIMs should play a big role in reeducating steel industry managers to think globally and foster innovation.

The cement industry has no special human resource needs that are not currently available in Karnataka.

Capital

The steel industry is highly capital intensive, but with the emphasis shifting toward mini-mills, the private sector in Karnataka should be increasingly capable of establishing steel plants.

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Table II-1
KARNATAKA'S ECONOMIC INFRASTRUCTURE NEEDS

Industry	Technology	Human Resources	Finance
Emerging			
• Software	In the long run will require greater investments in artificial intelligence, while in the near and medium terms, companies need better access to satellite and telecommunications equipment.	More engineering graduates with applied skills and specifically trained in software engineering. In the near term, need personnel skilled in R&D management and technology forecasting.	Capital to finance R&D and overseas marketing
• Telecommunications	Indigenous suppliers of quality semiconductor components.	Engineers with applied skills in circuit design, software engineering and materials research, as well as those with specialized technical skills in manufacturing and installation of telecommunications systems.	Better access to capital for smaller suppliers to finance product enhancements and equipment upgrading.
• Computers	Indigenize manufacture of components and parts. Develop engineering workstations for CAD/CAE. Develop on-line process control systems.	Develop strong R&D with IIT/IISc graduates. Work with vocational schools to train electronic technicians.	Better access to risk capital.
• Biotechnology	Development of capabilities in a broad range of technologies, from recombinant DNA to tissue culture. Better access to technologies for downstream production and production scale-up.	Scientific personnel interested in applied biotechnology work.	Risk capital for small start up firms.
Expanding			
• Pharmaceuticals	Greater internal investments in basic research. Improve commercial viability of technologies coming out of research labs and universities in Karnataka.	More personnel with skills in specific areas: quality assurance, material handling. More scientific personnel interested in applied work in biochemistry and pharmacology.	Incentives for equipment replacement.
• Automotive	Apply modern methods of manufacturing to improve quality.	Train production people in manufacturing methods such as SQC, quality circles. Educate designers in the use of new materials.	
• Food processing	Access to packing and food preparation technologies as well as techniques that allow for extension of shelf life of products. Capabilities to monitor technological developments overseas.	Development of personnel in market research and development; better quality control and engineering personnel; R&D management, planning and monitoring capabilities.	Capital for equipment upgrading.
Transforming			
• Chemicals	Development of indigenous equipment suppliers. Expansion of internal R&D efforts in chemicals and fertilizers.	Continuing education for scientific staff, training to enable technical and semiskilled workers to operate new production equipment.	Capital for modernization of plant and equipment.
• Machine tools	Develop flexible manufacturing systems. Improve quality, on-time delivery. Indigenize CNC equipment design.	Create a mnaufacturing center of excellence. Retrain designers for CNC equipment. Develop systems engineers.	Allow greater depreciation allowance to encourage R&D investment.
• Steel and concrete	Encourage energy conservation. Implement modern mini steel plants and mini cement plants.	Reeducate steel executive to think globally and foster innovation.	

III KARNATAKA'S ECONOMIC INFRASTRUCTURE

1. KARNATAKA'S TECHNOLOGY INFRASTRUCTURE

Introduction

The technology infrastructure of a state includes those public and private sources of information and materials that enable industry to innovate in both product development and production methods. Karnataka has one of the better-endowed technology infrastructures in India. Yet, as good as it is, it is unable to perform the roles it must if the Karnataka economy is to thrive and grow in the future because some key elements essential to a vital and adaptive technology infrastructure are absent, or at least underdeveloped.

Technology represents the application of scientific discovery. Scientific discoveries are fundamental to technological advancement, but proximity to sources of technological development is more important for economic development than is proximity to sources of scientific discovery. Proximity to both scientific and technological activities, of course, can be an extra advantage enhancing the economy by increasing the "critical mass" of human and technological capability within a region. Having a concentration of scientific capability alone, on the other hand, is no guarantee that discovery will be translated into economic utility.

Proximity of technological activities often gives rise to technological synergies, that is, a concentration of technologists working on similar problems, moving between institutions, examining each other's work, and competing and collaborating can yield a higher degree of technology application than isolated efforts. In addition, these concentrations can also have a natural economic multiplier effect in the form of "spin-offs"—new, independent firms formed by staff of existing firms.

These effects have been in evidence in California's Silicon Valley throughout the last 20 years. Similarly, they appeared in the Highway 128 Corridor in the Boston area in the past 15 years, and are now arising in Ann Arbor's "Automation Alley," among other places in the United States.

The agglomeration or clustering of activities linked to long- and medium-term technology development give rise to a social or economic ecology. The excitement and economic compensation generated in this environment represents a positive social "feedback." This feedback attracts new human resources, new ideas, new companies and escalates the "richness" of the environment and reinforces its technological infrastructure.

Initially, few had any advance understanding of the underlying requirements for building the thriving technology infrastructure that characterizes adaptive economies. Clearly, it is not simply a matter of "bricks and mortar" approaches that involve building more university laboratories, or opening up new technology research centers funded by state research grants.

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Many state governments in the United States have experienced the cost and disappointment from the failure of their "bricks and mortar" approach to developing their technology infrastructure. Developing a technology infrastructure is not a simple matter. Building an appropriate technology infrastructure is a long-term process that must start with the foundation into which technology roots can be placed and take hold. This foundation is less scientific than it is technical. In discussing technology infrastructure policy makers often confuse scientific inquiry with technology development. They are not the same, although one is the precursor of the other. This confusion has often led to the conclusion that universities are the basis of a technology infrastructure, since they are where much scientific inquiry takes place. But universities are not necessarily the core of technology infrastructure, although they are part of it.

Technology infrastructure is a broad continuum of development and supply capabilities. Thus, when examining the development of technology infrastructure investments, a state needs to recognize the respective roles of long-, medium-, and near-term institutions. Each has different ability to create the basis for technology, develop technology applications, and enable technologies to reach their ultimate users effectively. In most economies, an abundance of third-generation technology resources does not guarantee a viable economy of second-generation technology producers or first-generation technology users. The challenge of developing an effective technology infrastructure is to create a balanced set of institutional roles and capabilities that together enable a continual flow of technology to the marketplace.

A high degree of synergy between the early science, applied technology, and technology implementation institutions of a state gives rise to the optimum economic conditions. One indicator of technological synergy is the ability of the institutions in the state to achieve what is often called "technology capture." Technology capture is the ability of technology development to be directly applied to the state economy. Thus, biotechnology would be used to improve agricultural performance, or computer automation to enhance manufacturing productivity; advanced materials could be used to substitute for expensive raw materials or improve product performance among local providers.

The importance of technology capture as an overall criterion for state government evaluation of the technology infrastructure is that it dwells on treating the economy as a dynamic and adaptive environment. Technology, once developed, is highly mobile and can flow to markets where it can be best produced. A market that consists of dynamic and adaptive producers can respond to and capture the benefits of technology developments on a continual basis. The competitive economy can always become more competitive by improving production, by diversifying horizontally into new products it has the competency to produce, as well as vertically, to capture more value-added in the economic chain.

The sad lesson of many economies that have tried to capture technology without a strong technology infrastructure is that they acquired the lowest-level, lowest-paying, most vulnerable parts of the technology business, while the high-value-added manufacturing and design were located elsewhere where the economy had the appropriate infrastructure to respond.

Because of the importance of synergy between sources of technology supply in building a strong technology capture capability, the responsiveness of a state's public and private technology infrastructure to the marketplace is very important. Some general, practical criteria for examining the responsiveness of a state's technology system to its economy are:

- *Accessibility*—Are institutions willing and able to have direct contact with business, whether it is to develop a research agenda, share information and technologies, or perform technical services? How limited is this access relative to the mission of the institution?

- *Applicability*—Are the types of technical research going on within an institution relevant to the technology needs and trends within different industries—for example, agriculture as compared with manufacturing, electronics as opposed to chemicals? How cross-cutting are the capabilities?

- *Currency*—Are the technical skills within institutions in specific areas equal to or more advanced than those of public or private competitors in or out of the country?

- *Responsiveness*—Do the institutions respond to the inquiries and agreements made with businesses within a time frame that is workable for industry? If not, is this due to human resource limits or organizational constraints?

- *Cost*—Are the resources of institutions affordable to those requiring them? Are there differential pricing schemes for services? Are technical services dependent on subsidies or provided on a fee for service basis?

The following discussion examines the long-, medium-, and near-term technology capabilities of Karnataka's technology infrastructure in three ways. First relevant trends in the U.S. technology infrastructure are reviewed, including development of new state roles. Then Karnataka's technology system is examined in terms of its responsiveness to the economy. The discussion concludes with recommendations for enhancing Karnataka's current system. The priority recommendations are then explored in the "Blueprint for Action."

Long-Term Technology Infrastructure

Karnataka has a good long-term technology infrastructure. However, if the state is to become competitive in both the Indian and global economies, this infrastructure will have to make organizational changes that will better bridge the gaps between basic and applied science and between academic and business priorities. The following discussion reviews the elements of change in the long-term technology infrastructure in the United States, and then examines Karnataka in light of these changes and the needs expressed by Karnataka's industrial base.

U.S. Experience

The foundation for much technological innovation in the economy is long term scientific research that is primarily basic in focus. Basic science discoveries, however, are rarely translated *directly* into technology applications. When science does give rise to a technology development, the time frame from discovery to technology application can be from 5 to 10 years. In the United States, the life cycle of a technology, from development to product application, is now under 7 years and getting shorter. New institutional arrangements are starting to evolve to enable even more rapid linkages between the generators of science and technology.

Longer-term basic scientific and technological inquiry is typically carried out within universities, by advanced science institutions sponsored by the public sector, such as national laboratories, as well as by a few privately funded institutes. Larger corporations are also increasingly doing more basic research or are sponsoring affiliate (group) research at universities to maintain a "window" on what might be fundamental long-term changes in their industry.

Universities are the major centers of basic science inquiry in most countries. They depend on public grants-in-aid to conduct research, and the agendas for this research are driven by themes set up by peer review, departmental chairs, dissertation committees, postdoctoral fellowship opportunities, and patterns of faculty appointments. Moreover, university vice-chancellors for research have historically maintained strict policies on the need for openness in publication of research and attention to the development of science, rather than encouraging development of specific business applications of science. This tradition of academic independence and integrity has enabled broader dissemination of basic science information, but it also has discouraged industrially focused transfer of discoveries.

National laboratories have a long tradition of conducting basic and applied research in fields considered relevant to issues of national concern, such as health, agriculture, or defense. The National Institutes of Health in the United States are a major source of research on the cause of disease. The U.S. Federal Laboratory system is a major source of both basic and applied research on longer-term issues of defense and aerospace – some of which has led to commercial applications, although the pace of transfer has been quite slow.

Today, both U.S. universities and national laboratories are the subject of considerable concern, criticism, and reform related to their role in making science more applicable to the economy. Universities, in particular, have been the focus of considerable concern. For a long time, public officials believed that having top academic research capacity was likely to promote economic development. The experience of recent decades suggests that this is not the case. Universities are builders of the foundation for technological development, but not necessarily the source of that development.

In response to concern over this issue, university leaders in the past decade have started to consider how to harness the power of academic inquiry for the economy more effectively. One development in this direction is the emergence of new research fields in universities, many with a strong technological applications orientation, that are interdisciplinary and involve faculty and students of many different schools. These research "synergies" are a particularly important facet of the evolution of academic research institutions in the United States in the past 5 years. For example, what once were isolated programs in molecular biology, biochemistry, zoology, plant genetics, and chemical engineering are increasingly being given organizational cohesion under the auspices of biotechnology programs. Physics, chemistry, electronics, and chemical and electrical engineering are being brought together in special programs under the label of "advanced materials" in many universities. Similarly, programs in mathematics, computer science, and electrical and mechanical engineering are being linked through programs in manufacturing automation. None of these new disciplines could exist without multidisciplinary skills and without the supporting organizational structures provided by new university research settings. A number of universities have established research centers dedicated to these new disciplines; these centers represent a multidisciplinary locus for research across basic and applied science—primarily with a longer-term emphasis. Many leading institutions still maintain only informal interdisciplinary relations across programs. However, the movement toward building effective intermediary centers is growing, particularly since they are effective in attracting both national research funding and corporate support.

To achieve more interdisciplinary research ends and improve relations with private sector, universities have begun to open up and reform their organizational structures. First, university chancellors and their deans have had to modify policies concerning working with industry (and likewise, industry has had to find ways to accommodate universities). This has meant changing reward and promotion policies for faculty to encourage (or not discourage) them from working with industry, either as consultants or through research centers. Universities have had to modify policies concerning rights to intellectual capital, specifically rules governing rights to patents and royalties, so that researchers could benefit from discoveries or participate in benefits with companies sponsoring research. Although there have been a number of forums on this topic, most universities still maintain restrictive practices, including maintaining ownership of patents and royalties.

Although consulting to industry has a long history, the use of university consultants in the United States has often been perceived as having marginal value to companies compared with their own internal research capability or the responsiveness of research procured from R&D suppliers. To help improve responsiveness of universities to industry and to maximize the benefits of collaborative work to both the university and industry, the U.S. National Science Foundation has been sponsoring the development of Engineering Research Centers (ERCs) and providing financial support to university–industry activities focusing on precompetitive research (to improve industry competitiveness). These are designed to encourage more rapid movement of discoveries from the university laboratory to product development in companies. These efforts are relatively new and fairly small compared with large industry R&D efforts or industry-sponsored precompetitive research. The longer-run benefits of these arrangements remain to be seen. If successful, they may encourage dramatic changes in university policies and programs concerning work with industry. If not, each university may continue to try strategies that work best for it.

Efforts to move national laboratories more aggressively into the development and transfer of technology to the private sector in the United States are just under way. In some laboratories this is being achieved through having private R&D managers oversee laboratory operations. For example, at the Oak Ridge laboratories in Tennessee, Martin Marietta Corporation has been awarded a contract to manage laboratory technology commercialization activities. Other laboratories are engaged in similar efforts, mandated by the passage of the Stevenson-Wydler Act. The least successful aspects of national laboratory efforts are technology transfer programs involving dissemination of and consultation on technologies. The most successful relationships involve the direct participation of industry in development and application of a technology, such as composite material. In these cases, however, few industries are able to participate (usually the most sophisticated), and they require contracts with the government (usually defense contracts) to subsidize the R&D and applications work. Despite the limitations this realistic means of developing and applying new technologies, although the products are often restricted from commercial use until authorized by defense agencies.

Long-term private-sector research in the United States has undergone a dramatic transformation in the past 5 years, as international trade problems forced an awareness of the need for enhanced scientific and technical discovery especially in production process technology. Although long-term in focus, this industry research rarely can be described as basic in nature. Most industry studies are applied, even when the focus is on high technology rather than on traditional heavy industry.

The emerging sectors of the economy – e.g., semiconductors, computers – as well as transforming sectors – e.g., machine tools, steel – have started to organize their own, privately financed longer-term R&D facilities. The Microelectronics and Computer Technology Corporation (MCC), in Austin, Texas, for example, is sponsored by 20 computer companies (IBM, DEC, etc.) to develop new microprocessor and artificial intelligence applications that will be shared by the sponsors when developed. This center is in its early years and has almost 400 staff. Expectations have been very high for this center, but only time will

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prove its worth. Other consortium-sponsored programs, such a the Semiconductor Research Corporation (SRC) in Boston, Massachusetts, have contracted out for semiconductor research to be shared by industry sponsors. This program has been reasonably successful in its more than 5 years of operation. A new semiconductor research program being sponsored by industry members (Sematech), which will have its own laboratory facilities, is just getting started.

The transforming sectors of the United States economy have long had their own industry-sponsored research centers. For example, the paper, steel, energy, and chemicals industry associations have for many years operated research programs in their own laboratory settings and by brokered research programs. These have suffered from problems characteristic of industries where members are more worried about competing with each other than with global competition.

Paper industry research efforts, which take place both in a central laboratory and through sponsored efforts in universities, are often confined to topics that would not give competitors an edge over one another. In addition, research efforts sponsored by forestry and paper associations (such as tissue culture propagation techniques for high value added woods) were often not treated as having serious business utility. Thus, competitive advantages resulting from years of research were often either not developed or not used.

Similarly, until recently, the steel industry's research institute did useful, but not fundamental, research on steel processes that either were not taken seriously by industry or were too late to respond to advances already being made by competitors in the global marketplace. Thus, while research on continuous casting or specialty steel was going on in the Steel Institute, Japanese steelmakers had already deployed the technology and were making significant inroads.

The energy industry suffered from a less dramatic problem in its sponsored research efforts. Although endowed with a large budget supported by utility subscriptions, the Electric Power Research Institute (EPRI) has been characterized as sponsoring a very broad array of studies that were not relevant enough to the geographically specific needs of its utility members to satisfy their needs. Thus, this center is facing eventual discontinuation as utilities attempt to expend their resources on issues in their own backyards.

The chemical industry in the United States has stressed common problems in its research agendas, and thus has tried to emphasize pressing issues, such as hazardous and toxic waste treatment, in its sponsored research, rather than chemical product or process innovation. Notably, chemical companies have had sufficient research support internally to remain competitive in products, but have been dilatory in responding to waste treatment issues. The rising R&D rates in the industry suggest that an agenda focusing on shared problems does make sense, although research capabilities within an industry association lab may not be as high as within corporate labs, or, for that matter, university chemistry or chemical engineering departments.

In sum, long-term science and technology development is taking place in an evolving institutional environment.

Research universities, recognizing the limits of traditional structures, are beginning to review their organizational capabilities and policies and are opening up to newer, more effectively structured intermediary institutions that will bridge the gap between basic and applied science—without undertaking product development, however. Moreover, federal incentives to encourage this trend are increasing, although still limited. Federal laboratories are being given incentives and commands to work more effectively with the marketplace, but these efforts have only started and may focus more on near-term technology transfer. Industry-sponsored long-term research is moving toward a renaissance, in which companies agree that they can work on mutually advantageous issues to provide them with a competitive advantage in world markets.

State governments in the United States have not played an active, direct role in the development of the long-term technology infrastructure. Most state activity, other than direct financial support of state universities (and sometimes private universities), has emphasized medium-term, applied research. However, at least half of all states have "research excellence" and "centers of research excellence" programs. Most of these are relatively new and involve grant programs to support or match faculty research to build capacity within growing departments in specific areas, such as microelectronics. Ohio's program, for example, supports faculty who are building new capabilities in university departments. Others are intended to provide broader organizational support for interdisciplinary research program development (for new staff, equipment, facilities). Michigan's Research Excellence Fund (REF), for example, invests $25 million yearly in a diversity of efforts to enhance research capabilities within the Michigan university system. Some research efforts are focused on translating research into technology products, but this would be considered medium- or near-term research support. Most research excellence programs, however, have been more gesture than substance. State investments in long-term research cannot equal the size and scope of the national research programs; states simply do not have the resources.

More appropriate than trying to become sponsors of long-term research is state support for longer term development of universities and their institutions. A number of leading states have created new technology center programs, most of which are in universities (with the exception of Michigan, Virginia, New Jersey). These are discussed next under "Medium-Term Technology Infrastructure."

More and more states have tried to increase overall spending on research universities to prepare them for growth in new areas of science and technology (and to compete for their share of federal research dollars). Minnesota converted revenue-generating lands into $50 million to endow 50 university chairs. The University of Texas raised funds for 30 chairs to help attract MCC to Austin. Most other major universities have been raising large "war chests" to endow chairs and support facility improvements for the decade of the 90s. Some universities, such as Stanford, have extremely large targets (Stanford's target is $500 million). All universities are asking their states to match privately raised funds for new technology centers that have long-term scientific objectives in areas such as biotechnology or microelectronics.

In sum, the United States is at the beginning of a transformation of traditional public and private science and technology institutions and is in the process of developing new science and technology intermediaries to meet the needs of the economy. The evidence of the utility and success of these reforms and new institutions is not in and may still be some time off. However, SRI data on economic performance of U.S. states suggest that those with the best long-term (and near-term) technology infrastructure do better than those whose infrastructure is less developed. It still remains to be seen whether cooperation between industryand government (and university) and between industries will endure and enhance state economies in the midst of a global environment of intense industry struggle for competitive advantage. These observations, however, may provide a useful reference point for planning future public and private investments in long-term technology infrastructure in Karnataka and in India generally.

Karnataka's Long-Term Technology Infrastructure

Karnataka has what would appear to be a reasonably well-developed long-term technology infrastructure. However, on closer inspection, this longer-term capacity does not meet the traditional criteria discussed earlier. Although it has the Indian Institute of Science, which is a traditional higher education and academic research center, Karnataka also has an array of national laboratories and institutes that do more medium-term applied work than long-term basic science. Thus, it is not clear on first glance how much of Karnataka's technology infrastructure is truly long-term in focus, and how much is more medium-term.

A recent SRI analysis of Indian scientific publications of 1984 provides a means of identifying where Indian publications are prominent in leading worldwide science issues and where they are more focused on national and local technical issues. This bibliometric analysis shows that in a model of world publications, India contributed fewer than 2% of total publications. However, scientists publishing were active in 19% of specialties and in 57% of major "regions" or key areas of the published scientific world. This pattern suggests that Indian scientists may be developing specialized niches in international scientific areas and focusing their efforts on problems of more national concern.

Indian publication in biomedical fields was relatively weak, while activity in chemistry was very strong. Of the 100 strongest Indian specialties, 55 were in chemistry, 16 in agronomy and ecology, and 14 in biomedicine. Strengths in chemistry were in spectrographic analytical methods, studies of liquid crystals, and chemical synthesis. The strongest areas tended to be those where there was stronger local interest, such as development of energy systems, and mathematical methods.

In biotechnology, Indian research was shown to be strong, but not advancing rapidly. There was considerable emphasis on areas such as research on human and agronomic disease. Karnataka was well represented in these priority areas, including research carried out at the Indian Institute of Science and the University of Mysore (purification of cellulose, effects of structural changes on monoclonal antibodies, effects of pharmaceutical agents), and the Central Food Technology Research Institute (crystal structure of enzymes, synthetic bean proteins). However, Karnataka was not as active in biomedical areas as medical research centers in Delhi, Bombay, and Jaipur.

In physics and materials science, several Indian scientists were identified as world class researchers (e. g., C.N.R. Rao, D. P. Sharma). Forty-five Indian scientists were noted has having contributed to the fundamental intellectual base in this field. This was deemed by SRI and NSF to imply that India may have a critical mass in this field. These areas showed rapid advancement compared with biotechnology and solid-state physics. Among the centers ranked by experts as world class were the Indian Institute of Science, the Bhabha Atomic Research Center, the Indian Institute of Technology at Kanpur, and the Tata Institute of Fundamental Research. The Indian Institute of Science publications that were noted were in the fields of photoacoustic spectroscopy, ionic conductivity, fluid dynamics of combustion, and gravitation.

This assessment of Indian scientific publications suggests that India has focused much of its scientific agenda on national and local concerns and continues to do so. At the same time, there are fields where scientific expertise is contributing to world class developments in science.

In this analysis Karnataka appears to do reasonably well in addressing both national and world class scientific issues. The implication, however, is that Karnataka has fewer long-term research capabilities than do other states. As stated earlier, a large long-term capability may not be central to the future of the Karnataka economy, but it helps. However, to build a balanced foundation for the economy, Karnataka will have to recognize the importance of long-term technology infrastructure at different institutions in the state beyond IISc, such as CFTRI and the University of Mysore.

Indian Institute of Science (IISc)

The IISc is one of the leading academic and research institutions in India. As such, it has developed considerable depth and breadth in its long-term research capabilities. The IISc has five major divisions in which faculty and students pursue degree programs and research projects. In 1985–86, the Division of Physics and Mathematical Sciences admitted 27 students to perform research; the Divisions of Chemical and of Biological Sciences admitted 59; the Division of Electrical Sciences admitted 35; and the Division of Mechanical Sciences admitted 64. All told there were over 600 researchers, other than faculty, at the IISc. The IISc is active in sponsored research projects with a long-term focus. In 1985–86 it reported having over Rs. 1,556.9 lakhs under way in 259 projects, many of which were sponsored by national agencies from defense and aerospace to biological sciences. The centers of the IISc published over 40 books and papers, and there were over 800 individual publications in various scientific fields.

The IISc is Karnataka's most fundamental representative of long-term research capability. The institute has significant breadth and is likely to contribute to the national science base continuously over the coming years.

The IISc is a progressive organization with substantial autonomy that it can used to build and focus its long-term research capability. Increasingly, the IISc is performing contract research on theoretical and applied issues for national agencies. This type of support is very different from the type of national science support more common in the United States. The IISc's ability to extend its capabilities in the future may require that it distinguish more effectively between its basic and applied research missions for the nation. It cannot be all things to all people without losing some of its ability to advance science. The Center for Scientific and Industrial Consultancy, discussed in the section on near-term technology infrastructure, represents an important first step in building mechanisms that distinguish between near-term and longer-term research.

The IISc is primarily a long-term research organization, with a broad technical skill base (and some international distinction). It is highly accessible to the government defense and aerospace agencies, who sponsor much of the research there. This close relationship to national agencies suggests that the applicability of research to these organizations is relatively high, and possibly less so when regional issues are concerned. The currency of IISc skills are on a par with the highest-quality institutions in India, and faculty and staff are open to performing research on issues of concern that match their academic priorities. The cost of research is not a problem, since present clients are major national organizations. The IISc's long-term research issues are a separate consideration from medium-term ones that would be more likely to be of interest to Karnataka industry.

In sum, Karnataka's long-term technology infrastructure could benefit from expansion to other academic institutions in the state. Thus, Bangalore University, Mysore University, and some of the research centers should be encouraged to improve their academic credentials and participate more aggressively in world science development. This would require enhancing the faculty and facilities of the universities. Moreover, Karnataka's technology infrastructure would also be helped by development of curriculum and degree programs commensurate with those in world class educational institutions. Through these types of investments Karnataka, over time, could become identified with leading fundamental research that establishes new technology fields, as well as with applied technology. These objectives, however, are both costly and long-term in nature. As a result, they are likely to have a lower priority in recommendations for immediate action to enhance Karnataka's economic infrastructure.

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Karnataka is particularly well endowed with medium-term technology infrastructure, primarily made up of national laboratories and institutes. However, this infrastructure, despite claims to the contrary, does not appear to be as responsive to industry R&D needs as is desirable, particularly for those firms in the emerging stage of the life cycle. This problem is a product of the history of India and Karnataka's technology infrastructure development, which have emphasized a national laboratory system that is responsive to national research agendas and has limited experience in working directly with industry. Although this history is different from that of the United States, the problem of building a technology infrastructure oriented more to the medium-term R&D needs of industry is shared by both nations.

U.S. Experience

The medium-term infrastructure in the United States has been predominantly developed and operated by the private sector, although this situation is changing. For the most part, medium-term technological development has been the responsibility of individual firms that translate technological developments into products, or of research and development institutions that provide problem solving, product development, prototype building and testing, and market assessment services. Problem solving might involve the resolution of particularly complicated technical issues relating to the evaluation of technologies that might be transformed into a product (e.g., a new material, a new microprocessor capacity, a new biological principle), or technical problems in the design or manufacture of a product (e.g., how should group automation technologies be configured for production of powdered-metal production lines to optimize flexible mass production?).

The United States has had a long history of entrepreneurs and "tinkerers" whose particular skill it was to perform "bootstrap" research and development. From Thomas Edison and Henry Ford to Steve Jobs and Mrs. Fields, there has been a continual history of individuals who were willing to invest time and energy in studying new technology applications and developing new products. However, the R&D needs of companies grew over many years, and the U.S. marketplace also grew to respond to market demand for increasingly sophisticated levels of technical capacity.

Early in the century a number of schools of technology were developed in the United States. These schools were intended to prepare professionals for specific fields, such as civil and mechanical engineering. For example, Massachusetts Institute of Technology, Carnegie Tech, Michigan Technological University, Case Institute, California Polytechnic, Rensselaer Polytechnic, and Georgia Tech all were developed as (primarily private) institutions of higher education to train engineers. They performed this function very well and supplied leading industrial technologists, as well as founders of major companies, throughout the early years of this century (Dow Chemical, for example, was founded by a graduate of Case Institute of Technology, as was Lubrizol). During this time, growing companies absorbed engineering graduates and put them to work inventing and making products.

By the 1950s and early 1960s an important change in attitude began to characterize many of these institutions. First, the prestige of the field of engineering was at a low point, and considerable status was associated with becoming a fully accredited school with a letters and science degree program. To achieve this status, presidents of many technology schools began to seek partners for educational mergers. Case joined with Western Reserve, Carnegie Institute with Mellon University, and so on. Furthermore, during the 1960s the status of basic science research grew, and applied technological research was relegated by top research universities to "second-tier" institutions—usually either state colleges (as opposed to universities) and private engineering colleges.

This move toward science resulted in a deficiency of engineering talent during the 1970s and 1980s that has yet to be fully rectified. However, during the 1980s, many of those universities that had become more integrated centers of learning rediscovered their engineering roots. In these institutions, university presidents actively took on the role of bringing back and enhancing the engineering sciences and, in particular, increasing their responsiveness to industry. As a result, engineering schools have experienced a renaissance of attention and growth. The dean of the University of Michigan College of Engineering made engineering a state priority and doubled the school's student size to 4,000 and tripled its budget. The president of Carnegie-Mellon made engineering excellence in computer-aided design and manufacturing the focus for the school's engineering development and achieved national visibility for the school in these areas.

Despite the rediscovery of engineering among universities that had neglected it, the emphasis still remained on performing leading-edge, longer-term research. As a result, the leading engineering universities in the United States represented a new, specialized capacity in the research community but not a direct resource for industry. Industry-sponsored research at the first tier of engineering universities has continued to grow, but it generally represents very early-stage analysis of technological issues.

To respond more effectively to industry desires for "hands-on" engineering research, a number of leading engineering schools have established research centers at which cooperative research programs are carried out. Most also have consulting arrangements that help provide leading-edge information to larger industries. U.S. industry, however, still does not consider this capacity to be responsive to its medium-term R&D needs.

In addition to university engineering school research programs, which often have significant visibility, there have been two other important responses to industry needs for medium-term technology capabilities, outside of their own R&D units. These are the private (for-profit and not-for-profit) research and development sector, which has existed for several decades, and the emerging state-government-sponsored applied research and development centers.

The development of private research and development institutions in the United

States had its genesis in the post-World War II, cold-war era growth of defense-sponsored research. It was also stimulated by the growth of large corporate organizations who could afford to procure outside research when they did not have sufficient capacity and did not need permanent capacity in a given area. Major R&D *firms*, such as SRI, Arthur D. Little, Battelle, RAND Corporation, and a host of smaller national and regional organizations began to grow in the mid-1940s to early 1950s when it became evident to both government and industry that universities were not willing or able to supply nonacademic research with a clearly pragmatic and business focus. In several cases, R&D companies were originally started as business-oriented R&D centers within universities to meet purely business R&D requests. These centers soon were "spun out" as separate nonprofit or for-profit entities as demand for their services grew, so that applied R&D for commercial and government clients and traditional academic research could be kept separate.

These organizations were an explicit new response to market forces in the United States at the time. Since their initiation, these institutions have become important intermediaries in the fast-growing technology sectors, supplying expertise and services tailored to the needs of sponsors, *without* competing for their business.

Applied R&D organizations are known for having a wide variety of technical competencies, but also for taking that capability into the marketplace. In recent years, many of the leading R&D organizations have expanded their operations to include the development and commercialization of technology. These companies have taken "latent" technologies (that is, innovations that have not been fully developed) identified in prior research and have raised funds for commercialization and licensing to existing firms or new start-ups. Funds for commercialization and licensing are typically raised through working with either an independently owned or a subsidiary technology commercialization and finance company. In this way, R&D organizations have become not only a source of technology development for business and government, but also (under authorization of the federal government) mechanisms for technology transfer. This change heralds a new stage of R&D organizational activity that will expedite the pace of technology development in the U.S. economy.

States have learned important lessons from the inability of universities and federal laboratories to directly stimulate economic development or industry competitiveness within a medium time frame (less than 5 years). In assessing their own economies, almost half the states in the United States have decided that they need to create new intermediary research and development organizations to do, in the medium term, what traditional university academic centers cannot do, and perhaps should not be doing.

States have not, however, had good models to draw from in creating new, independent intermediary institutions. Moreover, there is always legislative pressure to use existing institutions as the basis for new science and technology development activities. As a result, *most* states have turned to universities as the best source of R&D capability.

The majority of state efforts to initiate technology intermediaries thus have en-

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compassed funding newly created university centers with existing or new staff recruited from departments across the university. In other words, these efforts have represented more of the same: support for longer-range research activities that are only marginally accountable to the medium-term marketplace requirements of industry. Moreover, the majority of these new centers were designed to foster development of new technology that might promote new business formation in the state economy, not to address competitiveness problems of existing industry. Despite high expectations, the modest scale of these endeavors will probably lead to minimal economic results.

A few states have discovered that it is unreasonable to expect a state-sponsored program to generate technologies that would transform their economies. Several have decided to take a more practical approach to medium-term technology issues that can have a useful economic impact. This approach is called "technology capture." The premise is simple: states should invest in development of technology applications that improve the innovativeness of products produced by industry in the state, or that improve the efficiency of production. There is no emphasis on completely new technologies or new industries in the technology capture concept, only on applying technology and expediting its use. Technology capture stresses making "second-generation" technologies work for the economy, rather than seeking discoveries in "third-generation" technologies, which may take a far longer time to realize and may be better undertaken in universities and major laboratories.

Technology capture approaches can be used in any field, whether biotechnology, automation, or advanced materials. For example, biotechnology research can be used to improve the ability of plants to self-fertilize, resist pests, produce more, or grow under more difficult conditions, or to provide useful chemical feedstocks. This would be like bringing the "Green Revolution" to a new stage of development. Similarly, research in automation would concentrate on applications for enhancing the introduction of new production techniques in existing manufacturing firms, as well as on helping to develop and standardize new manufacturing automation products for the state's manufacturing sector. Research on advanced materials applications could be oriented toward helping plastics fabricators and machine builders adapt to changing markets more quickly than competitors.

States have made some innovative efforts to create new applied research institutions that are intended to serve their economic base through technology capture. To some degree, these centers, which can still be considered experiments, build on earlier experiences in the development of the Agricultural Experiment Stations.

The Agricultural Experiment Stations are research and development centers that are sponsored by states and the U.S. Department of Agriculture, as well as by private contracts. They have independent staff, as well as university faculty, performing research on applied topics addressing critical issues facing a state's agricultural economy. Over the years, these centers have broadened their focus to encompass national issues, as well as far more complex technological issues. For example both Cornell's and the University of Georgia's Agricultural Experiment Stations are very active in agricultural biotechnology research. The principle of the Agricultural Experiment Station model, however, is the development of an independent research center focusing on medium-term state needs, not on broader academic scientific inquiry. In other words, Agricultural Experiment Stations have been examples of technology capture approaches, even though today they may not be as effective as they could be in responding to specific state issues.

States such as Michigan, Ohio, New Jersey, and a few others have created "Centers of Research Excellence" that have as their mission technology capture research on specific problems facing industries within their state economies. Ohio's Edison Program, for example, has created the Cleveland Advanced Manufacturing Program (CAMP), which sponsors research on manufacturing problems facing larger industrial firms. CAMP has research components at Case–Western Reserve, Cleveland State University, and Cuyahoga Community College. Each of these centers involves private industry collaborators, and each focuses on a different aspect of advanced-manufacturing problems. Case emphasizes the advanced-manufacturing problems, Cleveland State advises the more specific applied engineering issues, and Cuyahoga the issues of training in the use of automation equipment. The Edison Program has other centers as well on different topics, including biotechnology and information technology.

Michigan's Centers of Research Excellence are another state program that encompasses two large technology centers. The Industrial Technology Institute (ITI) is a multipurpose center for the study of applied problems in manufacturing automation, not unlike India's Central Machine Tool Institute. The center has over 200 staff doing applied research ranging from the individual unit of automation, such as testing new vision systems and robotic arms, to the intermediate level of automation, such as evaluating problems in development of flexible manufacturing cells, to the higher-order technical issues, such as systems integration and real-time communication from the plant to the cell level. ITI is supported by the state, foundations, federal grants and contracts with Michigan, and some national industries.

The Michigan Biotechnology Institute (MBI) is an integrated R&D facility that can undertake research on molecular biology issues from the lab top level up through to production prototyping. MBI's mission, not unlike that of India's Central Food Technology Institute, is to perform research that will lead to development of licensable biotechnologies for Michigan industry and farms. These technologies will be designed to degrade toxic wastes from paper and cheese producers and recycle them as chemical feedstocks, as well as to provide new higher-value-added agricultural plants for Michigan growers. In addition, the facility has been designed to serve as an incubator of biotechnology product developers, helping them move from the laboratory to the production scale-up level, and, as a resource for special evaluation studies for private industry. MBI has its own staff, as well as visiting faculty from Michigan State University. MBI is supported by the state, foundations, grants, and private contracts.

Beyond these current programs, Michigan is planning to redefine its Research Excellence Fund so that this pool of funds can be focused on medium-term industrial technology problem-solving and technical development, working with state technology centers.

In general, more states are beginning to perceive the cost-effectiveness of supporting technology capture types of centers rather than technology development initiatives that have minimal resources compared with industry efforts or national research programs. Increasingly, states are looking for ways to balance their role in building longer-term research capacity in the state and implementing medium-term applied research support for their economies. In making these choices, states are starting to study the dynamics of their own technology infrastructure in greater detail, looking for the match and mismatch between what industry can do for itself and where the state can "leverage" the most productive impact on the economy for its own limited investment.

In sum, the medium-term technology infrastructure consists of a wide array of suppliers, including engineering schools, corporate laboratories, state technology centers, and private R&D organizations. Each source has its limits. The engineering school research programs at various universities have developed increasingly long-term agendas for study which often make them less accessible to a state's industry. State-government-sponsored technology centers in some cases now emphasize technology capture that puts technology to work for the state economy, but very often pursue new technology development with only marginal financial or scientific capability. Finally, there are private R&D organizations that were formed as intermediaries to supply the private sector and government with capability they did not have or needed only for a short time. These are often expensive for smaller firms to use, and there are not many in the United States.

States are finding that their medium-term technology infrastructure is often underdeveloped. Whereas larger companies can seek out needed technology research from national and international sources, the smaller companies and more vulnerable sectors are having great difficulty in gaining access to the "second-generation" technologies that the medium-term technology infrastructure produces. As a result, states need to consider carefully how to structure their efforts to build the medium-term technology infrastructure. They are finding that their greatest impact can be gained from focusing investments on technologies that help their existing industries adapt and compete more effectively, not from emphasizing technological discoveries that hold vague promises for new economic development.

Karnataka's Medium-Term Technology Infrastructure

Karnataka has a more highly developed medium-term technology infrastructure than most Indian states, and even than many states in America. However, although Karnataka has a wealth of institutions that perform medium-term technology development, these institutions may not be able to respond to the requirements of Karnataka's industrial base. The reasons vary, as do the capabilities of each institution.

For this analysis, five Karnataka technology institutions will be briefly reviewed in terms of criteria of effectiveness relative to the economy. The institutions are:

- National Aeronautical Laboratory (NAL)
- Indian Space Research Organisation (ISRO)
- Central Power Research Institute (CPRI)
- Central Food Technology Research Institute (CFTRI)
- Central Machine Tool Institute (CMTI)

National Aeronautical Laboratory (NAL)

NAL is a national laboratory affiliated with the Council of Scientific and Industrial Research (CSIR). NAL's mission is to provide research and development services to the nation's aerospace and aeronautical industry. NAL has six major R&D programs – aerodynamics, fluid mechanics, materials sciences, propulsion, structural sciences, and systems engineering – in addition to supporting programs in engineering services, computer services, and aeronautic information.

Of NAL's R&D, 50% is performed on behalf of defense and aerospace agency clients. Another 15% is for various government agencies other than aerospace and defense. Another 10%, is for different technical offices of the government, and 25% is for the private sector, often under publicly sponsored programs.

NAL has considerable autonomy under the CSIR system and has been attempting to broaden its research base to include more sponsored research, as well more commercially oriented industrial research. The change has been incremental, and the shift in NAL's base to sponsored research is continuing. The sponsored research is providing NAL with the experience in more narrowly defined projects needed for more responsive service to the private sector. NAL is also producing technologies for license to the private sector, as part of its effort to make national laboratories more active in moving technology from the laboratory to the marketplace.

In many respects, NAL is similar to national laboratories in the United States in that, during most of its history, it has been driven by the R&D priorities of the national aerospace and defense sectors and not served industry directly. Although NAL is willing and eager to increase its response to private-sector needs, it has yet to organize itself specifically to achieve this end. NAL's leaders and technical staff are open to playing these new roles, but NAL needs to have a market-sensitive plan if it is to evolve beyond laboratory status.

Much to its credit, NAL has many of the technological capabilities that are pertinent to the rapidly evolving Karnataka economy. These skills, include development of advanced-materials applications (composites), as well as finite-unit analysis modeling and actual testing of structural products. NAL's skills are current relative to competitive sources in India, although possibly not as advanced as those of private firms involved with aerospace materials in the United States.

NAL's costs are not likely to be a barrier to prospective clients. Not only are costs lower than market price (because of the subsidized overhead structure of national laboratories), but also tax incentives are given for sponsored research. However, smaller firms are likely to find costs higher than desired, primarily because any cost is an obstacle to them.

In sum, NAL represents an important medium-term resource that could focus its applied technology skills for industry on a variety of advanced-materials, structures, testing, and measurement R&D services for business. NAL's capabilities could be useful to producers of hard goods, such as automotive parts (composite springs, drive shafts), consumer products (electronic packaging), energy systems (high efficiency), and construction (reinforced materials).

To achieve the desired responsiveness, important organizational changes are necessary, including possibly creating a subsidiary capability within NAL oriented to the private market and performing to market requirements. NAL's initiatives to develop technologies for the marketplace are less likely to be of major significance in helping the economy than are activities based on the R&D needs of potential industrial customers. Technological developments are important but they are sidelines to the more valuable human resources NAL is capable of offering industry. It is an important sign that NAL believes it they could become successful operating with a greater share of its budget coming from corporate contracts. This attitude suggests a willingness to innovate organizationally and collaborate with other medium-term technology institutions.

Indian Space Research Organisation (ISRO)

The Indian Space Research Organisation (ISRO) in Bangalore is the headquarters of India's growing space program. ISRO is a massive effort to provide India with its own array of satellite launch facilities, launch vehicles, satellites, and communication systems. More importantly, the ISRO system is a technology application vehicle of very large proportions. Through ISRO flow almost Rs. 120 crores to industry in the form of contracts for parts and components. In addition, through ISRO's technology transfer and technical consultancy program flow licenses to produce technological innovations that have arisen from ISRO work, and technical assistance in building vendor capacity. Although ISRO is headquartered in Bangalore, its over 15,000 employees are located in 19 science, technology and applications centers nationwide. Bangalore has many of the space program project offices, and divisions involved with civil engineering, propulsion systems, and satellite control. No one site, however, has the majority of facilities for space program R&D and production. Moreover, the program has a strong emphasis on procuring parts, components, and systems from Indian companies.

ISRO has a well-thought-out plan for achieving national space program objectives as well as building greater industry involvement in the program to the year 2000. ISRO takes pride in its efforts to build stronger supplier capabilities in the aerospace sector, but recognizes that to date basic marketplace obstacles have deterred companies from committing themselves to aerospace product development. As a result, ISRO in the past has found insufficient capacity to produce full systems for space program needs.

In the United State, for example, NASA would award contracts for full systems to companies such as Martin Marietta, Ford

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Aerospace, Lockheed, Rockwell, or McDonnell Douglas. Each of these major firms would be able to organize a team around its own capabilities to produce a system (satellite, launch vehicle, and so on); NASA's role would be project oversight. In India, the absence of these capabilities has forced ISRO to design and test most of the systems itself. Major systems might be produced, however, through the publicly owned Hindustan Aeronautics in Bangalore, which would recruit engineers and technicians for aerospace projects at each stage of need. Only ISRO and NAL were capable of maintaining the personnel needed for major projects in this field. ISRO has been slowly implementing efforts to build greater industrial capability to produce integrated systems, but has yet to reach its goals. At this stage, ISRO is still working on getting individual parts and components produced by the private sector. ISRO has managed to improve learning by companies through building its own pilot plants and transferring manufacturing skills to companies; it also monitors how well industry is doing in producing once a production technique has been passed along.

ISRO has also developed 5-year guaranteed offtake agreements with companies to induce them to produce parts needed for the space program. By ensuring a cash flow for producers, it may be able to build an enduring business—although in India aerospace has yet to achieve the standing of a full industry, as it has in the United States.

ISRO is also issuing licenses for ISRO-developed technologies, for which it collects royalties to encourage businesses to treat technology transfer seriously. The licensing program is growing rapidly, but very few Bangalore firms are involved. In 1986, ISRO not only developed technologies for licensing but also performed marketing studies to assess their attractiveness to industry. Among the technologies evaluated were the ISRO FEAST Software Package, the Micro Multispectral Interactive Data Analysis System, ISRO Telemetry Systems, and Micro Arts.

Technical consulting is available to Companies that would like to increase their capabilities in specific fields relating to use of new technologies. ISRO claims capacity in a wide variety of fields, including chemical engineering; polymers and specialty chemicals; communications and electronic information transfer engineering; computers, data processing, and simulation; educational technology; fiber-reinforced plastics (FRP); fluid and gas dynamics; heat transfer and combustion; industrial building design; metallurgy, materials science, and engineering; nondestructive testing; remote sensing systems; precision fabrication and production engineering; servo controls; and reliability and quality assurance and testing.

This capability, which is distributed across ISRO staff and facilities, has been used in about 50 projects for industries in India. This small number suggests that either the skills are not in demand or the delivery system for the consultation is not working sufficiently well. ISRO is probably not perceived as a supplier of technical assistance or R&D by most industries in India, or Bangalore. However, with such a presumably broad area of skills, there must be ways to enhance utilization by industry.

ISRO states that it is committed to improving the partnership between itself and industry and will achieve its objectives by transfer efforts, entrepreneur schemes, coordinating industrial consortia, encouraging companies to bid on systems management contracts, enhancing its vendor development program, and increasing demand for space products by marketing exports in addition to providing direct financial incentives to stimulate longer-term demand.

For many companies, however, ISRO remains beyond the real marketplace. To them, ISRO remains a high-quality but largely inaccessible organization, with *possibly* applicable technologies and skills that most firms, including many emerging sector companies, are not aware of or as yet interested in. ISRO's technologies and skills are broad and up-to-date, but its efforts to make companies aware of what it has to offer have not yet penetrated the Karnataka industrial sector (although it may have done better elsewhere). Clearly, the costs of ISRO's help are not an obstacle to its work. The real challenge appears to be to increase company technological sophistication and stimulate a commitment to production of technology-based products through financial incentives. This problem is not unlike those experienced by NASA in its early days.

ISRO's program targets and the needs for medium term technology in Karnataka may merit its considering development of a broader R&D and technology development venture with other concerned business organizations as a vehicle for drawing more industries into the technology business. ISRO has tremendous economic clout; how it could be effectively channeled to the Karnataka economy warrants further examination.

Central Power Research Institute (CPRI)

CPRI was established in 1960 as the National Power Research Organizations to sponsor R&D in the generation, transmission, and distribution of electricity and operation of electricity supply systems. A central mission of CPRI is also to provide research and testing facilities for evaluating electrical materials and performance of power equipment, as well as serving as a National Testing and Certification Authority for certification of electrical products.

CPRI has seven main divisions: Distribution, which operates the appliance, relay, and battery testing laboratories; High Voltage/High Current, which operates the high-voltage, mobile field testing, and short-circuit laboratories; Instrumentation, which operates the instrumentation laboratories and rural energy laboratory; Insulation, which runs the cables and capacitors, insulation, and polymer laboratories; Mechanical Engineering, which runs the tower testing station, vibration laboratory, and model testing laboratory; Materials Technology, which runs the materials and dielectric, gas chromatography, and thermal station chemistry laboratories; and Power Systems, which runs the power system laboratory, simulation center, and computer center.

Each division conducts R&D that helps advance understanding of India's power needs and problems. Studies include development of microprocessor-based winding fault indicators (to find flaws in cables and transformers), software for predicting power load problems, new

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polymers for use in insulation, characterization of Indian coals, and development of a high-efficiency wood-burning stove.

CPRI is self-sufficient, being supported by revenues earned from the testing and certification services it provides. Every new piece of electrical equipment must be certified by CPRI to be commercially successful.

CPRI believes that it offers very useful R&D capabilities for both new industries and mature ones. However, only a few industries use CPRI facilities, and even then CPRI often has to sell its services directly to companies. NGEF is one group that is currently working with CPRI on developing an electronic static changeover switch for use in power systems. In each case, CPRI is working on an issue of medium-term concern to the company, and for which commensurate skills and facilities are not readily available. Like other national laboratories or institutes, CPRI does not attempt to make a profit but to provide services at a break-even cost.

To reach out into the business sector, CPRI is now licensing production of a variety of technologies it has developed internally. Among these are the efficient wood-burning stove, domestic gasifiers, portable equipment for analyzing dissolved gases in transformers, a process for making high-quality transformer oil from rape seed, and a process for extracting aluminum from fly ash produced by thermal power stations.

CPRI apparently does not have the confidence of industry when companies seek technical help; as a result, its skills are underused. CPRI, however, is accessible to industries with power-related medium-term R&D needs. The skills at CPRI are appropriate to the level and form of work it performs in power research, although not highly sophisticated (CPRI finds it hard to recruit top staff because of wage limits). CPRI could examine how its energy expertise at the "big" energy scale could be applied more to medium-size and smaller companies with power problems. In general, CPRI could do a better job of assessing the market so that it could be more responsive to the market's needs.

Central Food Technology Research Institute (CFTRI)

CFTRI was established in the 1950s to facilitate the development of the nation's food processing industry through post-harvest technology programs. CFTRI research and training efforts started when processed foods were virtually unknown in Indian society. Its work started addressing the technical problems that began after food was harvested, including problems of handling, drying, milling, grinding, storage, preservation, creating nutritious foods, creating packaged and convenience foods, and designing equipment for these purposes. CFTRI added to this work the development of quality control processes, development of skilled manpower in food processing (e.g., milling technology), and continual innovation and diffusion of appropriate technologies in food processing. In general, CFTRI is intended to bridge food shortage problems through innovative conservation techniques, develop wholesome foods, minimize food imports, and advance knowledge of the dynamics of food processing.

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CFTRI's 600 staff conduct research through five divisions: Food Sciences, with food chemistry, nutrition, food safety, microbiology and sanitation, autotrophic cell culture, and experimental animal production; Food Technologies, such as grain science and technology, fruits, vegetables and plantation crops, oilseed technology, confectionery and convenience food, infestation control and protectants, and animal products; Food Engineering, with fermentation technology and bioengineering, fabrication design and process engineering, consumer acceptance, and packaging technology; Technology Utilization, including industrial development, regional stations, and technical publications; and Planning and Infrastructure, which encompasses support services and training for food programs.

Each of these divisions has R&D programs developed through an institute R&D planning system. CFTRI also offers services, such as processing of technical inquiries, consultation at the Institute, preparation of technical and project engineering reports, feasibility studies, technoeconomic surveys, evaluation of R&D projects, assessment of packaging characteristics of food materials, quality control guidance, and both advisory and engineering consultancy to the food industry.

CFTRI has provided technical guidance to many industries and organizations over the years, including many of the nation's major public and private food processors and marketing groups. Moreover, CFTRI develops a wide range of food processing techniques, foods, and food packaging, which it makes available to industry. CFTRI is proud of the innovations it has developed that have been adopted by Indian industry, among which are such products as corned beef, egg albumin flakes, egg coating oil, egg powder, fish meal and oil, flavor blends for soft drinks (e.g., "Thumbs Up" cola), instant mixes for traditional foods (dosas, idli, jamun, sambar, etc.), a buffalo milk for babies who are allergic to cow milk, and many others. These product concepts have indeed arrived at a time when the Indian consumer market appears willing and able to adopt new foods and eating styles. Thus, CFTRI is helping to encourage innovative thinking in the marketplace, particularly at the small and medium scales.

CFTRI will also undertake sponsored projects for development of new products or improvement of existing ones. Sponsors are given nonexclusive or limited rights to exploit the process development for a specific of time. A number of projects have been sponsored at CFTRI by food associations, such as the Cardamon, Coffee, and Tea Boards. However, CFTRI does not view itself as an applied R&D center serving industry on a direct basis, although it is not averse to expanding this role.

CFTRI is not an academic institution, but does offer master's degree in Food Technology and in Food Science through an affiliation with Mysore University. In addition, CFTRI provides members of the emerging food processing industry, from bakers and millers to fruit canners, with a variety of educational forums and training programs that help these industries establish professional standards and familiarity with current technologies being used in India. The All India Bakers Association, for example, is very concerned that there is no bakery training facility with contemporary mixing and oven technology equipment in India, even though the bakery industry is a fast-growing small-industry sector. Needs for such simple types of technology equipment and training enable CFTRI to respond to a wide variety of needs in the food processing industry at the earliest stage of its growth.

CFTRI is not nearly as sophisticated as most major food companies in the Western world. Yet in India, CFTRI provides an important source of innovation and advances in the food processing industry. At present, CFTRI may not be organized to provide the range of R&D services that some segments of the food industry might like. To some degree this is due to the limits on CFTRI resources, but to a larger degree it is a result of CFTRI's current structure. However, CFTRI's level of innovation in food technology is, in itself, a very important function that has considerable value at the current early stage of development of the Indian food industry, not unlike the role played by other institutes, such as CMTI. The question is whether CFTRI and its sister institutions are evolving as rapidly as are the industries they were intended to help seed and support.

CFTRI could undertake efforts to strengthen the diffusion of its many technological innovations into the market by developing a more formalized industry R&D service that emphasizes product market studies, product development, and testing. However, this does not seem to be a likely emphasis in the near term. By the time the food industry catches up with food innovations in India, private sources of technology and marketing services are likely to have also grown up within the Indian economy. How CFTRI will assist, participate in, or parallel this development is well worth exploring more.

Central Machine Tool Institute (CMTI)

CMTI was established in Bangalore in 1962, initially with Government of Yugoslavia support. CMTI has a staff of over 450, 150 of whom are production engineers.

As a medium-term technology source, CMTI can perform a wide range of R&D and product development studies. Most of its projects involve developing a machine tool system to meet the special needs of a customer. Typically, CMTI staff will work with a client's staff to design, manufacture, and test a machine and accessories.

CMTI has a CAD/CAM demonstration center where it trains staff and clients in the use of computer work stations. In addition, CMTI has developed several software programs for solving complex design problems for specific types of parts, such as gears, cams, clutches, and springs, for modeling static and dynamic behavior of parts, and for analysis of deformation and stress in different mechanical structures.

CMTI is most likely to provide consulting assistance to small and medium-scale industries. Small firms are also charged about 10% less for services rendered. In general, CMTI considers itself to be a major source of technical information on the state of the art in general- and special-purpose machine tool development and the application of low-cost automation in India, whether it is for a major producer, such as BHEL, or for a small enterprise. In fact, a small group of employees left CMTI to start producing and exporting a machine that CMTI designed. CMTI will help smaller companies license CMTI designs and begin producing a new product.

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Finally, CMTI is an important training center for machine tool technology, offering courses at various levels of technical depth for trainees. However, there are other training resources that also specialize in use of machine tool technology, such as the Government Tool Room.

Through consulting and training, CMTI has a a high degree of interaction with industry, from heavy industrial producers to the ISRO space program. CMTI represents a technology center that is able to reach both low-technology users of numeric controlled equipment, as well as more sophisticated users of CAD/CAM and computer numeric controlled machinery. CMTI thus represents a transitional technology institution; that is, CMTI serves an industrial environment in which the majority of industry does not use CNC machinery while at the same time there is a growing electronics and aerospace sector with expanding needs for advanced manufacturing technology. CMTI needs to be able to respond to both areas effectively, and, currently appears to be serving the middle range companies reasonably well.

In sum, CMTI appears to be accessible to industry in Karnataka, and it has the appropriate skills in the field of machine tool technology. CMTI is willing to work with most companies, and it charges reasonable fees. However, to continue serving the needs of the state economy over time, CMTI must remain able both to reach the less sophisticated user of first-generation technologies, and to facilitate the development of the second-generation advanced manufacturing techniques needed by Karnataka's emerging technology sectors.

Achieving this balanced program will be a challenge. CMTI appears capable of expanding skills in either direction—more technical assistance to smaller, less sophisticated firms, and more technically complex computer-aided manufacturing development. CMTI may need to develop effective partnerships with other institutions to expand facilities and capabilities in advanced manufacturing. ISRO and NAL may be logical partners. Private firms with CAD/CAM and manufacturing expertise will also soon begin to add their capabilities to the marketplace. Even in a more "technology-rich" setting, CMTI should be able to offer Karnataka many of the same important technical services it has in the past.

Near-Term Technology Infrastructure

Of the three time frames in which technological development, application, and use take place, the near term is the most fundamental. The near-term technology infrastructure consists of those sources of "first-generation" technology—already available through the market—that make firms more innovative or productive. However, first-generation technologies that might appear available in principle may not be available or accessible in practice. This discussion will examine the problem of building an adequate near-term technology infrastructure by examining the U.S. experience and its relevance to Karnataka's own technology resources.

U.S. Experience

In the United States the marketplace is presumed to generally be the best source of solutions to problems of technology development and application. The nation has a highly developed system of technology resources that are able to respond to most near-term needs a company might have. There is a very large U.S. technology supplier system, comprising developers, producers, distributors, and suppliers, in addition to trade organizations and professional associations. Yet this system is often oriented to those companies that are best able to anticipate their own needs and to plan technology purchases and implementation. A large number of small and medium-size firms experience considerable difficulty in meeting their specific near-term technology needs, including needs for training, and are, as a result, frequently at risk competitively.

The United States has never had formal national policies oriented toward the technology use of smaller companies. States, too, have paid relatively little attention to this issue, but they are beginning to examine it and consider new actions. Recently, a few have instituted efforts to reach out to smaller enterprises and assist them with technology problems. Similarly, some state colleges and community colleges have found an emerging niche in supplying technical expertise on industry technology problems. Perhaps most importantly, as industrial competitiveness issues have grown in importance, larger buyers of products, such as automobile makers, have started to become more concerned about the technological competence of small firms that are their suppliers.

Addressing near-term technological needs of industry, medium-size or small, remains both an immediate and a surprisingly difficult technology infrastructure problem. In part, this difficulty stems from the size of the problem: there are many small and medium-size firms that are not gaining access to current technologies. But more importantly, the problem has its roots in the economics of business operation and the process of innovation and change in industry. Unless states can make the process of technology diffusion work more efficiently, the larger-scale consequences will be a deterioration of the technology agglomerations that foster growth, and fewer competitive businesses.

States have traditionally concentrated their programmatic assistance to business on capitalization issues (loans, working capital). However, this assistance is often provided without an understanding of technology equipment. States assume that technology suppliers will reach the individual firm, and that firms will be able to make informed decisions about which technology they need before financial assistance is requested. However, most business owners know relatively little about changes in first-generation technologies. Moreover, suppliers often do not reach smaller firms directly on a routine basis. Sometimes businesses are bombarded by direct mail and trade magazines promoting new machinery, but until the firm asks a vendor for a demonstration, there is often little or no contact. Even when vendors make presentations to clients, the client is often at a considerable disadvantage technically when it comes to evaluating a technology product. Consequently, many firms avoid contacting manufacturers' representatives and depend on their own judgment, or that of a consultant, if they can afford one, when buying new technology.

In the manufacturing sector, in particular, choices about first-generation technology equipment have become increasingly complex. Firms will often defer changing the way they do business rather than risk an uninformed venture into the use of a new computer-aided design (CAD) system, data processing equipment, software, computer numeric controlled device, or statistical process control program. Business operators not familiar with what technology can do for them, and what its return on investment will be, may avoid considering technologies until their competitors are using them, and then it is often too late to catch up.

The challenge facing states has been to understand the way these market forces operate, and then to enable them to function more efficiently or bypass their inadequacies. Several states now operate industrial extension services. These programs build on the well-known agricultural extension model that was developed in the Depression years to assist disadvantaged farmers in the United States. The industrial extension programs vary in depth from state to state. The simplest programs involve having "agents" based at community colleges call businesses in a region to ascertain problems that they have and to help them identify sources of assistance. Often, these programs try to link the businessmen with local vendors or state or community college technical expertise. The firms are expected to pursue the resources identified for them.

The more sophisticated programs, such as Michigan's Manufacturing Modernization Service, involve a team of industry and technology experts making several visits to a firm to analyze the company's use of technology and its needs. The team evaluates the company's diverse technology equipment and training needs against its business objectives and production capabilities. It then makes recommendations, identifies appropriate vendors from a state-approved list, and describes community-college-based training programs to assist in implementation of the new technology. The firm must then decide whether to continue with the assistance. In most cases, this involves follow-up consultation with the firm as it implements recommendations made by the state program.

Industrial extension services probably are the newest and least extensively developed near-term technology programs being sponsored by states. However, one discovery that states are making as they

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assess their own technology infrastructure is that smaller state and community colleges are becoming more active in medium-term research and technical problem solving. Although research universities in the United States tend to disparage the technical competency of state universities (many of which were created as teachers' colleges in the 1950s and 1960s), many now are developing specific analytic capacities beyond their traditional training roles.

To a certain degree, these capabilities are an effort by smaller colleges to become more visible to industry as well as government. However, many smaller colleges (most of which have only bachelor's degree programs) have gained experience in working with local industries and are now turning this experience base into a technical resource. In some state colleges this capability has become quite sophisticated. Cleveland State University, for example, has an automation engineering consultation program that is popular with major local manufacturers. Oakland University in Michigan has developed a competent applied research program in robotics and vision inspection systems that is consulting with local manufacturers desiring to implement new technologies.

Many other state colleges are formalizing near-term technical assistance programs targeted toward regional industries. Some specialize, for example, in painting technology systems if they are near either suppliers or users of painting equipment (Eastern Michigan University). Others specialize in design, planning, installation, and integration problems of computer numeric controlled machinery (Ferris State College, Michigan). This technical capability is often well received in areas where many smaller industrial firms want to use new technologies but are not able to overcome technical difficulties with the equipment, even after receiving all the training support their vendors could provide.

State college capacity represents the bottom tier of technological sophistication. Yet these colleges are providing a very fundamental and immediate service to local and regional industries. Although very few such programs are in place and the majority emphasize training in emerging fields, such as computer-aided design and statistical process control, such programs at state colleges and some community colleges are likely to play a key regional role in state efforts to improve near-term technology infrastructure in the future.

Ultimately, the solution of near-term technological problems in state economies hinges on helping the marketplace to work better. In states that have large manufacturers who also purchase the products of local suppliers, there is justification in focusing state attention on improving buyer–supplier relationships. In the United States at present, a few large producers are beginning to work with their suppliers, and suppliers are eager to work with them. In part, motivation on both sides stems from the fact that overseas competitors are making increasing inroads in both finished goods and parts.

In response to market pressures, larger firms, many of which have had complex supplier systems for many years, are cutting back suppliers, selecting fewer companies with whom they will have longer-term contracts. These first-tier suppliers will then have the job of developing their own supplier networks, so that they

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can maintain their contracts. In this environment of restructuring of the supplier system, major purchasers are forcing suppliers to meet a variety of important criteria.

Among these new criteria are very high quality standards. Suppliers very often must meet quality requirements that involve very low production defect rates, which in turn require suppliers to use new calibration and statistical quality control technologies Suppliers are also increasingly expected to take designs from their buyers via computer and translate specifications into products rapidly using computer-aided design and manufacturing. Because of frequent client product line changes, suppliers also must be able to do rapid tooling and retooling of their own production lines, which requires use of technologies that permit flexible manufacturing (flexible manufacturing cells, group technologies). Finally, because of just-in-time requirements, suppliers need to be able to produce and deliver quickly (or else carry the cost of warehousing themselves). This capability requires computer-based manufacturing resource planning (MRP), which enables efficient organization and deployment of resources in the plant.

All these requirements are increasingly being imposed on suppliers as part of American corporations move toward "synchronous" manufacturing. States that want to help maintain suppliers in their geographic boundaries are helping bring together buyers and suppliers to work out their own technical assistance efforts. In some states conferences on supplier technology planning are being sponsored and held at technology centers that can follow up by offering limited technical assistance. Overall, however, states are doing far less to encourage effective buyer–supplier relations than they could. States may find themselves paying a steep cost for this oversight in the future.

In sum, the near-term technology infrastructure in the United States is made up primarily of private-sector vendors and major purchasers of products who can assist individual suppliers in improving their performance. However, in addition to the private-sector resources, states are becoming more involved in meeting the near-term needs of industry for technology. Because most larger companies are able to meet these needs themselves, states are concentrating more on developing industrial extension services that reach out to smaller and medium-size manufacturers. In addition, in an effort to establish a new niche in the technology application's field, state colleges and some community colleges are offering direct technical assistance services to local firms on a systematic basis (e.g., an industrial technology center). These programs are increasing in their sophistication and may be the basis for future regional centers of excellence in technical assistance (possibly linked to state or national centers). Overall, states are recognizing the need to do more to help the first-generation technology supply market work better for its users. To achieve this improvement, states are starting to bring buyers and suppliers together and are examining ways to provide more effective technical and training support to suppliers as they respond to major buyer needs.

Although technically less complex, addressing first-generation, near-term technology needs may have a greater, longer-term payoff for states than many very long-term technology development

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initiatives. At a minimum, balancing near-term priorities against longer-term aspirations is an important policy consideration for states.

Karnataka's Near-Term Technology Infrastructure

Karnataka is fortunate to have a moderately well-developed near-term technology infrastructure serving both the emerging and the transforming segments of the economy. Many of the major suppliers of near-term technology include the same organizations that provide medium-term technology development. For example, as discussed in the preceding section:

- *Central Machine Tool Institute* – In addition to performing R&D on machine tool development, CMTI staff will provide advisory and consultative services to firms. This is not a major business for them, but they do respond to requests for technical help and believe this is an important part of their mission. They feel that industry underutilizes their help and want to remedy this situation.

- *Central Food Technology Research Institute* – As well as developing technological innovations in food processing, CFTRI staff will provide technical consultations and feasibility studies for private industry. They do not view this as a major part of their mission and are more interested in transferring their own innovations to the market place. However, they can perform these services and could expand them if they wanted.

- *Central Power Research Institute* – In addition to their R&D work on power systems technology and standards development, CPRI staff help individual firms on their energy technology problems. In their case, they are going to firms to induce them to use their services and license their technologies.

- *National Aeronautical Laboratory* – NAL staff are interested in increasing the segment of their portfolio that is made up of technical projects for industry. They are beginning to define specific technical services they could make available. However, at this point, provision of near-term technological services to industry is not a common element of NAL's work.

- *Indian Space Research Organisation* – ISRO has a program of consulting to firms that are interested in entering sectors allied to the aerospace industry, and is encouraging firms to license its technologies. Although ISRO is beginning to reach out to these firms more systematically, ISRO activities could not be said to be very active in near-term technical assistance to local industry at this point.

In sum, the national laboratories and institutes that are part of Karnataka's technology infrastructure, and also members of the Council of Science and Industry Research (CSIR), are all mandated to try both to provide technical assistance to industry and license technology as technology transfer. Many of these technology centers have a strong past record of assistance to industry. All of them can enhance their efforts to directly assist industry beyond trying to commercialize technology. Moreover, in one way or another, each

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can contribute an important dimension to meeting the broader medium- and near-term technology needs of Karnataka's economy.

Indian Institute of Science Centre for Scientific and Industrial Consultancy

Other than the CSIR institutes and laboratories, the IISc Centre for Scientific and Industry Consultancy (CSIC) is the only major independent scientifically oriented near-term source of technology in Karnataka. CSIC is an example of recent efforts by the IISc to improve relationships with industry and expand the flow of industry support to faculty and facilities. CSIC is, essentially, an intermediary program established at the IISc to allow firms to identify technical themes for research that can be responded to by IISc faculty and staff.

IISc's technical consultancy program, however, competes against the ability of private firms to import technology in various forms from overseas sources. Although in India companies are constrained from purchasing foreign technology that is available from a domestic provider, firms can get around the rule by modifying their specifications enough to get an exemption. In general, they prefer to buy packaged foreign products that are available quickly, and perhaps less expensively, rather than wait for development of a domestic product tailored to their needs.

CSIC has been set up to try to penetrate the import-oriented research practices of Indian firms. It brokers research projects to faculty of the IISc. It has done about 125 projects, most of them for government industry, but some for the privately owned industrial sectors. The future activities of CSIC will emphasize more complex technological needs of firms, for which no easily imported solutions are available.

For the most part, CSIC provides consultation and research on issues that provide a scientific and technical challenge; routine research is discouraged. CSIC is also not likely to perform product development studies, which involve doing end-stage work on an existing technology. Also, if industry needs to have simple services provided, like certification or calibration, there are other sources that are more appropriate to use. CSIC is likely to be open to innovative research arrangements, including precompetitive research efforts involving industry, much as has been the case in the Engineering Research Centers in the United States. Although it is important for IISc faculty to reach out to industry and there should be incentives to do so, the IISc at present does not permit unlimited consulting time.

In sum, the IISc's CSIC is a fairly restricted technology resource for industry in Karnataka. IISc staff will do selected near- to medium-term research efforts, but, like university researchers, they want topics that relate to their interests and are not too close to the marketplace to lose their scientific value for inquiry. CSIC wants to attract more industry clients, but industry still views CSIC more as an avenue for exploring issues, not for addressing important near- to medium-term technological problems. Although CSIC is not inaccessible or irrelevant or out of date in its skills, it is often deliberately or inadvertently unresponsive to industry needs. The reason may be that IISc researchers will not do a given project, that industry does not believe they will, or that when

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they do a project, they are not sensitive to the time constraints and technical specificity required by the sponsoring business.

Yet, whatever future directions technology development takes in Karnataka, the IISc expects to be involved—and considers itself to be essential to its success. Thus, along with ISRO and NAL, the IISc is ready to play a strong role in the future development of a technology initiative in Karnataka, whether it focuses on long-term, medium-term, or near-term technology issues for industry.

Summary

In this review of the technological infrastructure in the United States and Karnataka, we can observe the strengths and weaknesses of each in the long, medium, and near terms. Tables III-1 and III-2 summarize the basic capacities of the U.S. and Karnataka technology infrastructures for each time frame. In comparing the two, the most obvious deficiency in Karnataka's technology infrastructure is in its long-term capacity to provide applied research that meets the needs of the state's industries. Perhaps even more importantly, Karnataka has a weak medium-term capacity to meet its industries' applied R&D needs. This weakness is reflected in the priorities of the recommendations made in Sections IV and V of this report.

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Table III-1

KEY ACTORS IN U.S. TECHNOLOGY INFRASTRUCTURE

Technology Time Frame	Research Universities	State Universities	Community Colleges	National Laboratories	R&D Institutes	Corporate Labs & Research Centers	State-Sponsored Programs	Technology Suppliers & Vendors
Long term	• Basic research • Advanced inter-disciplinary research • Publishing and disseminating	—	—	• Defense-related research with corporate contracts • Basic research	• SRI-type applied research • Contract grant research	• Internal research	• Research excellence programs • Grants to universities for capacity building	—
Medium term	• Engineering research centers (ERCs) • Precompetitive	• Applied problem-solving centers • Industry centers	—	• Technology transfer • Applied research in fields of national concern (e.g., health, agriculture, defense)	• Applied research for corpora-tions • SRI-type contract research	• Internal research	• Center of excellence (e.g., Michigan's ITI, MBI)	• Internal corporate research
Near term	• Consulting	• Consulting	• Technical assistance	• Publication and dissemination	• Consulting • Technical assistance	• Internal research	• Technology deployment • Outreach and technical assistance	• Vendor activities • Product distribution • Trade shows • Professional organizations • Publications

KEY ACTORS IN KARNATAKA'S TECHNOLOGY INFRASTRUCTURE

Technology Time Frame	IISc	State Universities (Rangaure and Mysore)	NAL	ISRO	CPRI	CFTRI	CMTI	State Sponsored Programs
Long term	• Basic research • Publicity • Contract research on theoretical issues	—	—	—	—	—	—	—
Medium term	• Contract research on applied issues for national agencies	—	• Sponsored R&D for defense and aerospace agencies • R&D contract research for private sector (limited)	• Sponsored R&D and testing facility • Technology transfer and technical consulting program • Technology licensing program	• Research and testing facility for power systems technology and standards development	• Funded R&D • Industry-sponsored research and product development (limited)	• R&D and product development studies for client	—
Near term	• Consulting (Centre for Scientific and Industrial Consultancy)	• Limited consulting	• Limited technical services available to industry	• Limited technical consulting • Technical assistance to potential vendors and producers of aerospace equipment	• Equipment testing and certification • Technical assistance to firms on energy technology problems	• Technical consultancy • Market feasibility studies for private industries • Technoeconomic surveys • Evaluation of R&D projects	• Technical consulting, mostly to small and medium-scale industries	—

2. KARNATAKA'S HUMAN RESOURCES INFRASTRUCTURE

Introduction

In building a modern, globally competitive manufacturing industry, India's greatest resource is its people. The talents, energies, education, and experience of India's technical and managerial workers will determine how effectively India's manufacturing industries can compete with those of other nations in the new global economy that is now evolving.

Karnataka has become a center of manufacturing in India, not only because of the attractiveness of Bangalore, but also because of the progressive attitude of its people. As the state consolidates and expands its manufacturing industry, however, the adequacy of its technical and managerial manpower base must be examined and any shortcomings remedied.

Human Resource Needs

The human resource needs of manufacturing industries vary according to the three phases of industry described earlier: emerging, expanding, and transforming.

Emerging Industries

Emerging industries are usually technology intensive and perform research and development work. Therefore, they require highly trained technical professionals (typically possessing master's or doctoral degrees in engineering and science) who can tackle new problems confidently. These industries often form close ties with the faculty of major research universities or technology centers and rely on academicians and researchers for insights and help in problem-solving. Technical support personnel are also necessary, such as research assistants, technicians, and computer operators who may have bachelor's degrees in science or diplomas from polytechnic and vocational training schools.

Emerging industries require managers different from those in expanding or transforming industries. The successful manager or founder of an emerging industry is often an entrepreneur with vision, drive, sound business sense, and the ability to inspire highly qualified technical professionals. Emerging industries also require R&D managers who can successfully manage product development from concept to market introduction, direct the work of creative professionals, and combine an understanding of the technology with market awareness and business sense.

Emerging industries also seek assistance from consultants and financing institutions in developing sound business plans and structuring financing arrangements.

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Expanding Industries

Expanding industries require a steady infusion of competent engineers with bachelor's or master's degrees in engineering and computer science to meet staffing needs in product development, manufacturing engineering, and sales/application engineering. Because these industries are likely to be expanding their manufacturing capacity, they recruit equipment operators, machinists, skilled and semiskilled assembly workers, equipment maintenance technicians, test and repair technicians, and the like. In fact, a definite worldwide trend is the ever-increasing need for electronics engineers and technicians and for mechanical engineers familiar with CAD/CAM and factory automation. Another growing need is for systems engineers who can integrate various product or process technology elements into whole systems using knowledge from several disciplines. Expanding industries must ensure, through continuing education, that their technical personnel are familiar with the state-of-the-art technologies in their fields.

Professional managers in expanding industries must have not only formal education (such as an M.B.A. degree plus a technical undergraduate degree), but also well-rounded work experience in increasingly responsible positions and proven track records. Essential for expanding industries are strong marketing managers who can identify new market opportunities, champion new products, perform global competitive analyses, and build effective sales and distribution systems.

Transforming Industries

Transforming industries require executives who can galvanize the work force into shedding old practices and finding new avenues for succeeding. Top managements can do this only by formulating and communicating a new vision for their companies and convincing their employees that the old ways are no longer tenable. Further, employees at all levels may need to be retrained to think in new ways, assimilate new technologies, and function in changed environments. Thus, companies institute in-house training programs for all employees, sometimes with the assistance of outside consultants, and encourage technical and managerial employees to pursue continuing education at external institutions such as universities and technical training institutes. Specific topics of retraining are CAD/CAM, computer programming, statistical quality control, statistical problem-solving, and the philosophy of just-in-time manufacturing and quality circles.

Managers in transforming industries need to develop an awareness of global trends and competition, develop new management styles conducive to greater employee involvement and commitment, become computer literate, and learn how to manage technological and cultural change.

Karnataka has a long-standing manufacturing industry and is generally well endowed with technical and managerial manpower. Several imbalances and weaknesses, however, need to be examined and remedied.

A useful way to view the adequacy of Karnataka's human resource infrastructure is in terms of long-, medium-, and near-term supply sources.

Long-Term Sources

Long-term supply sources are those that require more than 5 years after higher secondary school to develop human resources, such as the Indian Institute of Science (IISc), Indian Institutes of Technology (IITs), and Indian Institutes of Management (IIMs), that grant master's and doctoral degrees in engineering, management, and science. The IISc has a special mission to perform relevant research and provide teaching and consulting for the emerging sector, which includes high-technology companies. Employee career development programs within companies and the development of linkages between educational institutions and industry may also be classified under long-term sources.

In brief, Karnataka can draw on the excellent resources of the IISc, IITs, and IIMs to meet its long-term scientific, technical, and managerial needs, but closer linkages between these institutions and the state's industries must be developed through the efforts of both. Karnataka's companies also should strengthen their employee career development programs.

IISc/IITs – The IISc and IITs produce about a third of India's postgraduate engineers (2,000 per year). These institutions have generally excellent facilities for teaching and research and have budgets that exceed those of many universities with much greater student enrollments. They have also received donations of equipment and facilities from foreign governments and agencies.

The IISc, in Bangalore, was established in 1909 as an institution devoted to research and teaching in science and technology, particularly in the branches likely to promote the material and industrial welfare of India. Its founder, the visionary industrialist Jamsetji Tata, conceived the institute as a leader in scientific and technological research and a benefit to industry. The five IITs,* which were founded in the 1950s, have similar goals but emphasize technology. They are patterned after the Massachusetts Institute of Technology (MIT).

The IISc has a long and distinguished record in engineering and scientific research and emphasizes postgraduate research and teaching. Some industry observers, however, claim that the IISc has not realized its founder's vision – that a closer linkage between the IISc's work and industry's needs is required. The current industrial climate in Karnataka may enable the IISc to fully actualize that vision. In fact, because of its location in Bangalore,

*Although no IIT is located in Karnataka, the IITs are included in this review of Karnataka's human resource infrastructure because, being national in character, they are an important source of technical and managerial talent.

the IISc has a special responsibility to develop strong links with Karnataka's industries. Various activities of the IISc, such as industry consulting and continuing education programs, should be strengthened and expanded, particularly for the emerging industrial sector. Already, the institute works very closely with the nation's aerospace industry because of its strong program in aeronautical engineering. Similarly, close linkages with emerging industries can be fostered through research, teaching, and consulting on selected topics in computer science, electrical engineering, telecommunications, materials science, and biochemistry.

The IITs have a similar role to play as the IISc in postgraduate teaching, research, and consulting to support Karnataka's industrial growth.* The IISc and the IITs should grant leaves of absence of perhaps 1 year to faculty members so they can work directly for companies on special projects or problems. This would be one of the most effective ways to foster close links between the institutes and industry.

In the United States, major research universities such as MIT, Stanford, and the University of California at Berkeley have long been major suppliers of highly skilled scientists and engineers who have been responsible for advances in science and technology. An example of how U.S. universities are responsive to industry's needs is the 5-year plan for a Center of Engineering Excellence at Arizona State University. The plan was developed through the joint efforts of the university, government, and industry to address human resource development needs in several skill areas. In general, the faculty and students at many American universities have very close contacts with industry and perform extensive contract research and consulting.

IIMs—The discussion here includes all four IIMs, even though only one is located in Karnataka, because these institutions, like the IITs, are national in character. The IIMs were established to train young men and women in the approaches and techniques of management, to conduct research on management topics, to provide continuing education for industry executives, to offer management consultancy services to industry, and to contribute to the formulation of public policy.

The institutes offer degrees equivalent to the M.B.A. and Ph.D. in management, and they attract very capable students from all over India. The IIMs have excellent facilities for teaching and research and receive generous support from the Indian government.

Karnataka's industry should develop close relationships with these institutions to recruit graduates, train executives, and suggest industry-relevant topics for research and teaching. For example, emerging industries might suggest that the IIMs offer courses for students and executives in such areas as entrepreneurial management, small-business management, managing professionals, and managing technological innovation. Expanding industries will be most interested in marketing, global competitive analysis, international business, and production and

*Some of the state's engineering colleges, particularly the Regional Engineering College, have good postgraduate programs in certain engineering disciplines, and they, too, should build closer ties with the state's industry. In general, however, the state colleges are handicapped by the lack of research facilities.

operations management courses. Transforming companies will need courses on global trends and competition, managing technological and cultural change, ensuring greater employee involvement and commitment, and modern manufacturing information systems. Further, mid-level R&D managers may benefit from programs to upgrade their project management skills, including such aspects as project planning, project management tools, and project costing and reporting.

Business schools in the United States have been criticized in recent years for neglecting production management research and courses and for giving students principally a finance orientation. The neglect of manufacturing in engineering and business schools has been cited as one of the major causes of the decline of U.S. manufacturing prowess. The Harvard Business School has responded to this criticism by strengthening course requirements for M.B.A. students in production and operations management and in human resources management. The school has also expanded course offerings in interdisciplinary areas such as entrepreneurial management and small-business management, because much of the vitality, growth, and employment generation within the American economy is now in the small-business sector. In cooperation with MIT's Sloan School of Management, Harvard Business School also offers a seminar on the management of technology. The school has had long-standing executive education programs for senior and mid-level managers, which, along with the *Harvard Business Review* and extensive research, have fostered very close links with corporations. In fact, the school's unsurpassed influence, wealth, and prestige can be attributed to the relevance of its case method teaching approach and research to the needs of American and international businesses. The Harvard Business School is now working closely with Japanese companies to develop programs for meeting Japan's management education needs.

Corporate Human Resources Development—Long-term development of human resources to meet industry needs also depends on the actions of public and private companies in employee career development and developing links with universities.

Employee career development encompasses more than continuing education programs and learning through experience. Deliberate, well-conceived plans must be devised for providing employees with broad, meaningful work experiences over several years, consistent with the interests and aptitudes of the employees and the needs of the employer. Companies should use employee development programs to develop human resources as well as to retain highly talented people.

Karnataka's industries should strengthen the ability of their personnel departments to monitor and guide the career development of their employees. Employee career development programs are particularly feasible for Karnataka's companies because turnover is generally low and companies can make long-term investments in employees.

Some U.S. companies, faced with high employee turnover, are unable or unwilling to plan and execute long-term employee development activities, resulting in a human resource base that is narrowly experienced and parochial in its thinking. Many Japanese firms and a few U.S. firms,

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such as IBM and Hewlett–Packard, are known for rotating employees through various functions as a way to give them well-rounded experiences; some Indian companies also have similar career development activities. Much organizational conflict, such as between manufacturing and marketing functions or between manufacturing and product development functions, can be attributed to the lack of well-rounded experiences and sound career development programs.

Companies can work closely with universities in many ways, such as by:

- Donating laboratory equipment.
- Using university faculty members as consultants.
- Enrolling employees in continuing education programs.
- Permitting employees to teach part time.
- Participating in curriculum development.
- Providing research grants.
- Endowing student and faculty scholarships.
- Sponsoring class projects.
- Creating summer co-op programs for students.

Karnataka's companies do have contacts with certain educational institutions, but they mostly concern continuing education programs, campus recruiting, and some summer job programs. The manufacturing industries of Karnataka should strive to develop stronger links with IITs, the IISc, IIMs, the state's universities and engineering colleges, polytechnics, and vocational training institutes.

In the United States, the growth of the great private research universities like Harvard, Yale, Princeton, MIT, Stanford, and Cal Tech was possible only because of the enormous assistance received from private contributors such as corporations and individuals. Conversely, several U.S. companies owe their existence and growth to links with major universities. Silicon Valley companies near San Francisco owe much to Stanford, and the Route 128 companies near Boston similarly owe much to MIT and Harvard.

The Robotics Center at Carnegie–Mellon University is a particularly noteworthy example of companies sponsoring research activity at a university, both for advancing the state of the art and securing access to top students for potential employment.

Medium-Term Sources

Medium-term sources are generally those that require 3 to 5 years following higher secondary school to develop human resources. Among these sources are institutions that grant bachelor's degrees in engineering and science.

The IITs and the state's engineering colleges provide industry with a vast supply of engineers. Industry must find ways to attract, retain, and motivate the most talented engineers and reduce the brain drain to the West. Industry also must contribute to the development of relevant problem-solving skills by sponsoring class projects and summer co-op programs for students. The IIT at Madras should establish a manufacturing center of excellence, and all IITs need to develop programs in systems engineering. Karnataka's university system may need to be restructured to have smaller, more numerous, and more responsive universities.

IITs – The five IITs have exceptionally strong engineering undergraduate programs, with an annual capacity of 1,250 entering students. Admission to the IIT undergraduate programs is through a very challenging entrance examination, one of the most selective in the world. The students are drawn from all parts of India and possess diverse talents that enable them to excel in a variety of areas, including engineering research and development, marketing, and general management. The undergraduate education programs at the IITs stress sound understanding of the principles of science and engineering, require extensive work in very well equipped laboratories, and include course work in the humanities. The demand for the graduates of these programs is very high, and students generally find attractive positions with well-known Indian firms or pursue advanced degrees in engineering or management at U.S. universities or at the IIMs/IITs.

The IITs have acquired nationwide fame for their undergraduate programs, and the performance of their students – even in the highly competitive U.S. educational system and economy – has been excellent. Nevertheless, some issues and concerns must be addressed. For example: the relevance of the IIT curriculum to Indian industry has often been questioned. Some claim that the curriculum does not instill in students a sensitivity and concern for the problems of Indian industry and society. Thus, students do not approach problem-solving with a recognition of challenges peculiar to Indian conditions and do not find creative solutions based on indigenous resources. Industry, for its part, must realize that institutions like the IITs are meant to train students to think creatively and understand fundamental concepts, rather than merely to fit the specific, immediate requirements of companies. The responsibility for imparting the skills and knowledge specific to each company or industry belongs to the companies themselves. Fostering this awareness may be best accomplished through class projects sponsored by companies that bring real problems to students, expect practical solutions, and offer the guidance of practicing engineers. Summer co-op work for students at the end of their second and third years is another way to expose them to industry problems and develop the relevance of their problem-solving skills to Indian conditions.

The IITs also have the mission of spearheading India's move into future technologies and hence must prepare students to work at the leading edge of technology. Their curricula thus should address global trends and could be based on the curricula of selected technological institutions in the United States, Japan, and West Germany. The IITs must stress design automation and manufacturing systems engineering, encompassing such fields as CAD/CAM, computer-integrated manufacturing, robotics, vision systems, automated materials handling systems, process control, statistical quality control, group technology, and just-in-time manufacturing. Manufacturing centers of excellence, drawing on the combined resources of mechanical and industrial engineering departments, should be established. A candidate site is IIT Madras, which is strong in production engineering and has excellent facilities for manufacturing research.

Moreover, an increasing need is to move beyond traditional specialties such as mechanical, electrical, or industrial engineering to systems engineering, combining elements from various disciplines. Systems engineering training will be particularly necessary for large, complex technology programs (such as in the aerospace field) that require the ability to integrate various technologies as well as manage the projects.

In the United States, the University of California at Los Angeles and Stanford University are among those that have established manufacturing centers. The Rensselaer Polytechnic Institute in Troy, New York, has developed a Department of Decision Sciences and Engineering Systems that provides basic engineering training but adds operations research, statistics, production planning, accounting and cost control, and management of information systems.

Karnataka's Engineering Colleges – In 1986, the state had 50 engineering colleges, the highest number of any state in India. Of this total, 1 is a regional engineering college, 16 are state-government-run or -aided colleges, and 33 are private colleges. These colleges provide engineering education for a very large number of entering students (14,000) each year. The system, however, has many problems.

Many of the state's engineering colleges have inadequate facilities for teaching and research. Their budgets are insignificant compared with those of the IITs/IISc. The standards for admission and teaching are inferior at some colleges. In addition, some colleges suffer problems of politics, student unrest, faculty apathy, and so on.

The mission of the state colleges should be similar to that of the IITs: teach students the principles of science and engineering and develop creative problem-solving skills relevant to Indian conditions. In view of their limited resources, the engineering colleges should focus on providing sound undergraduate education covering the fundamental areas of science and engineering. To the extent that they can find additional resources, they should introduce new courses in CAD/CAM, modern production technologies, computer science, and automatic controls.

Engineering colleges have been requesting greater autonomy to develop their own curriculum and compose examinations. The general complaint now is that the colleges do not have the flexibility to respond effectively to changing industry needs. Although granting greater autonomy is, in principle, a highly desirable goal and the education system should progress in that direction, certain steps must be taken to ensure that the various colleges affiliated with a university meet prescribed standards for student admission, faculty competence, examinations, and teaching and research facilities before greater autonomy is granted. Current steps to develop an accreditation system will help to establish standards and qualify colleges for greater autonomy.

Much has been said about the autonomy of U.S. engineering colleges in determining curriculum and composing examinations. But a typical U.S. university has only one school of engineering, whereas Bangalore University has 15 engineering colleges affiliated with it and faces the problem of ensuring uniformity in teaching and examining students who are seeking the same degree through different colleges. Surely, a given degree from a university cannot be allowed to have different connotations due to the varying quality of the affiliated colleges. The problem arises from the growth pattern of Indian higher education wherein, typically, the colleges affiliated with a university proliferate but the number of universities does not grow as rapidly. The United States has a large number of small, independent universities, each with its own engineering school, which grant their own degrees. A city like Boston may have more than a dozen large universities, each of which grants its own degrees and has carved out its niche in the community. For instance, MIT's mission is to do leading-edge research and teach, whereas Worcester Polytechnic Institute and Northeastern University aim more at training students for current industry needs. This example may suggest the establishment of a larger number of universities in Karnataka, each with a single or small number of affiliated engineering colleges, granting their own degrees, and thereby being free to respond to market needs as they see fit.

Near-Term Sources

Near-term sources are those that generally require 3 years or less to develop human resources and include institutions providing vocational education and training, continuing education, corporate training, and the like.

Karnataka has a variety of near-term sources of human resources development, but the adequacy of its vocational education infrastructure should be determined by a joint industry–government panel. The vocational education and training system should be made highly responsive to changing industry needs by granting polytechnics greater autonomy to respond; industry should provide funds, equipment, and advice on curriculum development.

Polytechnics—In 1986, there were approximately 150 polytechnics in the state with an annual capacity of over 20,000 entering students. The growth of these institutions in Karnataka has been explosive in recent years. Polytechnics offer programs leading to diplomas in a variety of fields that, although providing education in the fundamentals of science and engineering, are more vocational than the engineering programs. As such, they are more likely to be directly linked to the current needs of industries than the engineering colleges. Therefore, they have an important role to play in developing human resources for Karnataka's industries.

Polytechnics in Karnataka often lack resources such as adequate laboratory equipment and qualified instructors. They also do not have the autonomy to respond to the needs of the industry in their area. The state government should grant polytechnics greater autonomy to determine curriculum based on industry suggestions, and perhaps allow each polytechnic to conduct its own examinations and confer its own diplomas, as do U.S. community colleges.

Industry, for its part, must play a greater role by helping to define the curriculum, allowing employees to teach, and providing equipment, thereby enhancing the quality and relevance of the programs.

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In the United States, the system of community colleges resembles India's system of polytechnics. Many of the community colleges have programs to foster close ties between them and companies. For example, California's Foothill Community College's Business and Industry Interchange Program employs several individuals who act as brokers, visiting local industry, explaining the variety of services available for upgrading the skills of employees through the college, and arranging for delivery of services when requested. College administrators support this staff by responding quickly to industry requests in developing noncredit courses or reformatting existing courses. Often, a contract-type education arrangement is developed, with the college providing the instructor, facility, and curriculum, and business providing the funding, the students, and sometimes the equipment, instructional assistance, and facilities. North Dakota's State School of Science offers the Mobile Training Program using specially fitted semi-trailers to bring classroom, laboratory, and technical equipment to outlying areas. In one case, the program helped a rural manufacturer upgrade 60 employees with new welding skills, helping the company maintain its competitiveness and the region retain important, high-paying jobs. Arizona's Glendale Community College offers programs that are tailored to fit and complement corporate internal training programs, such as a program in production management that picked up where a company's basic training offerings ended. Similarly, Central Michigan University has developed a program on management and supervision that builds directly on Chrysler Corporation's 2-year certificate program, allowing a smooth transition for employees interested in further career development.

There are numerous other examples of U.S. community colleges finding creative ways to work very closely with businesses in their areas. The polytechnics of Karnataka should have the freedom to establish similar ties with the companies of the state.

Technical/Vocational Training Schools – Vocational training is highly relevant to Indian industry, particularly in manufacturing skills such as machining, tool and die making, metrology and inspection, heat treatment, machine tool maintenance, welding, electrical work, and foundry. For a significant portion of the nation's population, vocational education rather than higher education would be the appropriate follow-on to secondary school education.

According to a Government of India Ministry of Education report, Karnataka appears to lag far behind states like Tamil Nadu and Maharashtra in the number of vocational training institutions. There were only six junior technical institutes in the state in 1986, with a meager annual capacity of 360 entering students. For a state with so many degree-granting engineering colleges, this situation reflects lopsided priorities, partly because certificates from technical schools lack social prestige.

But there are excellent examples of vocational training institutions in Karnataka that can serve as models for numerous future institutions. The Government Tool Room and Training Center was started in Bangalore in 1971 with Danish assistance to train students in tool, jig, and fixture making. The center has also introduced courses in CNC and CAD/CAM. Although the center is under the administrative control of the state

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government, it supports itself completely through industry contracts. But the state does provide capital grants for buying equipment. Training is provided for only about 200 full-time and 50 part-time trainees who are admitted from within the state, but who accept jobs all over India, particularly in high-wage states like Maharashtra—only 50% of the trainees remain in the state following completion of the program. Given the relevance of the training, Karnataka's companies would do well to offer competitive salaries and retain these trained people within the state.

The Foreman Training Institute in Bangalore was established with West German assistance for training manufacturing supervisors. A total of 600 students are trained each year in many aspects of manufacturing. The institute also offers courses tailored to the needs of specific industries. Future plans include training programs on CNC equipment.

The Central Machine Tool Institute (CMTI) in Bangalore provides short-term courses for industry sponsored candidates in areas such as CNC machines, metrology, machine tool inspection and testing, CAD/CAM, group technology, etc.

Karnataka also has 209 Industrial Training Institutes (ITIs) where 3,000 trainees are trained each year in various trades.

Judging from the marketability of the graduates from these institutions, Karnataka appears to need more institutions like these, and the state's industries should play a leading role in establishing and funding them.

Corporate Education — The development of human resources for manufacturing industries is a major responsibility of the industries themselves. Consequently, public and private companies, especially the large and established ones, should be involved in a variety of educational programs aimed at both current and future employees. In the United States, the expenditure on formal corporate education by companies has been estimated at $30 billion to $60 billion (Rs. 36,000 crores to 72,000 crores) per year, which reflects the enormous importance attached to education by companies. Indian companies have training programs, too, ranging from inducting new employees into the corporate culture to specific training programs on new equipment. The actual extent and adequacy of these programs are not known.

The types of programs that industries need to offer or support can be classified into various categories:

- *General Orientation* — Companies need to orient new employees to their policies, procedures, and culture. They need to emphasize those aspects that contribute to success in their businesses, similar to IBM's stressing customer service in its orientation programs. The companies of Karnataka, especially the emerging ones that wish to foster new corporate cultures and use culture as a competitive advantage, need to orient new employees to the companies' way of doing things.

- *Continuing Education* — In this era of rapid technological change, employees need to be continually retrained in modern technologies and new ways of

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doing business. This retraining is accomplished through sponsored part-time education for employees at universities and technical institutions, attendance at conferences and workshops, and in-house training programs, sometimes using outside consultants. Training areas that are relevant to expanding and transforming industries include: CAD/CAM, just-in-time manufacturing, statistical quality control and problem solving, group technology, etc. Some of Karnataka's companies provide good continuing education programs for their employees at the IISc/IITs, the Foreman Training Institute, CMTI, etc.

- *Management Development* — Companies with strong cultures, such as IBM and Hewlett-Packard in the United States, promote employees almost exclusively from within. To ensure a steady supply of qualified employees to fill management openings, they have developed extensive in-house management development programs. Alternatively, companies may use the executive education programs at management schools to train their mid-level and senior executives. Manufacturing industries in Karnataka have the option of collaborating with institutions such as the IIMs to develop suitable management training programs. Important training areas include R&D management, modern manufacturing management, entrepreneurial management, management of technological and cultural change, global competitive analysis, and marketing.

- *Specific Skills Training* — The most prevalent form of corporate education in Karnataka involves training on operating and maintaining purchased equipment from vendors, and on using new tools such as personal computers. The quality of training programs and reference manuals provided by equipment vendors has now become an important criterion in choosing equipment.

- *Apprenticeships* — Manufacturing industries have major responsibility for training skilled workers such as machinists, tool and die makers, welders, electronic technicians, etc. They can accomplish this training through in-house apprenticeship programs and by supporting and funding vocational training institutes. The companies of Karnataka do offer apprenticeship programs under the Apprentices Act, but they need to work more closely with vocational training institutes by communicating their manpower needs and helping develop the curriculum.

- *Other Sources* — Besides the above sources and institutions, other sources of training are available to the industries of Karnataka. One such source is the National Productivity Council, whose objectives are to create productivity consciousness in the country and provide specialized services to industries. The council consists of a large group of industrial engineers who provide consultancy and training services in various areas of industrial engineering.

The Manpower Development Center is a private institution that provides development programs for clients' employees ranging from workers to executives. It also assists companies in recruiting and placing employees. Training is provided in functional areas such as marketing and sales, information systems, R&D management, materials management, and computers and computer applications.

Summary of Recommendations for Human Resources Development

Karnataka's human resources infrastructure to support its industries is very good in general, but several areas need emphasis or remedial action. The most important recommendations are summarized below.

Long-Term Human Resources Development

The IISc must build very close relationships with the emerging-sector industries of Karnataka through doing research, teaching, and consulting on topics relevant to the sector, which includes computer hardware and software, biotechnology, aerospace, and telecommunication companies. The institute shall grant leaves of absence to faculty members who wish to work directly for emerging-sector companies on special projects for periods of up to 1 year.

The major public and private companies of Karnataka should develop close long-term relations in a variety of ways with the IISc, IITs, IIMs, and the state's engineering colleges, polytechnics, and vocational training institutions. In particular, the companies should assist polytechnics and vocational training institutions by suggesting the curriculum, providing equipment and facilities, and permitting qualified employees to teach.

The state government should view industry as its equal partner in promoting technical education. An ongoing public-private panel, involving representatives from industry, government, and the state's universities and coordinated by the state's director of technical education, should be created to examine the changing technical education needs of the state, establish priorities, develop action plans, and raise funds from industry, government, and other sources to implement the plans. The government, while providing seed capital, should expect vocational institutions to progressively increase their revenues from industry contracts and fees, and eventually become self-supporting. Even with the universities and their engineering colleges, the government should match its grants for new equipment and expanded facilities to industry contributions, thereby encouraging the universities and colleges to seek industry funding for the programs.

The IIMs should strengthen research, teaching, consulting, and continuing education programs on topics in entrepreneurship, research and development management, global competitiveness, international business, modern production management, and the management of technological, cultural and organizational change.

Medium-Term Human Resources Development

A center of excellence for design automation and manufacturing systems engineering should be established at one or more of the IITs to conduct research, teaching, consulting, and continuing education programs on CAD/CAM, CNC machines, computer-integrated manufacturing, group technology, automated assembly and materials handling, robotics, vision systems, and statistical quality control and problem solving. All IITs should establish programs in systems engineering.

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which combines elements from various engineering disciplines and includes project management education.

The major public and private industries of Karnataka should tailor their practices for hiring and developing employees to attract and retain the best talent in India, particularly graduates from the IITs and IIMs. They should sponsor class projects for engineering students, create summer co-op programs for engineering students after their second and third years; establish attractive career development and continuing education programs, and provide creative, rewarding, and yet demanding work environments.

The state government should examine restructuring its university system to have smaller and more numerous universities, each with one or a small number of affiliated engineering colleges, which will have greater autonomy to determine curriculum, set examinations, and develop their own niches.

Near-Term Human Resources Development

The public–private panel for technical education recommended earlier should begin its work by examining the status of polytechnics and vocational training in the state to identify gaps in education and shortages of resources. The panel should develop action plans and raise funds for enhancing the relevance and adequacy of the state's vocational education system.

The government should find ways of granting greater autonomy to polytechnics and vocational training institutes to respond quickly to changing industry needs for vocational education. The polytechnics should be allowed to determine their own curricula based on industry suggestions, and grant their own diplomas.

Emerging-sector industry should enroll mid-level and senior executives in continuing education programs on entrepreneurship and research and development management; expanding-sector industry programs on global competitiveness, marketing, and modern production management; and transforming-sector industry in programs on global trends and competition, managing change (technological, cultural, and organizational), and modern production management, including Japanese techniques. Further, design and manufacturing personnel in many companies should be trained on CAD/CAM.

3. KARNATAKA'S FINANCE INFRASTRUCTURE

Introduction

Capital availability in Karnataka — or the ability of a variety of financial institutions to meet the financing needs of industries at different stages of their life cycle — is a third factor increasingly important to Karnataka's industries as they seek to adapt to changing economic conditions. Capital is critical not only to finance the start-up of new businesses, but to finance the development of new products, use of new processes, retraining of workers, and development of new marketing strategies required in today's economic environment. Karnataka's financial infrastructure is well developed in terms of both its first-rate public development banks and its fast-growing commercial banks. However, good as it is in meeting traditional financial needs, the emerging financial needs of Karnataka's dynamic economy require new and innovative mechanisms, especially in financing higher-risk activities.

In the longer term, the ability of financial institutions to meet industry R&D needs and the financial needs of new high-risk enterprises is a function of the overall structure of capital markets within a region, including the regulatory and policy framework that provides incentives for the formation of various types of capital. In the medium term, a financial infrastructure that can support the major investment requirements of the state's economy must be able to supply the basic investment capital needed to both enable the growth of new businesses and industries and ensure the survival of existing firms. In the near term, the capital infrastructure consists of the institutions and mechanisms through which individual industries meet their ongoing capital needs. As is true for technology, capital is a highly mobile resource; it makes no difference whether a capital source is located within or outside a region. What is important is whether barriers such as information costs, regulations, or the practices of investors inhibit the flow of capital to various types of firms. Therefore, what is most important is the existence of needed linkages between industries and financial sources.

Because capital is highly mobile, it is not necessary that industries obtain capital from a local source. However, industries do require capital that is "available" in two senses: accessibility (can firms get the type of capital they need, when they need it?), and affordability (can firms obtain capital at a price commensurate with the risk involved in the venture?). Therefore, proximity to the financing source becomes a factor in capital availability only to the extent that the information, search, or other real costs of obtaining financing are increased by the need to go to a capital source outside the state.

Why is a developed financial infrastructure so critical for Karnataka's industry? With the increasing liberalization of the nation's economy, Karnataka's industries are facing significant new domestic and international competition. Emerging, expanding, and transforming industries in Karnataka are operating in an environment in which competitive pressures are greater than they have been. As a result, innovation in business, and in industry as a

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whole, is a requisite for survival today. Innovation in the present economy consists of being better able to respond to the need to rapidly and flexibly develop, produce, and market new products sensitive to user needs—whether the firm is young or old, small or large. These changing economic conditions pose unusual needs for adaptation in an industry, and an increasing number of its new and older firms may find it difficult to gain access to the capital they need because they cannot afford capital priced at the level of risk it represents to lenders or investors.

Financing is essential to the ongoing process of adaptation and development required of today's industry. The rapid pace of change in business may sometimes require specialized financing that varies by where the business is in its life cycle. As a result, different businesses have different needs, and those needs change at different stages. For example:

- *New firms*—Newer firms typically have significant investment capital needs—high at the start—but have no track record in the market. They are, as a result, considered riskier, and must demonstrate their ability to produce and market a product. They are less attractive to lenders because of the general risk and higher costs for transaction and risk management. Yet because they are not encumbered by debt and have the potential for high profitability, they might be attractive to higher-risk investors with longer-run return objectives.

- *Older Firms*—Older firms have unusual, often higher-risk capital needs because they are attempting to demature or adapt to transforming markets. Although in some cases they may find the process of seeking capital easier than it is for a new business because they have a track record, their circumstances are more likely to make this process difficult because they have existing, probably high, debt-to-equity ratios, and they have substantial recapitalization needs. In addition, they may have a management style that makes their efforts to adapt occur later than is desirable and thus makes new investment strategies appear riskier. However, because these firms are established, they usually have lower transaction costs and shorter-term financial requirements.

The problem limiting the financing of adaptation and innovation in industry in the United States or India is not lack of money, but the efficiency with which funds are channeled in the aggregate to industries undergoing change. Traditional sources of capital in the marketplace operate in a risk–return framework. Financial markets serve industry needs when the market is well defined, and the risk–returns make lending or investment profitable. However, a given industry may not be attractive to conventional capital markets. There are inevitably a variety of constraints on the operation of financial markets. Investors and lenders face different corporate, legal, regulatory, and public policies that shape their willingness or ability to supply capital to an enterprise in need of debt or equity financing. These factors include:

- Information and transaction costs associated with making investments.

- Risk–return priorities for how funds are used.

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- Time preferences or constraints for return of capital.

- Risk management and monitoring costs for loans or investments.

- Lending and investment amount limits defined by portfolio and asset base characteristics.

Making a better match between the priorities and needs of financial markets and industries is essential to encouraging innovation in industry. However, this improvement requires action in several areas, possibly including:

- New information and brokerage that enable markets to be identified and served.

- Incentives that make new investments and loans attractive.

- Restructuring of public policies to eliminate constraints on existing financial markets.

- Subsidies to fill gaps where present or new financial services cannot profitably respond.

In short, the problem is not the availability of money, but the efficiency of capital markets in the face of changing demands. Karnataka's emerging, expanding, and transforming industries all face problems in this area, although different ones because of the different challenges they face.

India's Financial Markets Today

Industry in Karnataka, and India generally, depend predominantly on the public financial institutions to meet their capital needs. Much of industry's investment capital comes from the state. Without the pressures of a highly competitive financial marketplace, the introduction of new instruments and mechanisms has lagged behind changing industry financial needs considerably. Increasingly, however, state financial institutions are developing innovative financial schemes. The growth of sources of equity financing through capital markets in recent years has greatly enhanced the financial options of Indian industry.

Overall, capital markets in India developed only slowly until recently. Savings have been unusually high in the country – gross domestic savings are 23% of GDP, with the household sector accounting for nearly 75% of total savings. However, as in most developing countries, a large part of these savings have been invested in nonfinancial assets like precious metals and real estate. Although the investment of household savings sector in financial assets has increased from 43% in 1971–72 to 54% in 1983–84, it is still considerably less than in developed economies with mature financial systems. Only a small part of this increase has found its way into the stock market or corporate securities, the bulk going into commercial bank savings accounts, deposits with post offices, and government securities and savings schemes. Other financial institutions such as pension funds, insurance companies, and mutual funds – which in the United States absorb a large proportion of national savings and channel them into the stock market—are almost entirely in India's public sector and are severely constrained.

During the past few years, India's capital markets have expanded in several dimensions. The stock market has become a more attractive investment opportunity during this decade and has experienced a steady increase in investors. New public issues by "Foreign Exchange Regulation Act (FERA) companies" seeking to dilute their foreign holdings during the 1970s induced a number of first-time investors to enter the stock market. More recently, the upward trends of the market during the early 1980s and the boom conditions during 1985—largely the result of government policy liberalization—have enticed more players to the market. In addition, investments from nonresident Indians (NRIs) in secondary market securities, on a repatriable basis, were limited under the portfolio investment scheme.

Mutual funds have become a more important institution for channeling household savings into corporate securities; however, the information of such funds by the private sector has been limited. The Unit Trust of India (UTI), the major public-sector institution, operates a number of schemes. In 1986 UTI launched two closed-ended mutual fund schemes: the India Fund (for NRIs and other individuals/institutions outside India) and the Mastershares (for resident Indians). Both funds were highly oversubscribed, a fact that points to the lack of opportunities to invest in private funds. More mutual funds are expected to be launched shortly. Funds for resident Indians are being launched by commercial banks, with the SBI Capital Markets Fund expected to open for subscription in October 1987 and the Canbank Financial Services Fund to follow shortly thereafter. Whereas the UTI fund has full tax exemption and the commercial banks' funds would also be granted similar status, the absence of the same tax treatment for the income and capital gains of private-sector mutual funds has effectively blocked their entry. Portfolio investment services have made their appearance, but these are not effective substitutes since they are unable to pool investable funds or act with as much flexibility and economy. A number of NRI mutual fund proposals are in the offing, with a proposal for a Birla-Warburg Fund having reportedly been cleared recently. The development of a large number of mutual funds competing with each other is an important requirement in the current situation if a greater number of individual investors have to be wooed back to the markets.

A number of stock exchange reforms are required to develop a strong, healthy, active, and innovative securities market in India. Some recommendations of the recent G. S. Patel Committee report have been implemented; others still need to be acted on.

Merchant (or investment) financing is another capability in India and Karnataka that deserves mention. Merchant banking is the Indian counterpart of investment banking in the United States. Merchant banking in India is concentrated in Bombay, which is estimated to account for as much as 50% of this activity in the country. Not many merchant bankers are located in Karnataka, and Karnataka-based companies usually turn to Bombay for their merchant banking needs. Merchant bankers in India fall into three classes:

- Public financial institutions such as ICICI and IFCI—ICICI provides

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probably the widest range of merchant banking services in the country, while IFCI has only recently set up its merchant banking operations.

- The commercial banks—led by SBI Capital Markets Ltd. and Canbank Financial Services Ltd., which are wholly owned subsidiaries, and also including the merchant banking divisions of foreign banks such as Grindlay's, Standard Chartered, Citibank, and Hong-Kong Bank.

- The private-sector firms such as Credit-capital Finance Corporation Ltd., JM Financial & Investment Consultancy Services Pvt. Ltd., and HL Financial Consultants & Management Services Pvt. Ltd.

A large number of merchant bankers are involved primarily with issue management, loan syndication probably being the second major activity. Only a few of the merchant bankers provide a complete range of project advisory services. Other services that may be offered by some merchant bankers include private placements of securities, arranging for takeovers and mergers, sales of blocks of shares or divisions of companies, portfolio and funds management, arranging for and assisting in foreign collaborations, advice on leasing and equipment finance, and assistance in intercorporate lending. Perhaps a critical difference between merchant banking in India and investment banking in the United States is a much lower level of fiduciary responsibility in merchant banking activities, which makes a vital difference to merchant bankers' attitudes and operations. The need for some kind of code of conduct, regulation or certification of merchant banking has been expressed in various forums.

The financial infrastructure in the United States, as well as in India and Karnataka, is undergoing considerable change. The following discussion examines the financial infrastructure in Karnataka in terms of its capacity to finance research and early-stage commercialization, traditional project investment, and short-term funding requirements. These aspects are addressed for each element of the financial infrastructure. First, relevant U.S. innovations, especially public-sector initiatives, in financing industry needs are highlighted. Second, the effectiveness of India's major financial institutions in meeting the needs of Karnataka's industries is assessed. Finally, recommendations on how Karnataka can enhance its financial infrastructure are discussed.

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Despite the introduction of several new financing schemes by the development banks, Karnataka's ability to finance R&D, product commercialization and testing, and production scale-up in emerging firms is limited. A variety of new schemes for financing innovations and emerging industry start-ups have recently been established; however, both public and private financial institutions are moving ahead very slowly and cautiously. Yet, if Karnataka is to become competitive, the state will have to broaden and deepen its capacity to finance the R&D and start-up ventures of the state's entrepreneurs.

U.S. Experience

The United States is relatively highly evolved in its capability to finance R&D and early-stage industry development. The regulatory and policy environment in the United States allows for financial institutions to respond to industry needs in fairly flexible and innovative ways. The number of mechanisms for mobilizing capital resources to fund R&D and other activities of emerging industries has increased in recent years.

The need for a financial infrastructure is most critical for emerging industries during their initial stages of development: early research and development, product commercialization, product testing, and production scale-up. Typically, the funds for the R&D phase of development in emerging industries are provided by personal savings, a second or third mortgage on a private home (or other assets), and financing from friends, family, and associates of the entrepreneur. On rare occasions, large corporations in a related industry will start a new industry. In local communities where an entrepreneur is known to bankers, an unsecured loan or line of credit might be available, based on the entrepreneur's good credit rating, not the merits of the business. However, this approach is less common than secured loans for short maturities. At this stage the risk of failure is high, particularly for enterprises in new fields whose entrepreneurs are not familiar with the potential market they are entering, or possibly generating. In addition, because new industries are usually led by people with new technologies or new concepts, it is not unusual for the industry to suffer from inadequate management competency.

The product development and early commercialization phase varies substantially from industry to industry. Sources of capital are basically the same as those in the earlier phase, except that some firms are able to attract additional outside financing to commercialize a given product—loans for working capital and second-stage equity, or "mezzanine," financing. Such loans are made mostly to businesses in which the basic technology is the driving force, and investors—either venture capitalists or R&D limited partners—desire to gain a share of future development. By comparison, established industries that are developing new products are—if they are in good financial health—able to use retained earnings and conventional debt to get the working capital needed for these activities.

During the initial test marketing phase, financing typically draws from the existing capital already invested in the firms, but

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may also include specific loans for the initial production secured by the firm's existing capital assets and inventory. However, because the inventory does not have a clear market, secured loans are difficult to acquire. Again, investors interested in sharing in the production and distribution of the product may invest as partners or in a joint venture at this point.

At the production scale-up, firms are able to draw on a wider variety of financing sources. Commercial finance companies or equipment leasing firms may now finance equipment on the basis of the equipment's asset value – as they would for anyone else. Commercial banks may lend for short terms on the basis of advance orders for products or the firm's inventory, now that the product has been market tested, although they may remain suspicious of the new industry's prospects. Large firms will be more interested in joint ventures with the new firms, to "capture" products for their own production or distribution system (as we have seen in the emerging biotechnology, software, and telecommunications industries). Still, firms in emerging industries with an unproven larger market will not be able, as yet, to negotiate easy terms for finance. Firms may have to give up substantial amounts of equity or pay steep finance charges to move into the full marketing stage. Another option for firms at this stage is a merger with another small firm in the same or related industry that has complementary skills – in production or distribution, for example. Firms that are not doing well at this point, but have recognized skills or assets (such as licenses for proprietary technologies), may be candidates for acquisition by larger firms.

Investments that address the start-up and early-stage financing needs of emerging growth firms are considered the riskiest and require great skill. Many U.S. states have endeavored to ensure that flexible sources of capital willing to undertake new kinds of risk are present. It is no accident that many of the nation's most highly touted economic growth areas, such as California's Silicon Valley and Massachusetts' Route 128, are also the home of unconventional, even daring lenders. It is not easy to foster this kind of financial climate. Even so, this critical element of the economic infrastructure can be promoted in a variety of ways: by identifying market gaps not being met by the financial community, adjusting tax and regulatory policies to allow lenders more flexibility, reducing the transaction costs of firms with unusual lending needs (e.g., through loan clearinghouses), and reducing lending risk (e.g., through technical and managerial assistance and possibly loan guarantees).

In the United States perhaps the most innovative financial mechanisms for meeting the R&D and early-stage capital needs of industry have been through venture capital and corporate investment (including R&D limited partnerships). Venture capital investment has gained considerable attention in the past few years. Increasingly, state governments and other local public entities are both making indirect investment in venture capital funds and directly capitalizing and operating of such funds. Karnataka's financial infrastructure is weak in this area, and expansion of venture capital and corporate investment mechanisms to meet industry R&D needs is important.

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Venture Capital—The venture capital industry in the United States gained considerable visibility in the mid-1970s, when technology-based industries became popular investments. The growth in this market was initially stimulated by a reduction in the capital gains tax in 1978, combined with a good market for new public issues, as well as relaxed federal regulations pertaining to pension fund investments. Despite the visibility of the industry as a source of capital for new firms, there are significant limits on where it is applicable and who can really make use of it. First, venture capitalists are looking for investments that will provide a high return in exchange for high risk. Firms that do not offer a substantial potential for growth are generally less attractive. Furthermore, such placements are typically over $500,000, making such sources of funds predominantly attractive to mid-size and larger enterprises. Second, venture fund managers are concerned about reducing their information costs and exposure to risk, so they typically look for a venture that has already passed the crucial start-up stage. Finally, despite the considerable enthusiasm about the growing amounts of venture capital available, the total amount is relatively small compared with the assets of the more conventional sources used by business. The increasing participation of pension funds in this market is likely to boost the importance of venture capital.

Over 20 states now have revised their state employee retirement pension plans to permit investment of a portion of those funds in venture capital. Most states now have funds in the range of $5 million to $10 million, although some states, such as Michigan ($400 million), have very large state venture capital funds. Pension fund investment in venture capital is increasing because this area of investment is seen as a means of both improving the return on fund assets and assisting state economic development. Pensions have long time horizons for their investments because they can calculate benefit payments over a long time. Pension fund liabilities are only partially indexed to inflation or interest rates, and the funds thus have some flexibility in investment choices. The amount available for investment from public pension funds is likely to amount to almost $1 trillion; private pension funds may account for $2 trillion.

At least 10 states own operating, privately managed venture capital companies. Another 17 more permit state pension fund investments in privately managed venture capital funds. The state venture capital funds provide financing in the form of equity investments in firms for fixed assets, R&D, working capital, and so on. Several states have established venture programs to respond to the needs of firms developing new products and production processes: royalty agreements on products, technology research and development grant programs; unsecured long-term debt with warrants or convertible features.

Venture capital financing is likely to continue to be somewhat controversial. States are worried that their funds might be subjected to manipulation and inappropriate investment because of the influence of politics or poor management by civil servants. However, the trend seems to be toward placing the venture capital funds through private professional management, as part of a larger portfolio of investments. This approach in turn raises the question of whether sufficient funds will reach businesses within the state itself. Some states have structured the conditions of their

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investment so that a certain level of investment must be made within the state – often between 35% and 60% of the total state investment. Other states have created public venture capital corporations specializing in the state and funded out of revenue bonds. States must face the chance that by targeting a portion of their pension investment in venture capital to business within the state, they may be getting less than the maximum return. The role of pension funds in financing business capital needs must be carefully thought out.

Direct Corporate Investment. Direct corporate investment in the higher-risk, early-stage activities of industries is another important private source of capital. Types of direct corporate investment in business innovation include corporate debt, partnerships, joint ventures, and acquisitions, mergers, and spin-offs.

Corporate Debt. Many corporations invest in the debt of other firms. Insurance companies are one major source of this type of long-term debt. Because of the structure of insurance liabilities, they have what can be called "patient" capital. Insurance companies are moving into the venture capital field as well, although state insurance regulations often limit the permissible investments of insurance companies. Corporate debt tends to be oriented to larger businesses. Small and new businesses are rarely the target for long-term debt because the amounts borrowed are small and the loans are risky and expensive to monitor. Even the more mature firms are often considered unattractive because of their uncertain market conditions and existing debt levels.

Partnerships. Partnerships are simple investment tools through which larger companies can help in the development of needed, or potentially profitable, business and take ownership of part of the company, product, or technology developed. These arrangements can yield short-term tax benefits, as well as longer-term gains. Limited partnerships in the United States have boomed in technology businesses, in which start-ups are seen as having major growth potential. R&D limited partnerships grew rapidly because of incentives permitting significant early write-offs of investments. This instrument's use is constrained primarily by uncertainty about tax policy and the costs of brokering partnerships between small and mid-sized firms and individual investors.

Joint Ventures. Joint ventures are used when a common business objective is being financed collaboratively: resources of both companies are used, and each shares in the outcome of a product or marketing effort.

Acquisitions, Mergers, and Spin-offs. Acquisitions and mergers are a simple way for one firm to gain the resources of another firm or for two firms to join forces as one enterprise. Spinning off a subsidiary (partially or wholly owned) is a way to separate business activities and preserve emerging lines of business. Acquisitions and mergers have characterized the period following the boom in venture-capitalized technology industries, with larger companies with established track records picking up the high-value-added investment of weak or unsuccessful companies (in computers or biotechnology, for example). Mergers between small businesses with complementary capacities, however, are increasing and are seen as a means of avoiding acquisitions by larger competitors. Spin-offs are usually a means of preserving the health of a business by separating different enterprises, such as contract R&D, or by developing an ancillary service market, such as product testing or equipment support.

Another mechanism that has been initiated in states for expanding the range of R&D financing to companies has been to create a product development corporation. States can issue bonds to finance contracts (equity investments) with companies to cover a portion of their product development costs in exchange for royalties on sales of the products. The vehicle for such arrangements could be a product development corporation, similar to the one now operating in Connecticut. This approach is novel in that it permits the state to help a company finance a product, rather than helping to finance the entire firm. The program assumes that the state financing is appropriate. This subsidy approach has the potential for generating a payback, but experience with it is limited.

Karnataka's R&D and Early-Stage Commercialization Financial Infrastructure

R&D in Indian industry is more for the adaptation of imported technology than for development of new products and processes, and it is largely financed through retained earnings. R&D in emerging industries is carried out mainly in the government sector (e.g., national laboratories, academic institutions, training centers) and in nonprofit private institutions (financed almost entirely from government funds). Some R&D is carried out by a few large private-sector corporations in lines related to their main business (and is normally financed by retained earnings). Entrepreneurial R&D is extremely limited and essentially occurs only in certain specific industries, such as software development.

Although the development of technology for new products and processes has been limited in India, mainly because of the protection enjoyed by industry that allows for lower-risk ways of making money and the tendency to acquire tried-and-true technologies from abroad, the development of technology has also been constrained by the availability of funds.

However, a number of public initiatives have been started to address this issue. Limited amounts of funding for the commercialization of laboratory stage technology are becoming available through schemes such as the provision of risk finance by the National Research Development Corporation (NRDC), the Program for Advancement of Commercial Technology (PACT), venture capital funds launched by the Industrial Credit and Investment Corporation of India (ICICI) and Industrial Development Bank of India (IDBI), Investment Finance Corporation of India's (IFCI) scheme for development of technology through in-house R&D efforts, and state-level schemes such as the Karnataka State Financial Corporation's (KSFC's) program for assisting the Karnataka State Council for Science and Technology (KSCST) in technology development. Although these schemes and programs, all of which have been implemented recently, go some way toward meeting the need for capital finance at this stage of development, most of them have inherent limitations.

National Research Development Corporation (NRDC) – National Research Development Corporation (NRDC),

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operating with the primary objective of commercializing research carried out in national laboratories, provides risk finance for technology development (see box), both by equity participation in companies set up for the first commercialization of NRDC know-how and by development loans for setting up pilot plants. The scheme provides low-cost finance and is quite flexible as to repayment terms, but is constrained by availability of funds. As reported in the Annual Report of the DSIR for 1986–87, approval of financing through equity participation and/or development loans during the year was limited to a total of Rs. 23.30 lakhs for three projects. Other constraining factors on NRDC's provision of risk finance are its limitation to technologies marketed by NRDC and the nonexclusive basis on which technologies are marketed.

Program for Advancement of Commercial Technology (PACT) – A $10-million fund managed by the Industrial Credit and Investment Corporation of India Limited (ICICI) assists Indo-U.S. joint ventures in commercializing a laboratory-proven product or process or sharing the risk of investment with the co-promoters of the joint venture. PACT envisages conditional grants up to 50% of project cost (including the cost of market research and product testing) to be repaid (if the project succeeds in the marketplace) by royalties limited to a maximum of 200% of the initial investment. Although the scheme has the advantage of being simple in operation, with flexibility to accommodate various kinds of collaborations between Indian and U.S. partners, its principal limitations are the small quantity of funds and its restriction to joint Indo-U.S. R&D ventures.

NATIONAL RESEARCH DEVELOPMENT CORPORATION

NRDC has perhaps the oldest scheme in India for providing risk finance for technology development. The corporatioan strives to provide a link between research and industry in the country, and its primary activity is the marketing and licensing of technologies on a nonexclusive basis for commercializing know-how developed in R&D laboratories. It has over 1,900 technologies ready for licensing, almost all of which have been developed in national and government laboratories. Recognizing that a crucial link in the indigenous innovation chain is engineering development (pilot plants or prototype/batch production units) for upscaling laboratory processes, NRDC has been providing risk finance through equity participation and development loans for this stage of technology development. NRDC's loans are given on easy terms (usually only slightly above NRDC's cost of raising the capital) for setting up of pilot plants, fabrication of prototypes, and preparation of production technology packages. NRDC is prepared to share in risks by writing off a part or the whole of the development loan if the project is unsuccessful. Until recently, NRDC's cost of capital was around 12% to 13%, but it has now been assured of interest-free financing from the government, which would bring down its lending rates considerably. NRDC's participation in equity capital is limited to companies set up specifically for commercializing NRDC know-how, having total capital investment of the order of Rs. 50 lakhs or more, restricted to the first commercial plant based on the technology given by NRDC, and only where the process has not gone through the stage of demonstration or pilot plant. NRDC's equity participation in any individual company cannot exceed 26% of the total equity of that company or 15% of its own paid-up share capital, and is disinvested by offer to public-sector financial institutions or to the general public when the company is progressing well.

PROGRAM FOR ADVANCEMENT OF COMMERCIAL TECHNOLOGY

PACT, a scheme designed specifically to promote and finance private-sector/joint-sector Indo-U.S. R&D joint ventures, was instituted with an initial grant of $10 million from the United States Agency for International Development (USAID). Managed by the Industrial Credit and Investment Corporation of India Limited (ICICI), PACT focuses on the "development end" of R&D undertaken jointly by Indian and U.S. companies with the intent of commercializing an innovative product or process, i.e., to translate research already completed at the laboratory stage into products and processes that will succeed in the market. PACT envisages technology development (not just technology transfer) through its assisted joint ventures, and is willing to co-finance preproduction R&D costs of qualifying ventures on a risk-share basis. Accordingly, PACT offers need-based promotional assistance and conditional grants of up to 50% of the project cost, on the condition that a negotiated percentage of revenues arising from the project on commercialization, limited to a maximum of 200% of the PACT share in the project, be paid to ICICI.

PACT became operational in August 1986 and has already received over 300 inquiries and 50 project profiles, of which at least 30 appear to be prima facie eligible. Assistance aggregating approximately U.S. $2 million has already been approved for 7 full-scale projects and one prefeasibility study (2 of these are Karnataka-based companies), although disbursements are still to take place.

ICICI's Venture Capital Scheme — The Industrial Credit and Investment Corporation of India's (ICICI's) venture capital scheme, closely resembling PACT in its objectives, is more flexible in the manner in which financing is provided as well as in who can avail themselves of it. Assistance aggregating approximately Rs. 2 crores has been approved so far for four projects (one of these is Karnataka based) for financing the building of a prototype, the development and marketing of software packages, and the setting up of the first commercial plant of a particular type.

ICICI's VENTURE CAPITAL SCHEME

ICICI has recently started a division to provide venture capital assistance to industry for development and/or commercialization of new technologies that, because of their inherent high risks, may not be able to raise funds through conventional lending mechanisms. The purpose of the scheme is to encourage innovation in industry, but it is not confined to high-technology industries. It provides for making available risk finance to suitable projects during the "pre-market" phase, starting from technology development up to market acceptance. The assistance is available not only for development of a new technology (product or process), but also for its initial marketing, or for commercial implementation of a new technology, whether indigenous or imported.

The manner in which financing is provided is flexible to meet the requirements of a wide spectrum of clients, both start-ups and existing businesses. It may be provided by way of equity participation (immediate, deferred, or part immediate and part deferred), a conditional loan (with a charge linked to the level of sales generated by the project on commercialization, perhaps with a provision for write-off or conversion into equity of a part of the principal amount outstanding after a certain period), or even a conventional loan. The initial investment in a typical project may not exceed Rs.2 crores, although ICICI is prepared to finance larger ventures in consortium with other agencies that may be prepared to share the risk.

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IDBI's Venture Capital Scheme – In contrast, the Industrial Development Bank of India's (IDBI's) venture capital scheme, while providing as much as 85% to 90% of the funds required during the technology development phase on very soft terms, does not extend sufficiently into the commercial-scale operation that is based on the technology. IDBI also makes available loans for improvement/upgrading of an existing unit's technology under its Technical Development Fund (TDF) Scheme. This service, however, is restricted to financing a part of the import costs of equipment, technical know-how, consultancy services, and drawings/designs obtained under a TDF import license, and is discussed in a subsequent section of this report dealing with modernization and rehabilitation.

IDBI's VENTURE CAPITAL SCHEME

IDBI launched a venture capital scheme in March 1987 to encourage the commercial application of indigenously developed technology and the adaptation of imported technology to wider domestic applications, consistent with national objectives and the priorities of economic development. While the scheme was to be financed from a venture capital fund established with a 5% levy on all payments made for purchase of technology from abroad, IDBI has made fund appropriations to enable an earlier launch. Two projects have already been sanctioned, with assistance amounting to approximately Rs. 70 lakhs from the fund, while others are in the pipeline. The fund supports the development of technology from the level of laboratory/bench scale onward to the stage where it is mature for commercial application. It provides assistance for setting up pilot plants, upscaling pilot to demonstration scale, making technological innovation, and adapting/modifying imported processes/products to make them suitable for Indian operating conditions, or for meeting the costs of studies, surveys, seed marketing, market promotion programs, and training in relation to these. As much as 85% to 90% of the total cost (capital as well as revenue expenditure during development phase) of an eligible project costing not more than Rs. 250 lakhs may be financed out of this fund. Assistance is provided by way of a loan carrying a concessional interest of 6% per year during the development period, which is built into the cost of the project and funded as part of it. Although the terms of assistance are liberal during the development phase, the interest rate rises to 17% per year once the process/product is accepted in the market and the venture is in a position to start commercial production. IDBI has the option to convert a part of the assistance into equity at any time during the period of commercial exploitation; this conversion into equity may go as high as 49%. Also, the period of repayment may take into account not only the cash-generating capacity of the assisted venture, but also the availability of cash surplus from the other operations of an assisted company. Effectively, the terms of assistance are structured to prompt the substitution of alternative cheaper financing for these funds as soon as the venture is in a position to commence commercial production or the commercial viability is established. This substitution, however, may not be possible in many cases because assisted projects are likely to involve high commercial risk in the early stages of commercialization, for which the availability of capital finance is highly constrained in any case (see subsequent discussion on venture capital).

IFCI's Technology Development Scheme — Industrial Finance Corporation of India's (IFCI's) scheme for technology development through in-house R&D efforts provides loans at 11% per year for up to 50% of the cost of commercializing laboratory-proven products or processes. The scheme has evoked low interest because of the total absence of risk sharing and its restrictive application.

IFCI's TECHNOLOGY DEVELOPMENT SCHEME

IFCI has a promotional scheme for development/harnessing of technology indigenously, from laboratory to commercial scale, through in-house R&D efforts undertaken by concerns in the corporate and cooperative sectors. The assistance is provided by a loan, at 11% per year interest, for up to 50% of the cost of the in-house R&D efforts, and repayable in installments after the technology has been successfully harnessed and operated on a commercial scale, or after a period of 3 years from the date of the first disbursement, whichever is earlier. The low interest evoked by this scheme may be attributable in part to the absence of any risk-sharing element in the scheme, but also to its other constraining features, such as the small size of eligible projects (normally in the range of Rs. 5 to 50 lakhs for the total cost of R&D efforts), the absence of financing for allied activities that have to accompany R&D for successful commercialization of laboratory technology, the restriction of the assistance to existing concerns that have been approved for financial assistance by an SFC, IFCI, IDBI, and/or ICICI, and the exclusion of MRTP/FERA companies from its purview.

KSFC's R&D Funding Scheme — The Karnataka State Financial Corporation (KSFC) is initiating a program to provide equity financing for R&D activities in the state. KSFC has recently entered into a collaborative arrangement with the Karnataka State Council for Science and Technology (KSCST) in the development of indigenous technology. KSFC has invested Rs. 7.30 lakhs for R&D to develop a process for extraction and refinement of Hecogenin from the sisal plant to produce Prezone, a drug currently imported. KSFC and KSCST will become the patent holders, and KSFC plans ultimately to identify and assist an entrepreneur to bring the process into commercial production. Although still in its early stages, this innovative program suggests that KSFC is taking a leadership role in pioneering new funding programs for R&D.

Proposed Scheme of Technology Development and Finance — Another financing source for technology development, which is expected to be available shortly, is the Scheme of Technology Development & Finance to be launched by the Risk Capital Foundation (RCF) after its conversion into a company.

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PROPOSED SCHEME OF TECHNOLOGY DEVELOPMENT AND FINANCE

The proposed Scheme of Technology Development & Finance aims at providing assistance for:

- Indigenously developing technology from laboratory to commercial scale through in-house R&D efforts.
- Exploitation of indigenously developed technology on a commercial scale for development of new products/processes, or for improving the quality of existing products or efficiency of existing processes.
- Establishment and procurement of in-house R&D facilities in an existing industrial unit with a view to improving the production processes or the quality of the products, reducing the production costs, or leading to energy conservation or pollution control.
- Marketing/start-up of new processes/products and need-based testing and publicity expenses for them.
- Importing appropriate technology by production units in areas where the technology is not available or is not up to date.
- Adoption and improvement of imported technology with the objective of reducing the production costs and increasing the productivity of the industry.
- Meeting expenditures on foreign technical advisers for training of R&D personnel in connection with contemplated technological improvements that are basic (not merely peripheral) to the manufacture of a particular product.

The assistance would be provided in the form of a conventional loan, a conditional loan (normally to be repaid through royalty on sales, with provision for partial write-off of principal if the project is not successful), or by way of an equity stake in the form of direct investment (with suitable arrangements for buy-back or marketability of shares).

Venture Capital—There appears to be general agreement on the need for venture capital in India, corresponding to the kind available in the United States for the formation and start-up of small firms specializing in new ideas or new technologies. In India, some public financial institutions are advancing capital for new but risky ventures to new entrepreneurs. This financing may be by way of loans (without risk sharing or management of investment built into it) or under one of the schemes discussed earlier in this report. The ICICI schemes are probably closest to the definition of venture capital, although even these do not envisage substantial management involvement. The SIDC and SFC participation in equity or projects may, in occasional cases, resemble venture capital, but it is generally in lower-risk projects based on commercially proven technology. The IDBI scheme is only for the very early stages and appears to cover only technology risks. Another limitation of all these schemes is that they are in the public sector and therefore do not enjoy the all-out risk commitment of their managers, who, moreover, are not businessmen. Also, state institutions are not usually run on purely economic criteria and find themselves being used as vehicles for implementing government policy. Consequently, the need for private venture capital firms in India has been often expressed.

The virtual absence of private-sector venture capital in India is due largely to various regulatory provisions, and in part to the prevailing business environment and opportunities (some of which may again be traced back to regulatory provisions). Some critical regulatory changes required for facilitating the growth of private-sector venture capital in India are:

- Tax concessions for investments in venture capital funds.
- Amendment of CCI guidelines to enable the venture capitalists to obtain market-determined premiums on public offer of their shares.
- Modification of stock market regulations and institutional/government support for the creation of subsidiary/over-the-counter markets as in the United States and the United Kingdom, to provide a quick-exit route to venture capitalists and to impart some liquidity to their holdings.
- Reduction in the capital gains tax, at least as applicable to the investments of these venture capitalists (current corporate income tax on long-term capital gains is 40%).
- Tax concessions to avoid double taxation of the venture capital profits, first in the hands of the fund and then in the hands of its backers.

Two private-sector nonbanking financial companies have recently launched venture capital funds (Grindlay's Bank India Investment Fund and the Creditcapital Venture Fund India Ltd.). These private-sector funds are encouraging developments.

THE CREDITCAPITAL VENTURE FUND INDIA LTD.

The Creditcapital Venture Fund India Ltd. is in direct response to the need for this kind of financing encountered by CFC for client companies in their merchant banking business. The venture capital company is expected to have a Rs. 25 crores equity capital base, with approximately Rs. 10 crores being tied up with a number of business houses who are co-promoters (including the Tatas, the Thapars, and the R. P. Goenka group) and with the Asian Development Bank and the Commonwealth Development Corporation (who will subscribe Rs. 1.3 crores each to the equity capital and will also be represented on the board). The balance will be offered to the public. The participation of established industrial houses and multilateral funding agencies in the fund is expected to give it the required credibility for mobilizing resources from the public. The entity would be characterized as a nonbanking financial company. In addition to providing venture capital assistance, it intends to go into leasing and also offer bridge finance for projects on the strength of institutions' sanction letters (during the intervening period until compliance with conditions before disbursement).

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GRINDLAY'S BANK INDIA INVESTMENT FUND

The Grindlay's Bank India Investment Fund raised approximately $7.5 million (against an offer of $15 million), of which 60% is from NRIs and the balance largely from foreign institutions, such as Kuwait Investment Authority and the Rockefeller Foundation. Grindlay's Bank has also participated to the extent of 10%. The fund is a closed-ended one with a 7- to 8-year term, registered in Guernsey and qualifying as "Nonresident Indian." The principal objective is long-term capital appreciation. The fund intends to invest in the securities of both young and mature Indian companies engaged in fast-growing or potentially fast-growing industries. Financing would be provided in the form of "venture capital" to young and growing companies seeking initial funding and also to established companies requiring "development capital" for modernization, expansion, and/or diversification. The fund would normally invest only in companies that either have a share listing or intend to obtain a share listing within 3 years from the date of investment by the fund. Although the fund may seek representation on the boards of companies invested in, it normally does not intend to take either legal or management control of underlying investments. The fund is not anticipated to take more than 10% of the issues share capital of the investee company, but this investment of risk capital in the venture is expected to act as a kind of certification, which would make the raising of capital from the public easier. Although investment by the fund would normally be by participation in equity share capital, capital may also be provided in the form of debenture stock, redeemable preference shares, or loans, generally carrying rights to be converted in whole or in part into equity share capital or some other security. The Offer for Subscription closed on 30 June 1987, and the fund is expected to go into operation shortly.

In sum, Karnataka's long-term finance infrastructure has been infused with a set of relatively recent programs that expand the sources of financing for R&D, product development and commercialization, technology development, and other high-risk ventures. India's and Karnataka's financial institutions have, within the constraints of the overall regulatory environment, responded well to improve access to finance for technology development. However, the type of financing available is predominantly through debt financing. Public-sector financial institutions are moving very cautiously in providing equity financing for R&D and other higher-risk technology development activities. One result of the lack of depth in India's capacity to finance R&D is that Indian industries go into project financing at an earlier stage than do similar firms in the United States.

The financial infrastructure for traditional project investment provides access to capital required for setting up projects on a commercial scale, whether these be new projects, substantial expansions, or diversification. This investment financing usually takes the form of traditional debt and equity financing. All industries, whether emerging, expanding, or transforming, make use of this most basic element of the financial infrastructure. Emerging and expanding industries require new investment capital, while transforming industries need capital for diversification, modernization, and rehabilitation. Karnataka has a very well developed financial infrastructure to meet traditional industrial investment needs.

U.S. Experience

Traditional project investment in the United States is provided largely by commercial banks, interbusiness finance, public and private offerings, direct corporate investment, and venture capital. Since venture capital and direct corporate investment were discussed in the previous section, the following discussion will focus on commercial banks and interbusiness finance, both of which are important sources of debt financing, and on public and private offerings used to raise equity capital.

Commercial Banking—Banks and commercial lenders (including credit unions, mutual savings banks, savings and loan associations, and financial credit corporations) provide over 75% of small-business financing. Bank services to small borrowers are more constrained than those for larger borrowers, however, because of the transaction costs and perceived risks associated with lending to small borrowers.

Commercial lending to new and existing business may be higher or lower in particular regions than in others for many reasons. Several studies of unmet credit demand in U.S. capital markets point out that credit turndown rates vary substantially from state to state. To some extent, higher turndown rates are explained by economic conditions, banking laws, and the economic characteristics and banking structure of the counties in the states where the credit needs of firms were studied.

General factors associated with meeting credit needs of firms include:

- *Bank commercial loan portfolio*—Bank effort (i.e., commercial and industrial loans as a percentage of total loans or assets) does not appear to make credit easier to obtain. Higher levels of banking effort are often related to an increased turndown rate. This fact might result from the implicit portfolio, or mixture of commercial and industrial loans and other investments, that the bank desires to maintain.

- *Regional economy*—The characteristics of bank effort to make commercial and industrial loans relate to the past and present conditions of the regional economy. If a region is heavily concentrated in manufacturing employment, bank portfolios would reflect this fact by having more commercial and industrial loans and a higher overall turndown rate for new loans. Similarly, if

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a region is concentrated in manufacturing and is experiencing a decline, banks may try to diversify their portfolios to reduce risk and may thereby turn down more commercial and industrial loans.

- *Firm characteristics* – Short-term loans are easier to obtain than long-term loans, and secured loans are easier to obtain than unsecured loans. The ease of obtaining loans is influenced by the characteristics of the firm. Net worth/asset ratio has a positive effect on obtaining loans. Older and larger firms are generally considered more creditworthy than younger and smaller firms; but smaller existing firms (fewer than 10 employees) have an easier time obtaining loans than larger existing firms, probably because of the level of personal contact between the established small-business owner and the lender. New firms, rather than small firms, appear to have greater difficulties obtaining credit, as well as manufacturing firms in regional markets that are older or more industrialized, particularly those that are not growing.

A number of costs of doing business influence the granting of credit. Important costs associated with issuing debt include transaction costs relative to the amount of a loan – including collecting information about the loan applicant, processing the loan, and monitoring the loan. Costs associated with risk management have to do with the problems of granting a loan, including determining loan amount and repayment conditions, relative debt-to-equity ratio, and perceived riskiness of the borrower. The level of these costs is often influenced by how public policy dictates bank operation.

Among the regulatory factors that may constrain bank responsiveness to changing industry needs are:

- *Regulation of competition* – Entry of financial institutions into the marketplace can reduce the pressures on institutions to serve what they might consider marginal markets, such as small business. Branching restrictions and restrictions on provision of ancillary services, such as accounting, payroll management, and consulting, are one form of constraint on competition by banks. Greater competition is likely to increase credit availability to industry.

- *Regulation of interest rates* – Interest rate ceilings, or usury rates, are statutorily defined limits imposed on lending. These limits on interest rates that can be charged may, on the one hand, prevent higher costs from being imposed on more vulnerable small business, but may also prevent higher-risk borrowers from gaining access to capital. In addition, when usury rates are imposed, many banks shift costs to loan fees and reduce loan-to-value ratios (to reduce risks further). Furthermore, innovative lending practices, such as equity participation agreements (also known as "equity kickers") may not be permitted.

- *Regulation of safety and soundness* – Federal and state laws provide for regulation of safety and soundness of banks through both written statute and regulation, as well as through periodic examination of bank books and records. Banks are limited in the percentage of their portfolio that can go into higher-risk assets. They are also limited in how much they can lend to any one borrower (usually 10% to 20% of the firm's capital base) and in the quality of these loans (loan-to-value ratio). Although these practices, in principle, help to protect depositors, they also inhibit banks from taking marginal risks, and they inhibit the risk neutrality of bankers, who wish to avoid any possible examination problems. As a result, banks are generally more conservative in their lending than they might be if they used their own definitions of prudent lending. A percentage of loans that are classified as substandard, doubtful, or lost are deducted from the bank's net available assets as a protection against loss.

Interbusiness Finance — Interbusiness investment costs for financing small and new businesses are likely to be dispersed in the overall costs and benefits of the business relationship. In most instances, they are borne by the seller or an intermediary as a cost of doing business. In industries where capital and supply needs are well defined during the life cycle of the business, many buyers or suppliers help their clients to start up or finance sales. Terms of these lines of credit can be generous, assuming that the business relationship between the two firms is expected to be of long duration and suitable volume. There are two limits on this form of financing:

- *Industry specialization* — Unless a new or small business is in one of the industries in which these relationships exist — as between a furniture manufacturer and a wholesale furniture buyer — the role of interbusiness financing is minimal. Often a vendor or buyer will instead be served by a commercial finance corporation. The machine tool industry, for example, has a variety of lease finance services to facilitate acquiring equipment. Commercial finance interest rates tend to be higher than conventional bank rates. However, commercial finance corporations also tend to have industry specialists that serve well-known markets, such as machine tools or the garment industry.

- *Limits caused by interest rates* — The cost of credit to distributors who finance sales of equipment to their buyers is often as high as the cost of commercial credit, although the distributor might still give the buyer a lower rate in order to close a sale. Only the larger suppliers can afford to subsidize credit to buyers.

Public and Private Offerings — Securities markets are an important source of project finance for U.S. businesses that are of sufficient size and economic health. Most firms never grow to the size that makes the fixed costs of issuing equity shares worthwhile, or have a suitably attractive, ready-to-sell product that makes an initial public offering feasible. Most businesses in the services or wholesale trades can pass through their entire life cycle without ever making use of public financing because of the scale of their operations. Small and mid-size businesses are often reluctant to make use of public offerings to raise capital because they dilute their own share of the ownership and introduce new pressures for performance they may not wish to have. Some of the factors constraining the use of the securities markets by business include:

- *Securities regulation and new issues* — In the United States, as in India, the cost of registering a public issue is major expense for most businesses. A number of opportunities within Security Exchange

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Commission (SEC) regulations now make it feasible for small firms to issue public equity more easily.

- *Costs of floating new issues*—Businesses issuing public debt face major expenses other than registration. These are expenses for legal, accounting, and engineering fees; printing costs; and SEC filing compensation to the underwriter. Underwriter costs are the difference between the value of the issue sold and proceeds to the issuer. These costs, which can amount to 20% of the total proceeds from an issue, are a disincentive to most businesses already concerned about the dilution of their equity.

- *The absence of a secondary market for small issues*—Without the ability to resell shares of small firms at reasonable cost in the secondary market, investors may be reluctant to purchase such shares in the primary market. Only 20,000 firms, of the 11 million proprietorships and 2 million corporations in operation, are publicly traded. The stock market's minimum listing requirements set the minimum entry at $1 million in assets and 350 shareholders (the over-the-counter market has no minimum). To assure a secondary market for buyers and traders, a substantial volume must be traded. For mid-size and smaller businesses, this volume does not yet exist.

- *Uncertainty of the stock markets*—The continual fluctuations in the vitality of the stock market, particularly the receptiveness of the market to new stock issues, tend to scare off smaller issuers. However, there is a small trend toward self-issues of public debt, through which companies with very small asset bases successfully seek funds. These self-issues are still very few, and they do not represent a new attitude on the part of the public-issue capital market.

Venture capital and direct corporate investment through partnerships and joint ventures are also important sources of equity capital for U.S. firms. As noted in the previous section, larger firms have easier access to capital than small and medium-size firms because of the minimum size of placements by venture capitalists, the substantial information costs in preparing smaller projects, and the high expense of monitoring smaller loans or investments.

State Role in U.S. Industry Finance—States are increasingly recognizing how state policy can enable financial markets to serve the needs of industry. Until recently, however, state government has traditionally focused on direct provision of finance to industries in need of assistance. In these programs, funds from the state general fund, or from bond issues, are used to provide direct loans or loan guarantees. At best, such programs can provide only limited funds to industries in need of assistance.

In recent years, U.S. states have started to realize that they can respond directly to the constraints on capital markets by helping lenders and investors to reduce risks, increase return, improve channels of access, enhance information, and change investor attitudes toward investment.

States are addressing capital market constraints by redefining their financial industry regulatory policies and industry finance programs. They recognize that they

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cannot effectively replace the marketplace, but that they can work with the marketplace to:

- *Identify markets* — When there is a problem, states can point to where demand for financial market opportunities may be, rather than trying to substitute for the market's action. They can do this through collecting and providing information and brokering industry linkages between industry and the financial community.

- *Enable market action* — Where there is potential demand, states can enable financial market supply, rather than constraining the market's action through restructuring public policy.

PROVIDING INFORMATION AND BROKERAGE

States can invest in finding market gaps. They can make this information available to the financial services industry and thereby steer existing providers to this market or precipitate the creation of new enterprise to satisfy demand. In some cases, this effort might also include helping to broker new relationships between firms in an industry (or related industries) that might have common interests. This approach can result in mergers and acquisitions, as well as lending and investment relationships.

The role of the state in performing this market analysis and brokerage function in the public interest is likely to be better received by the private sector and to be more cost-effective than approaches in which the state attempts to substitute for market action.

States do not necessarily have to perform these functions in-house. They can procure services to identify markets that might ordinarily be perceived as undesirable by existing institutions. They can also hire firms to perform brokerage functions. The source of value in this state role is that the state is paying for information collection and brokerage functions that existing markets have not discovered or considered too small or risky to bother with. By making up this marginal difference, the state may be able to stimulate more significant market action.

BUSINESS/INDUSTRIAL DEVELOPMENT CORPORATIONS (BIDCOs)

Some states have recently looked at how regulatory and managerial functions can be used to increase the amount and efficiency of funds flowing through capital markets. Michigan, for example, established a working group of financial industry officials to examine, with the state, how franchising and securities regulations could be modified to increase business access to capital. Legislation was passed to enable easier franchise licensing and easier issuance of securities. Michigan has also earmarked its unclaimed bank funds for economic development purposes, and a bank regulation is pending that, among other things, will allow banks to make venture capital investments and permit the formation of business/industrial development corporations (BIDCOs).

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- *Provide incentives* — If there is a gap between what the financial market can supply and what is needed to meet demand, states can develop direct and indirect financial or programmatic incentives.

- *When markets fail, subsidize* — If financial market gaps remain after best efforts, states can fill them through direct and indirect subsidies, but only when it is clear that the social costs of not acting will be high.

Karnataka's Financial Infrastructure for Traditional Project Investment

Karnataka's capacity to provide long-term funds required for setting up projects on a commercial scale — whether new projects or for major expansion or diversification — is well developed. SRI's interviews with Karnataka's industries have revealed that there is adequate access to sources of both long-term debt and equity capital.

Long-Term Debt — The infrastructure for making debt finance available to new projects in India and Karnataka is vast. At the national level, there are six all-India financial institutions, consisting of three development banking institutions — IDBI, IFCI, and ICICI — and three financial investment institutions (Life Insurance Corporation of India [LIC], General Insurance Corporation of India [GIC], and Unit Trust of India [UTI]. These institutions cater to the finance requirements of medium- and large-scale industrial units (generally with project costs exceeding Rs. 3 crores). The long- and medium-term financial requirements of small- and medium-scale industrial units are met by the 18 State Financial Corporations (SFCs), including the Karnataka State Financial Corporation (KSFC) and 26 State Industrial Development Corporations (SIDCs), including the Karnataka State Industrial Investments and Development Corporation (KSIIDC) and commercial and cooperative banks with their extensive network of branches. These may, in turn, get refinanced by IDBI. Long-term finance may also be available from the Export–Import Bank of India (EXIM Bank) for export-oriented units and Indian joint ventures being set up overseas.

In Karnataka, both KSIIDC and KSFC are state-level agencies that have performed a major role in the promotion and assistance of projects. Both have a Project Identification cell and take an aggressive approach in identifying suitable projects and assisting in their promotion. KSIIDC had assisted 414 units as of March 1987, and promoted 45 projects, of which 22 had gone into commercial production. Another state government agency, Karnataka State Electronics Development Corporation (KEONICS), promotes and assists projects in the electronics industry, including entering into joint ventures for this purpose.

For funding of projects through the development banking system (including the SIDCs and the SFCs), commercial viability is desirable but is not of paramount importance. Plan priorities like backward-area development, employment generation, self-sufficiency in capital goods industries, and export promotion are other criteria for making project finance available in this system. Because development banking institutions are the primary sources of debt finance for projects, these priorities restrict the availability of finance to nonpriority but commercially viable

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projects. Other factors limiting institutional assistance to certain projects are government regulation of institutional exposure to individual companies and industries, and directions that MRTP/FERA houses should mobilize resources for setting up certain projects without institutional assistance.

Issue of debentures has emerged as an important source of long-term funds for financing new undertakings, expansions, and diversifications, and also for augmenting the long-term resources of the company for working capital requirements. Issues are governed by the Capital Issues Control Act (1947) and also must be within permissible parameters of, and in conformance with, the government guidelines for such issues. Whereas convertible debentures were popular with the investing public because of the promise of equity shares at values much below the market price, nonconvertible debentures did not get ready public acceptance. These were promoted initially through linked issues with equity shares and by holding out the possibility of conversion into equity (now allowed by the government). Nonconvertible debentures have gained in popularity through a combination of innovative and aggressive marketing, modifications in guidelines, and institutional support. A major contributor has been the extension of the buy-back facility to small investors, made possible by institutional support, which makes the investment virtually at call after a 1-year holding period. Institutional support by underwriting the issue (up to 50% by investment institutions and 25% by the Army Insurance Fund), direct subscription for privately placed debentures, and purchases of debentures in the secondary market have also helped considerably. From the company's viewpoint, nonconvertible debentures could be one way of getting away from the convertibility clause applicable to rupee loans from institutions. Of late, nonconvertible debentures have received several setbacks: reduction in maximum allowable interest, ban on conversion into equity, competition from recently introduced public-sector bonds enjoying tax exemption/deduction, and the requirement for setting aside substantial amounts for debenture redemption. Debenture financing as an option may also be restricted by the requirements of listing of the company's shares, an above-par market quotation, and a satisfactory dividend record.

Equity—Although there are substantive tax benefits associated with debt financing, established companies may still prefer to rely on retained earnings and equity rather than on institutional debt for financing their expansion and diversification, for fear of dilution of control due to the convertibility option (normally 20% of loans or debentures held by financial institutions may be converted into equity where aggregate assistance exceeds Rs. 5 crores) and the nominee director clause in the case of substantial assistance from financial institutions, while term debt financing available outside of institutional sources may be limited. Long-term interest-free unsecured loans from the promoters or from the state government or central government agencies are also treated as equity for purposes of applying debt–equity norms, as is central or state government investment subsidy for projects located in backward areas.

The "equity" portion of a project may be financed through the issue of equity or preference shares or from retained earnings. In India there is only one class of

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equity shares. Preference shares may be cumulative or noncumulative, redeemable or irredeemable, and carry a fixed dividend rate. These are hardly ever issued now, except perhaps to financial institutions. A new class of shares termed cumulative convertible preference (CCP) shares were introduced in 1985. These are intended mainly for new companies undertaking highly capital-intensive projects, which may have difficulty raising equity capital since the company would not be in a position to pay equity dividends for the first few years. These have also not been used much, and the forthcoming issue of CCP shares by Tata Fertilisers Ltd. is probably the first major public issue of this class of shares.

Within the "equity" portion, the promoters are expected to contribute a certain percentage of the overall project cost. Whereas CCI requirements are in the range of 10% to 15% of project cost, institutional requirements vary from 12.5% to 22.5%, depending on the location of the project, its capital-intensive nature, its priority, and, above all, the type of entrepreneurs (MRTP/FERA status) promoting the project. The funds for meeting the promoters' contribution are normally raised from promoter/group companies (intercompany investments), individual promoters' personal resources, and from friends, relatives, and associates (including nonresident Indians [NRIs]), foreign collaborators, investments from Oil Exporting Developing Countries without technology transfer linkages, and/or through state government participation (normally through the SIDCs). Several schemes are in operation to attract NRI investment/promotion of industry in India, allowing for 100% equity participation on a nonrepatriable basis and 40% participation on a repatriable basis (74% in the case of priority industries).

Despite government constraints on intercorporate investments (e.g., government control limiting intercorporate purchase of equity), intercorporate investment by group companies is one of the most commonly used ways of meeting the promoters' contribution for companies set up to implement new projects. An important factor leading to the promotion of new companies by an existing company/group for implementation of new projects is the larger capital finance resources that can be raised from external sources, while retaining effective control, than could be raised if the project were to be implemented as a division of the existing company. The intercorporate investment can provide the promoters' contribution, which can then support the raising of equity from the public in widely dispersed holdings (provided the promoter/group has a good track record), which in turn is leveraged for raising substantial term debts.

State government participation may be as a co-promoter in case of a joint sector project, where, typically, the SIDC holds 26% of equity (as against 25% by the private promoter and 49% offered to the public). A higher proportion of equity may also be held by the SIDC, particularly in the early stages of a project prior to the public issue. The SIDCs may disinvest their equity after the unit goes into production. Such disinvestment by SIDCs is required to be made, preferably in favor of the public or the financial institutions. Although disinvestment may be made in favor of co-promoters, prior approval of the central government is required whenever the co-promoter is an MRTP/FERA

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company. SIDCs may also invest from 10% to 15% in the equity of assisted units, with the private promoter retaining the dominant share, both in ownership and control.

Despite the existence of these alternative sources, the raising of the promoters' contribution is one of the most serious hurdles for new project financing, even for traditional projects based on established technology. The problem is particularly acute for first-generation entrepreneurs and for graduating from the small and tiny scales to the medium and medium-large sectors. A number of institutional schemes have been created to fill this void, including the Risk Capital Foundation (RCF) scheme, IDBI's seed capital scheme, and the special capital assistance scheme).

severe constraints on this form of financing for projects of certain types and at the early stage of commercialization. During the capital market boom of 1985 and early 1986, practically all public issues evoked a good response from the public, resulting in substantial oversubscriptions; also, interest earnings on the funds collected were often sufficient to offset all or a substantial part of the cost of making the issue. With the passing of the boom conditions, the withdrawal from the markets of a number of new investors, and the depressed conditions resulting from political uncertainty and the drought/flood conditions in substantial parts of the country, a large number of issues have had problems in obtaining a satisfactory public response. The problem has been most acute for issues of modest size from new or relatively unknown entrepreneurs.

INNOVATIVE NEW PROJECT FINANCING SCHEMES

IDBI's seed capital assistance scheme is operated through SIDCs and SFCs, and provides for the granting of assistance not exceeding Rs. 15 lakhs per project in the form of an interest-free loan, or subscription to 1% preference or equity shares of the project. The assistance is available to technically and professionally qualified or experienced new entrepreneurs for setting up projects costing not more than Rs. 3 crores.

The *special seed capital assistance scheme* is operated through the SFCs out of funds provided to them by the respective state governments and IDBI. The assistance is similar to the seed capital assistance scheme, but is for smaller projects and is limited to Rs. 4 lakhs or 10% of the project cost, whichever is lower, with a 3-year moratorium on repayment of principal.

Karnataka's financial infrastructure is reasonably well developed in general. However, investment financing for new and small companies remains difficult.

Although the balance of "equity" for a project, over and above the promoters' contribution, theoretically may be raised from the public, practical limitations place

Public issues of up to Rs. 1 crore are definitely uneconomical, because expenses incurred on them by way of underwriting expenses, broker's commission, managing broker's remuneration, issue manager's fee, registrar's fee, printing expenses, postage, advertising and publicity, stamp duty and listing fees would aggregate to as much as 15% to 18% of the amount raised,

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despite government guidelines for limiting the cost of public issues. In fact, if 8% to 10% is regarded as the maximum acceptable level of costs, the minimum economic issue size may be placed still higher, at around Rs. 2.5 to 3 crores.

Public issues from new or relatively unknown entrepreneurs face serious problems due to the emphasis laid by the investing public on the track record of the company or its promoters, the existence of a reputed foreign collaboration, and the collaborator's equity participation in the project. Even getting such issues underwritten is often a problem. There are also instances of the underwriters not being in a position to discharge their responsibilities when large amounts have devolved on them because of poor response to a public issue.

Another important factor in the poor response to public issues from new or relatively unknown entrepreneurs is the stage in the life cycle of a business/project for which such an issue is made. Unlike in the United States, there are no stock exchange guidelines prescribing a minimum operating period before a company can make an issue to the public. The financing needs during the construction stage of a project usually dictate that a public issue be made as much as 6 months to a year (and perhaps even longer) before the completion of the plant. It is estimated that 90% of the companies make their first public issue when the project is still in the construction phase. Immature issues arriving directly in the primary market consequently often fail, despite the fiscal incentive of the Income Tax Act, provided by way of a 50% deduction from taxable income of the amount invested (subject to a maximum of Rs. 200,000 in a year) through direct subscription in the first public issue of an industrial undertaking that has not yet declared a dividend.

The financial institutions (IDBI, ICICI, and IFCI) have a scheme for direct institutional subscription to shares to help overcome this problem. Under this scheme, the institutions may take up the entire lot of shares for the public where the amount for public subscription does not exceed Rs. 1 crore (recently raised from Rs. 50 lakhs). The institutions may insist on a buy-back arrangement with the promoter, which will assure them of a return on their investment that is at least equivalent to their lending rate of interest at the time of the issue. Alternatively, they reserve the right to sell their shares to the general public through prospectus at a time and stage when, in their opinion, the public response is expected to be reasonable, with all expenses of such an offer being borne by the company. The assistance under the scheme is extendable to both private and joint-sector companies for new projects and for expansion of existing projects, but is not extendable to rights issues made by existing companies or to projects belonging to the large industrial houses. The objective of the scheme is to help small entrepreneurs save avoidable expenditures involved in making uneconomic-size public issues through prospectus. In practice, the scheme is of very limited application because the institutions are very selective in the cases that they agree to take up.

Another institutional (IDBI, IFCI, ICICI) scheme for deferring public issues to a more opportune time without delaying the project (either to take advantage of more favorable market conditions or to reduce the lead time between the making of public issues and the commencement of commercial production) is the scheme for granting bridge loans against public issues. Under this scheme, the institutions grant bridge loans against their sanctioned underwriting assistance at an interest rate of 10% per year. Generally, the duration of this assistance does not exceed 6 months (although it may be extended) and is repaid from the proceeds of the public issue that must be made in consultation with the lead financial institution. Significant limitations to assistance provided under this scheme are its confinement to the amount underwritten by the financial institutions themselves, combined with the reluctance of the institutions to underwrite substantial portions of the equity of any project in order to guard against excessive exposure. Assistance may be extended to projects promoted by experienced as well as new entrepreneurs, but FERA companies are not eligible, while concerns promoted by large houses may be assisted on a very selective basis only.

An alternative to uneconomic-size and premature public issues is the private placement of equity. In boom conditions this method was confined to portions of the promoters' contribution, but is now resorted to even for the balance equity of small projects. Private placement is arranged by merchant bankers and brokers through their sub-broker network. A portion of the equity may be taken by investment institutions such as UTI, LIC, and GIC. (There may even be a reservation in favor of these institutions from a public issue.) The balance is preferably placed in dispersed holdings to avoid any potential dilution of control. The lack of liquidity (due to nonlisting of these securities and the absence of subsidiary markets in India) restricts the amount up to which private placements may be feasible, particularly without placing large blocks with certain investors. Normally, dispersed private placement of equity may be confined to issues of up to Rs. 60 to 70 lakhs at most, and may be arranged at a cost of around 4%. Additional costs may be incurred by way of a 1% higher interest charge on institutional loans and a higher tax incidence on the project's profits, if the private placement results in the company's continuing to be closely held.

Recently, to overcome the problem of obtaining a favorable public response to immature and/or small issues of good projects promoted by new or relatively unknown promoters, SBI Capital Markets (SBICAP) has entered into some "bought-out deals." In each of these, SBICAP has taken up to 49% of the issued capital, which it intends to hold for 2 to 4 years to allow for commercial production to commence and operating results to demonstrate the worth of the project. A part or all of the equity taken up by SBICAP is intended to be offloaded to the public at that stage. SBICAP expects to obtain a return on its investment by way of a front-end fee, the premium obtained on public offer or subsequent disposal in the markets of any portion retained, and the earnings on other business attracted from the client as a result of the goodwill engendered. In some cases, SBICAP has taken a personal buy-back guarantee from the promoters, but this is not a precondition and would in most cases be of little practical significance because of the limited personal resources of the promoters outside of their investment in the project. SBICAP has so far announced five such deals, aggregating to approximately Rs. 3.5 crores. Issues supported are usually relatively small: up to Rs. 1 crore or thereabouts. Other bought-out deals are in the pipeline, and other banks/merchant bankers are expected to follow the SBICAP lead, but certain problems relating to these deals have still to be resolved. These include nonliquidity of the investment due to absence of subsidiary markets and failure to comply with the stock exchange listing requirements for the main market (SBICAP has approached CCI about listing of these securities, but has not yet received a positive response), the requirement of obtaining approvals under the Companies Act for each such deal, the limitation on premium that may be allowed on a public offer if CCI follows the usually applicable guidelines, and the high tax rate on capital gains (40% for companies on long-term capital gains). If more than 60% of the equity of the company is held by individuals or closely held companies as a result of such bought-out deals, there are additional problems of higher income tax and higher rate of interest on loans from financial institutions. As yet, these deals are confined to low-risk, high-potential-return projects in which it may be worthwhile investing despite the aforementioned problems, and are on a selective and experimental basis.

Financing Modernization and Rehabilitation—Besides needing finances for new projects, including diversification and substantial expansion, the Indian industry has large financing needs for streamlining, modernizing, and rehabilitating the existing units that have failed to keep up with advances in technology and improvements in production methods. These units may belong to expanding industries (such as sugar and edible oil), mature industries needing to demature (such as jute, natural silk, and leather), and transforming industries (such as machine tools and textiles).

The major institutional scheme for modernization/rehabilitation is the Soft Loan Scheme. Available at concessional rates (10% to 11.5% instead of the normal project finance rate of 14%), assistance under the scheme is exempt from the convertibility stipulations and is flexible on requirements of promoters' contribution (10% to 40%), repayment period (up to 15 years with a moratorium of 3 to 5 years), and debt/equity ratio.

Since January 1, 1984, manufacturing units in all industries can avail themselves of up to Rs. 4 crores under this scheme at 11.5% per year interest for projects aimed at:

- Upgrading of process, technology, and product.
- Export orientation/import substitution.
- Energy-saving/antipollution measures.
- Conservation/substitution of scarce raw materials and other inputs, including recycling/recovery of wastes and by-products.
- Improvement in capacity utilization within existing capacity through increase in productivity and debottlenecking.

Old businesses in expanding and mature industries, with low profitability and cash flows, often do not have the retained earnings required toward promoters' contribution for the soft loan assistance and have to resort to disinvestment in real estate or sale of divisions/subsidiaries. Sale and lease-back of assets at revalued figures is also resorted to at times. For sugar and jute industries, the government has instituted special modernization funds that provide

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funds at 6% interest, with a 6-year moratorium, toward promoters' contribution for modernization schemes approved by the government/financial institutions.

Another mechanism for financing modernization/rehabilitation is takeover or merger of the company with a profitable business. However such mergers are rare except within the same group or at institutional direction. One of the major reasons is that in many such cases the units have degenerated so much that the only solution is to liquidate the company; but the criterion of continued employment for the work force overrides all others, and the units limp along, making continued demand on scarce institutional resources.

The institutional conduit for rehabilitating sick industrial units is the Industrial Reconstruction Bank of India (IRBI), which is charged with coordinating with other lenders in working out a rehabilitation package for sick units. There are no fixed norms for providing rehabilitation assistance to sick units, and the terms are decided case by case. IRBI has been hampered in its endeavors to rehabilitate sick units by the lack of powers to enforce the package of reliefs to be granted to the sick unit by other financial institutions, state governments, and commercial banks. The recently constituted (January 1987) Board of Industrial and Financial Reconstruction (BIFR), deemed a civil court, aims at filling this gap.

Financial Infrastructure for Short-Term Funding Requirements

Financial needs of firms on a near-term basis include short-term borrowing for working capital and other needs. Commercial banks provide the bulk of finance for working capital in India, although deposits, debentures, suppliers' credit, advances from customers/dealers, and credit from specialized institutions like EXIM Bank are used extensively to supplement this source. Karnataka is well represented by Indian commercial banks that provide for the working capital needs of industrial firms. Another source of near-term support to industries are the trade development agencies that provide technical assistance to entrepreneurs and new firms.

U.S. Experience

In the United States, the short-term financial needs of industry are met primarily by commercial banks and suppliers' credit. Since these sources are discussed elsewhere, the state government's role in increasing industry access to short-term capital is highlighted. Some innovative ways in which state governments have assisted firms in obtaining short-term capital needs include loan guarantees or insurance and business incubators.

Loan Guarantees or Insurance—By guaranteeing a loan made by a bank to a business, a state can reduce risk management costs for the bank and increase lending to businesses in riskier industries, as well as open up the possibility of secondary markets for debt. At least 19 states have loan guarantee or loan insurance programs. States can annually, or on a one-time basis, appropriate funds to capitalize a reserve fund for defaults on loans made by private lenders. States may target eligible participants for such programs. These programs are an indirect subsidy of the business borrowing.

Programs are typically operated by state industrial finance agencies, state or regional development corporations, or state or local economic development agencies. These guarantees can be used for short- or long-term loans, revolving lines of credit, or equipment purchases. The guarantees are usually for 50% to 90% of the loan and guarantee repayment to the lender should the borrower default. States using this approach include Maine (Guarantee Authority), New Jersey (Economic Development Authority), and Ohio (Development Finance Commission).

Different types of guarantees can be used, including partial loan or project cost or total loan or project cost. Lenders are typically charged a fee for participation in the program, which helps to offset the cost to the state. Capitalization usually comes from state appropriations or industrial development bond proceeds. There is not much of a secondary market for these guarantees because they must compete with more traditional and well-understood federal programs (FNMA, for example). In some states, usury laws constrain the use of guarantees.

Business Incubators – "Business incubators" are now emerging nationwide. Many of these are private or nonprofit organizations, but many others receive support from states. Principally, incubator programs are designed to help new firms overcome many of the traditional early barriers to survival. Incubators provide low rent, shared facilities, financial counseling, management assistance, and technical assistance in areas related to corporate structure and product development and marketing.

States may find themselves increasingly examining the concept of incubators as a vehicle for facilitating new business development. Universities, in particular, may be an important resource in providing both a supply of entrepreneurs and technical expertise for incubators. Pennsylvania has a number of university innovation centers involved with incubators; these are financed partially with seed grants from the state's Ben Franklin Partnership and partially with matching capital from the private sector. This partnership brings together the state government, the university, and the private investor to foster new enterprise through loans and technical assistance.

The major value of successful incubators appears to be their integrated approach to guiding new enterprise through its first stages of development. Financial support is also frequently an important aspect.

Karnataka's Short-Term Financial Infrastructure

Commercial Banks – Commercial banks provide the bulk of finance for working capital in India, although deposits, debentures, suppliers' credit, advances from customers/dealers, and credit from specialized institutions like EXIM bank are used extensively to supplement this source.

Obtaining working capital finance from commercial banks, although difficult and protracted, is not a major problem except in high-growth and seasonal industries, partly because of the reliance placed by the banking system on past trends for projecting future requirements. New units in emerging industries like electronics and software, for which working capital norms have not yet been established, also tend to lose out because application of norms for the general industry leaves much too large a gap to be covered by internal sources. Units relying on imported components in the initial phase of production usually find bank finance inadequate to meet their working capital requirements, since they are forced to import and stock larger quantities of components than allowed by working capital norms to hedge against uncertainties in arrival of the next batch.

Public Deposits—Unsecured public deposits were a major source of working capital finance at the beginning of industrialization in India, especially in the textile industry of Ahmedabad. Regulation of the amount of deposits that can be collected by a company (up to a maximum of 25% of the paid-up capital and free reserves from the general public and an additional 10% from shareholders, etc.) and formalization of deposit terms have reduced the use of this instrument. These deposits continue to be in use, however, normally up to nearly the maximum permissible amount, relying largely on the goodwill of local investors. Intercorporate deposits used for financing short-term requirements of working capital (particularly for payment of customs duty, canalized imports of raw material, etc.) had received a boost with co-acceptance by the banks of the bills issued to raise such deposits. Major funding sources for these deposits included disputed excise dues of companies and oversubscription amounts received on public issues. The availability of such deposits has been reduced considerably by the setback received by the market because of several prominent defaults, RBI's banning of co-acceptance by banks, calling up of excise dues by the government, and passing of the boom phase in the share markets.

Advances from Customers—Advances from customers have traditionally been used to finance working capital needs of industries having long realization cycles, like heavy engineering and machine tools. The last two decades have seen the successful use of this financing instrument by the automobile industry against orders for products in short supply. Dealer deposits are likewise a good source of working capital for premium companies in the expanding consumer goods industries. Recently, there have been instances of the emerging software industry resorting to this source for financing working capital, especially where customized products are being developed for overseas customers.

Leasing Schemes—Besides the above, leasing and hire purchase schemes organized for promoting sales of products also help finance working capital. Various forms of these schemes are in use in India, especially by the emerging office equipment and expanding automobile industry.

Working Capital Finance for Exports—Working capital finance for export activities can also be obtained from EXIM bank, which finances export activities through grants of:

- Foreign currency and rupee term loans to project and consultancy exporters.
- Refinance for deferred-payment suppliers' credit.

Ajit

- Preshipment credit to exporters for procuring raw materials and inputs.

- Postshipment credit.

In addition, it assumes a part of the export risk through its guarantee scheme, and indirectly provides working capital to exporters by extending lines of credit to overseas governments to finance imports from India.

Scheme	Industry
Sale and leaseback	Office equipment
Hire purchase	Automobiles for public transport
Financial lease	Automobiles for private use, office equipment
Sales and lease through group leasing company	Automobiles for public transport

Summary of Karnataka's Financial Infrastructure

The foregoing analysis of the availability of capital and financial infrastructure in Karnataka and India indicates that several deficiencies in the financial infrastructure constrain availability of capital, and consequently industrial growth in emerging, expanding, and transforming firms.

The most striking features of India's vast financial infrastructure are its lack of depth, its concentration in the state sector, and its highly regulated nature. Perhaps because of these characteristics, this infrastructure has been singularly ineffective in engendering innovation and entrepreneurship in industry.

The reason can be said to lie mainly in the obsession of this infrastructure with "security," which perhaps is natural for institutions in the public sector. Thus, projects with a good physical asset base that can be mortgaged against future payments have been nurtured in this system, to the almost complete detriment of those whose main assets are innovative developments with good growth potential. Set in this context, it becomes easier to understand the gaps in finance availability for Indian industry, which are mainly in:

- Raising equity with which to leverage institutional debt for start-ups across all industries, whatever their stage in industry life cycle (this is specially true for medium-size projects, Rs. 50 lakhs to Rs. 10 crores, where the finances that could be raised from the promoters' close circle are not adequate and the issue size is not large enough for equity to be economically raised from the general public).

- Raising finances (both debt and equity) for technology development and its early commercialization where the potential returns, although expected to be high, are probabilistic in nature and there are no physical assets to mortgage.

- Raising debt for financing working capital in the high-growth emerging (e.g., computers) and expanding (e.g., automobiles) industries where financing norms have not yet been established and the application of general norms leaves too great a margin uncovered; also, where working capital requirements are more for revenue expenditure rather than for inventories and receivables (e.g., software).

The key players in the Indian financial infrastructure are aware of these gaps, and the last few years have seen several public-sector institutional initiatives in this area (see Table III-3 for positioning of these on the business life cycle/industry life cycle matrix). But the finances thus made available go a very small way toward bridging the resource gap. Also, some of the activities mentioned above, such as technology development and its early commercialization, require not only injection of adequate finances at appropriate times but also highly skilled and committed managerial talent for guiding the units to the marketplace.

In this scenario there is need for either larger institutional commitment to this cause or changes in the policy environment that are conducive to the vitality of the private sector in this area. Given the limited resources of the private sector on the one hand and the inherent risk aversion of the public sector on the other, perhaps it would be necessary forboth of the above changes to take place for the pace of innovation and entrepreneurship to accelerate in India.

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Table III-3

AVAILABILITY OF INSTITUTIONAL FINANCE FOR TECHNOLOGY DEVELOPMENT

INDUSTRY LIFE CYCLE / BUSINESS LIFE CYCLE	Emerging	Expanding	Transforming
Seeding			
- R&D	• KSFC's Scheme		• KSFC's Scheme • IFCI's Scheme • NRDC's Scheme
- Pilot Plant	• ICICI's PACT & Venture Fund • IFCI's Scheme • IDBI's Venture Fund • NRDC's Scheme • RCF's technology scheme		• ICICI's PACT & Venture Fund • IFCI's Scheme • IDBI's Venture Fund • NRDC's Scheme • RCF's technology scheme
- Product Testing/ Market Feasibility	• ICICI's PACT & Venture Fund • RCF's technology scheme • IDBI/IFCI's schemes for subsidy for feasibility report • Grindlay's Venture Fund	• IDBI/IFCI's schemes for subsidy for feasibility report	• ICICI's PACT & Venture Fund • RCF's technology scheme • IDBI/IFCI's schemes for subsidy for feasibility report • Grindlay's Venture Fund
Start-ups	• RCF's Risk Capital Scheme • IDBI's Seed Capital Scheme • Grindlay's Venture Fund • SBI's Bought-Out Deals • SIDCs & Institutions Equity participation	• RCF's Risk Capital Scheme • IDBI's Seed Capital Scheme • Grindlay's Venture Fund • SBI's Bought-Out Deals • SIDCs & Institutions Equity participation	• RCF's Risk Capital Scheme • IDBI's Seed Capital Scheme • Grindlay's Venture Fund • SBI's Bought-Out Deals • SIDCs & Institutions Equity participation
Consolidation & Expansion			
Modernization/ Rehabilitation	• Equipment Finance Schemes	• Equipment Finance Schemes • Institutional Soft Loan Scheme • Institutional Special	• Equipment Finance Schemes • Institutional Soft Loan Scheme • Institutional Special

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IV KARNATAKA'S ECONOMIC INFRASTRUCTURE AGENDA: A BLUEPRINT FOR ACTION

Overview

Karnataka is fortunate in that it has most of the infrastructure elements essential to building an economy capable of participating in the global marketplace. These infrastructure elements, like Karnataka's economy, are evolving to meet both an expanding domestic marketplace, as well as international opportunities. Not unlike a business that must invest in its own capital and human resources to thrive and grow, Karnataka too must invest in its technological, human resource, and financial assets if it is to establish the foundation for a successful economy.

Karnataka faces the challenge of selecting and implementing the most effective public- and private-sector actions needed to support the growth and adaptation of the state's future economy. This section provides some insights into the priorities for action that build on and reinforce the concern for change and commitment for action already expressed by Karnataka's business and government leaders.

The analysis begins with the premise that Karnataka can become an important part of the global economy and avoid being inwardly directed, ignoring the realities of a changing world. Accepting this premise, while recognizing that Karnataka's concern for its citizens will grow as it moves toward more competitive practices, requires that the business and government communities prioritize how and where their resources will be spent.

Because the economic infrastructure of a state encompasses the entire community, not only the state budget or a single firm, the available resources are greater than what one might expect. An infrastructure strategy can draw from the entire breadth of technological, human resource, and financial capabilities of Karnataka's citizenry, companies, institutions, universities, and colleges.

Yet there are limits to what any person or organization can and will do. For this reason, the actions to be selected and implemented must be strategic in nature, generating the highest payback in terms of enhanced innovation and productivity in the economy.

Karnataka needs to focus its energy on attainable goals that will reinforce continued growth and adaptation in the state economy. Based on the analysis of the economic infrastructure described in this report and the broader set of recommendations presented in each infrastructure discussion, SRI recommends that Karnataka develop a "Blueprint for Action" that concentrates on specific areas of its industries' technology, human resource, and finance needs within specific time frames.

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Vision and Priorities

Karnataka can produce world class products with world class technologies and skills in a number of areas—however, not with its current economic infrastructure. Because near-term strategies will not solve problems that are market driven or basically institutional, near-term actions should not be the focus of improving the infrastructure. Long-term strategies are important, but need to address all-India policy concerns. Given Karnataka's need to become a world class economy within 3 to 5 years, however, opportunities will be lost if Karnataka waits for resolution of national policy issues.

Karnataka thus needs to think globally, but it must act locally. The highest-level priorities identified in this study are actions focusing on medium-term outcomes. These should be supported by easier-to-accomplish, less complex, near-term actions, as well as by a longer-term program of broader reforms and capacity-building initiatives. The set of proposed actions presented here reflects the importance of building an economic infrastructure that maximizes the synergies between economic sectors and institutions, and captures the benefits of adaptation and growth in the Karnataka economy.

Recommended Medium-Term Initiatives

The primary focus for a medium-term infrastructure agenda should be improved technology access, with human resources development stressing technology skills and financial strategies supporting emerging-sector business development. The emphasis is on technology because competitiveness in domestic as well as international markets requires incorporating appropriate technology more aggressively at all stages of business activity.

Technology

Karnataka's technology infrastructure has several deficiencies that relate to medium-term actions.

First, although technology capabilities are highly concentrated in Karnataka, they do not work well for the economy.The technology providers in Karnataka are not market driven and do not respond to the economic requirements of industries at different stages of development.

Second, Karnataka's technology resources are not sufficiently sensitive to different types of industry needs, and therefore do not offer the specialized research and development capabilities that different sectors (e.g., software, automotives, food processing) might require at important stages of product development (product R&D, manufacturing R&D).

Third, technology supply institutions in Karnataka are also not very adaptive to the immediate environment. Because they are primarily national laboratories and institutes, they are slow to change or take the initiative in reaching out to the Karnataka marketplace.

Fourth, although they may desire to serve industry better, their limited financial resources and dependency on Government of India programs tend to eliminate the technology centers' incentive to respond to needs that would require nontraditional financing and contracts.

In sum, because existing technology institutions (national laboratories and institutes) have often not evolved as rapidly as the economic sectors they are chartered to assist, a new configuration of technology suppliers is needed. Thus, the highest priority for action in Karnataka is development of a technology infrastructure that responds to the increasingly market-driven R&D needs of sectors at each stage of the life cycle. Two priority actions are recommended to achieve this goal:

- Create an applied research and development center that directly responds to Karnataka industry's technology needs.
- Develop a buyer–supplier initiative that focuses on emerging-sector technology and human resource needs.

Create Applied Research Center—No one technology center is responding adequately to the needs of the economy, although some have more or different capabilities than others or are more willing to help than others. A central part of the solution to the medium-term action agenda, therefore, is developing a market driven applied R&D capacity in Karnataka. This center would be new in organization and operation, reflecting Karnataka's movement toward a market-sensitive economy.

The applied technology research center would be designed to build on the lessons learned from state initiatives in the United States, especially in Michigan, California, and Pennsylvania, as well as on the history of applied research and development institutions such as SRI.

The applied research institution would stress identification of industry needs as the basis for organizing its research and staffing structure. Research capacity should be oriented to the marketplace and cover key aspects of at least four major areas: manufacturing automation, advanced materials, biotechnology, and computer sciences. It would be designed to produce timelyresults that are responsive to business needs.

This technology center would not necessarily represent any one organization. The provider could be an existing institution, but the center could be privately operated and managed, with its own staff as well as staff from universities and other centers. It would make extensive use of existing Karnataka science and technology resources (e.g., IISc, NAL, ISRO, CFTRI, CMTI) through direct and indirect staffing agreements.

This institution would have to be independent of any dominant funding or oversight by the national or state government. It would, however, take advantage of existing funds for government research, without letting these sources of funds drive out the high-priority need to serve industry clients.

Because it would have to be market oriented, the applied research center should initially be started by businesses with government participation, shifting to a predominantly client-centered practice over time. Despite this funding source, this center would have as its fundamental

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charge the development of a contract research revenue base to serve the Karnataka economy.

Section V, "Next Steps," provides a detailed outline of the implementation steps for developing an applied research center, drawing from lessons learned in the United States and based on Karnataka's requirements for development.

Develop Buyer–Supplier Initiative – Development of a buyer–supplier initiative represents an important complement to development of an applied research center. The need for a buyer–supplier initiative arises from two observations. First and foremost, U.S. and Indian history has proven that the development of suppliers, subcontractors, ancillaries, subsidiaries, and all forms of smaller-scale enterprise related to larger industrial sectors is a primary means of stimulating and capturing the benefits of economic growth. Second, although the need for suppliers and ancillaries with higher technical competency and capability is increasing rapidly in Karnataka, the development of ancillaries with suitable capabilities has proven difficult – a fact that has slowed growth of local business in emerging sectors.

A company often sets up ancillaries to act as low-cost producers of specialized low-value-added items. They rarely are established with the goal of broadening their supplier roles. As a result, they tend to be small and undercapitalized, with marginal human resource capabilities. Ancillaries are often virtually prisoners of their major buyer, who worries that they might become competitors or sell to their competitors. Suppliers are often caught in the dilemma of not being large enough, skilled enough, or wealthy enough to diversify production into similar products, or increase their value-added by moving up the manufacturing continuum from assemblers of parts to producers of components and possibly entire systems. Even though ancillaries and suppliers are essential to Karnataka's industrial base, and increasingly so in the emerging sectors, suppliers are still treated as second class businesses.

If Karnataka is to become active in the global economy, it must energize the development of small enterprises that can supply increasingly complex products, from semiconductors to avionics systems. Karnataka needs world class suppliers that can become, in some cases, world class companies. To this end, creation of a buyer–supplier initiative could provide some of the technology equipment, production technique, and management skills required by existing or new suppliers. Thus, when one or more firms need better suppliers of a standard, high-quality component, their efforts can be pooled to set up one or more suppliers that the organization then assists in meeting quality and production needs. More detail on this topic is provided in Section V, "Next Steps."

Human Resources

As Karnataka moves into a more adaptive, technology-oriented economy, the human resource system will need to become better attuned to the requirements of the industrial base. Industries at all stages of the life cycle now demand that staff members have expertise in computer sciences and manufacturing technology.

Although some panels have explored higher education quality and needs, Karnataka has not yet formed a human

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resource partnership that would tackle the issue of better linking the education system to the economy, without necessarily creating a schism between primary educational missions and industrial needs. Yet, linking education and industry on technology issues is essential if Karnataka's economic infrastructure is to be more responsive.

Two key actions are needed to improve medium-term human resources:

- Building a center of excellence in engineering to meet changing needs in specific areas of computer science and computer-aided engineering.
- Implementing industry education outreach by increasing systematic efforts by Karnataka industry to develop and retain skilled employees.

Center of Excellence in Engineering — Because the Karnataka economy needs engineers skilled in the use of automation-based technologies, the Karnataka partnership could sponsor a center of excellence in engineering training. However, the best location for such a center may be at the IIT in Madras because it provides much of the engineering talent used by Karnataka industry. Thus, Karnataka government and industry may wish to work with the IIT system, as well as the public and private sectors in the neighboring state, on this issue. Whatever institution is the focus for development of a center of excellence, it should stress curriculum that has become essential to a rapidly changing, technologically driven economy. These areas of curriculum should be defined by a panel of industries, but are likely to include specific training in computer-aided software development, as well as computer-aided design, engineering, and manufacturing. In particular, breaking the traditional barriers between design engineering, production engineering, and business planning should be a high priority for new educational programs. Thus, new engineers with both state of the art and broader industry skills will be available when they are most needed in Karnataka.

Industry Education Outreach — Because considerable human talent is lost to overseas companies and institutions, Karnataka's partnership should initiate a set of programs and practices to retain skilled employees. The members of the partnership should agree to take action themselves, not just recommend it to others. They could, for example, establish stronger and earlier ties to students in universities, including sponsoring class projects for engineering students, establishing summer internships and co-ops, creating attractive career development and continuing education programs, and, most importantly, offering rewarding and demanding work environments. These actions should be used to demonstrate productive trends and build confidence in the value of such efforts.

Build a Partnership for Human Resources — To implement these initiatives in human resources, Karnataka should create a formal public–private partnership for human resources where members include leaders of industry and heads of educational institutions. The charter of the partnership will be to implement direct programs to meet Karnataka's human resource needs, working as a group with the state's key education and training institutions.

Finance

As Karnataka's industries face increasing competition, both within India and worldwide, their financial requirements are expanding. Perhaps the most critical needs that are currently not well met by Karnataka's financial infrastructure are for financing the early-stage development and R&D activities of emerging-sector firms, as well as the riskier diversification and restructuring activities of transforming industries.

Karnataka's financial infrastructure is particularly "thin" in terms of available risk capital. The virtual absence of private-sector venture capital in the state is especially noteworthy and relates largely to the lack of tax concessions and other India-wide regulatory constraints on the mobilization of risk capital.

Critical regulatory changes are required to facilitate the growth of private-sector venture capital in India. These include:

- Tax concessions for investments in venture capital funds.
- Amendment of CCI guidelines to enable the venture capitalists to obtain market-determined premiums on public offer of their shares.
- Modification of stock market regulations and institutional/government support for the creation of subsidiary/over-the-counter markets as in the United States and the United Kingdom, to provide a quick-exit route to venture capitalists and to impart some liquidity to their holdings.
- Reduction in the capital gains tax, at least as applicable to the investments of these venture capitalists (current corporate income tax on long-term capital gains is 40%).
- Tax concessions to avoid double taxation of the venture capital profits, first in the hands of the fund and then in the hands of its backers.

The proliferation of private venture capital funds in the United States, which has been essential to the growth of technology-based industries, was initially stimulated by a reduction in the capital gains tax, as well as by relaxed federal regulations pertaining to pension fund investments.

Although several U.S. states have also established public venture capital funds (mostly privately managed), there are problems in pursuing this approach in Karnataka. The main objection is that the market, not the public sector, is the most efficient allocator of capital resources. Sources of considerable risk capital exist in India (and abroad with NRIs), but they are constrained by the regulatory environment. The logic of using scarce public resources where private resources exist is questionable. Thus, the best approach is to remove the regulatory constraints on individuals and corporations willing to place investments in high-risk firms and projects and thereby free up this source of capital.

However, a public venture capital fund may be appropriate if it could attract sources of private risk capital. In this way, public resources could be used to "prime the pump" and to facilitate the mobilization of private capital.

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Karnataka has the opportunity to act now on a number of specific needs that will enhance its economic infrastructure in the near term. These actions should help build a climate of collaboration essential to undertaking medium- and longer-term initiatives. The actions recommended here, and described in more detail in the following section, focus primarily on improving the flow of information and development of skills needed to enhance a firm's competitiveness. Again, the technological side of the economy is emphasized.

Implementation plans for these activities are described in greater detail in Section V, "Next Steps," drawing from examples in the United States, and discussions with Karnataka industry leaders.

Technology

Gaining easy access to technological information is central to product development and market strategy. The need for improved access to technological information stands out as a historic and continuing problem in India and Karnataka, not only among emerging industries, but also among those in the expanding and transforming stages as well. Three actions are recommended here: the are creation of a Technology Deployment Service, an international technology network, and work sessions on international technology. This last recommendation is also a human resource recommendation but fits in well with the proposed technology initiatives.

Develop a Technology Deployment Service—An important near-term technology strategy for Karnataka that responds to the technology access needs of smaller and mature companies is development of a Technology Deployment Service. This service uses professional consultants, supported by a mix of fees and subsidy, to help smaller-scale, first- and second-generation technology oriented firms evaluate their competency and needs for technology. The Technology Deployment Service would be run along business parameters. Staff members would come from industry; their performance would be measured by their ability to reach out to companies, help them develop technology deployment plans, and link the client firms with appropriate suppliers and training resources.

The Technology Deployment Service concept is a near-term strategy because once agreed to it can be implemented within a short time, unlike the time needed to build an applied research center or a buyer–supplier initiative. Moreover, the implementation of this type of program can provide insights that will assist in the development of both the applied research center and the buyer–supplier initiative.

Establish International Technology Network—Beyond the more first- and second-generation technology needs to which the Technology Deployment Service is focused are needs for second- and third-generation technological information from international sources. SRI's analysis of Indian scientific publications for the National Science Foundation suggested that Indian scientists experienced difficulty in keeping track of advances in their disciplines and among their peers overseas. This problems hindered their ability to channel research activities into world class fields.

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Larger industries have different near-term limits on their access to information. The largest companies and those with few technology import disincentives can get current information about product technologies and research developments from parent companies and overseas subsidiaries, although at a high cost. Yet, even here, the flow is not as fast and as sensitive to the needs of Karnataka's industries as it should be if the economy is to become part of the world economy.

Although the barriers to optimal communication are significant, some steps to enhance access to technology information can be taken in the near term and would be well received by Karnataka industry. The first and most logical step would be to create an effective satellite network accessible to industries in Karnataka. This step would require a rapid transmission and receiving capability so that transactions, such as conferencing and literature searches, could be carried out cost-effectively either in real time or off-line. Such a system could also require subscriptions to specific U.S. and Western European computer services and data bases.

At present, several companies and organizations have satellite hook-up capabilities (e.g., ISRO, NAL). Texas Instruments, for example, has facilities available to local firms in Karnataka. Clearly, Karnataka should identify the most cost-effective sources of this type of service that would make this type of technology resource more easily accessible to local firms, possibly with backup technical assistance for firms less familiar with satellite telecommunications.

The value of this type of development is not only for the emerging-sector firms, although they may be best able to pay for and use such a system. Mature transforming companies also may have very specific needs that this type of service could address. For example, Karnataka Soaps and Detergents might want to determine whether a chemical agent is available that could substitute for a more expensive chemical feedstock. Access to one of many U.S. chemical association data bases or private subscriber data bases might help the company find the answer.

International Technology Work Sessions—Another activity that would improve technology access would be to develop a program of work sessions on international technology themes. Such meetings would bring state-of-the-art professionals in key fields or industries to Karnataka to lead in-depth work sessions with industry leaders and technologists in the state. These meetings, and their cost, could be supported by a private industry-technology group that would set the agenda for the sessions. Nonresident Indian scientists and technologists in the United States might be candidates for initial forums. U.S. government assistance in making contacts and facilitating travel could be very helpful.

Human Resources

Human resources face two challenges in the near term. Both recommendations address the need to help labor and management respond to the opportunities facing the Karnataka economy in the near future.

Strengthen Polytechnics—The first recommendation is to enhance the strengths and capabilities of polytechnics and vocational institutes so that they can

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respond quickly to industry training needs. With greater autonomy and increased resources, polytechnics can become highly effective systems of preparation for the evolving Karnataka economy. These efforts should start initially with targeting specific polytechnics as demonstration sites. The success of the first site should be used as the basis for rapidly enhancing the capabilities of other polytechnics. Once the first efforts are under way, the polytechnics may find that they want to develop more specialized capabilities. Although many already specialize, they often serve the more mature and less dynamic markets. From the lessons learned in the United States, Karnataka's polytechics should be encouraged to become the leading edge in the campaign to prepare a skilled work force.

Entrepreneurship and R&D Management Training—The second challenge is to get managers to understand the underlying principles essential to Karnataka's industrial evolution. That is, executives and managers need to be rapidly moved into continuing education programs on entrepreneurship and R&D management, as well as training on competitiveness, marketing, and modern production management. This step is essential if they are to pilot their businesses into a more aggressive world economic environment. Corporate leaders need to recognize the need for this training. Moreover, the training should come from experts with hands-on experience, not just from textbooks. Executives and managers need a balance of practitioners and trained instructors.

Finance

Karnataka and India are at the beginning of period of history where the financial services sector will be changing considerably. Laws affecting the stock market, public issues, taxation of capital gains, as well as development of new instruments will make the coming years a difficult and challenging time for financial managers, within both the financial sector and individual companies.

Training in Investment Banking and Business Plan Evaluation— To anticipate the impact of these changes, and to position Karnataka industry effectively to take advantage of these changes, training in investment banking, business plan evaluation, and new enterprise finance is recommended. Such training is usually gained from direct experience; however, Karnataka industry leaders should work closely with Karnataka state industrial development officials to plan and implement business courses that bring the experience of other nations to India. Early training will pay off in terms of greater sophistication in financial planning and management later on.

A number of financial organizations, concerned with both investment banking and business development, could be invited to carry out initial symposia on these themes. Later, curricula at colleges and university business and engineering schools could be introduced to expand continuing education programs for business.

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The future of India and Karnataka will depend on how well the economic infrastructure evolves over time to serve a dynamic business environment. However, an adaptive economic infrastructure cannot be mandated or implemented overnight. For this reason, long-term agendas for reform or development at the all-India level need to be considered and defined clearly, as soon as possible.

The focus for longer-term initiatives are those institutions where change is most difficult to introduce, or where marshalling of resources will be most difficult. The highest-priority long-term initiatives concern the development of greater scientific and technological capacity across academic and technical institutions in the state of Karnataka. The highest priority also includes building into these centers a greater ability to respond adequately to the needs of industry—recognizing that they move at a pace quite apart from that within academic or research institutions.

Other initiatives where actions are important but less centered in Karnataka than at the national level, such as encouraging reform of securities and stock regulations, as well as import restraints, are not discussed here. Because of their overlap, technology and human resource issues are treated together.

Creating Focused World Class Science Capability—The long-term challenge for Karnataka is to expand the ability of more universities in the state to perform first-rate science research. Karnataka, while having IISc, does not have as many world class scientists as do other states in India. The presence of world class science is important; although not central to economic development, it can help to attract and build a critical mass of technologists. The challenge of world class science poses some difficulties in India and Karnataka. The tradition of science in India has emphasized many areas where the focus is domestic, not global. However, building a world class science capability should not be achieved while ignoring the imperative of "technology capture," and the relationship between achieving a world class science capability and domestically relevant developments should not be overlooked.

How can a balanced perspective be achieved in academic and research institutions as they evolve over time? This question has no simple answer. Indian institutions sometimes assume that working on world class technology issues (e.g., critical topics such as mapping the genome) will steer resources away from domestic scientific issues. However, Indian institutions should recognize that world class technology can also focus on local needs, and not shy away from exploring new fields. Thus, as work at the Raman Institute and some corporate R&D labs has shown, biotechnology developments can emphasize new applications of genetic research to tropical diseases—thus combining advancing the science and responding to national needs.

Research on advanced materials, such as polymeric, ceramic, and metallic composites, can be justified as providing solutions in the long run to such problems as reducing raw-materials costs and imports. Work at NAL and through ISRO has shown how these advances can be applied to structures and energy systems. Research

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on artificial intelligence and computer-man-machine interfaces should not be perceived as detracting from concern about employment, but as helping to create more forms of economic opportunity and competitive capability.

The first recommendation is thus that Karnataka universities help to attain more world class capability that will enhance the application of technology to the state economy and community.

Develop Interdisciplinary University Centers—A second recommendation that evolves from the first is that Karnataka universities be encouraged to develop more interdisciplinary research programs that represent emerging scientific disciplines, such as biotechnology, advanced materials, automated manufacturing, and computer science.

Interdisciplinary programs and centers not only allow the collaboration of scientists from different departments and schools, but also serve as the point of contact for industrial relations. Thus, a center for advanced materials could have a specific industrial research program on new electronic surfaces with superconducting properties that would provide Karnataka industries with an advanced view of developments—or draw from their own experience in microprocessor design and production.

In the future, such interdisciplinary and intersectoral research programs might offer an improved link between science and technology and between academe and industry, if sufficient incentives are provided to both sides. This capability could flow naturally into the applied research and development activities of other centers in Karnataka. The sought-after synergies between elements of the technology infrastructure thus would be maximized through interdisciplinary centers.

In particular, Karnataka industry and government need to work with the Indian Institute of Science to build close ties with the emerging sector of the economy. As the leading science institution, IISc can certainly serve as the focus for development of more world class research, new interdisciplinary centers, and improved industry-university relations. These longer-term changes, however, should evolve out of an understanding of the medium-term priorities for technology and human resource development in Karnataka.

Summary

Karnataka's highest priority should be to begin immediately to create the medium-term research and development capacity it needs to respond to rapidly changing markets. A scope and mission study should be the point of departure for this priority. Karnataka also needs to make a stronger effort to work with buyers to strengthen and increase the formation of suppliers. These two actions should be carried out over the next 2 to 3 years, or sooner if possible.

Concurrently with initiation of the medium-term priorities, Karnataka should undertake the more direct, near-term actions that will respond to the immediate needs of industry. These actions are development of a Technology Deployment Service, to reach out to smaller industries and help them plan their technology requirements, and creation of an international technology network that provides local companies with easier access to current information on product development and marketing. Efforts to enhance the education of managers in entrepreneurship and R&D management are also important, but not as important as the other priorities.

Finally, beginning now, but following the progress of the medium-term priorities, Karnataka business and government leaders should start to review the university system in the state and determine how to expand world class scientific research and introduce more interdisciplinary centers that also link more effectively with industry. In addition, Karnataka industry and government leaders should continue to develop a shared agenda for larger, all-India-level reforms that will enable the economic infrastructure to adapt more effectively and thus help to bring about a world class economy in Karnataka.

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V NEXT STEPS

Introduction

Karnataka has the opportunity to prioritize and implement elements of the Blueprint for Action described in the preceding section. This discussion describes a work program for beginning the implementation of high-priority Blueprint elements. The priorities for focus are the medium-term strategies, primarily those aimed at technology infrastructure development.

Medium-Term Priority

SRI suggests that the highest priority for Karnataka's Blueprint for Action be given to the two medium-term technology recommendations: creation of applied research capacity and development of a buyer–supplier initiative. The creation of applied research capacity will have the highest payback for Karnataka, whether the outcome is a new research center or new capabilities within existing institutions. A buyer–supplier initiative will also have a high payoff in the medium term because it will strengthen the development of smaller-scale, technologically competent business. Together, these efforts would be part of a strategy to modernize the economic infrastructure of Karnataka.

The following work programs outline the next steps that should be undertaken by Karnataka's public and private sectors, in conjunction with USAID as appropriate, on these medium-term actions. U.S. examples in each area of activity are provided as illustrations of Karnataka's options.

Applied Research Center

The recommended work program for creating an applied research institution involves a developmental process that begins with defining the institution's mission and scope and continues through to actual organization and start-up. These activities are described below.

The SRI study suggests that despite the presence of a large number of institutions whose mission it is to assist industry, there is a mismatch between what these institutions are able to do and what industry needs. To some degree, this mismatch appears to be due to the rapid evolution of industries in different stages of their life cycle, particularly those in the emerging stage, without commensurate evolution of applied research capacity in existing institutions. The implication is that applied research capacity has not evolved to meet market needs. Yet, a second important finding is that while industries have been evolving, their ability to use research capacity external to their organization has not developed as it would in a more traditional open market environment. As a result, demand for applied research capacity has lagged behind apparent need. Thus, both those with needs and those capable of responding have not evolved satisfactory methods of responding to each other. This mismatch implies a need to

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build new mechanisms for facilitating applied research, not just to supply science or technological capabilities. For this reason, the primary next step in implementing this priority is to complete a thorough mission and scope study. This study will provide the starting point for developing an applied research capacity that is well matched to Karnataka's needs.

The first step in developing an appropriate research institution, therefore, is to carry out a mission and scope study that provides a detailed analysis of what types of capabilities are needed, and what types of organizational settings would be best able to supply them. A mission and scope study would provide the detailed work plan for implementing the applied research institution. There are two parts to a mission and scope study: the evaluation and specification of mission and the development of detailed organization parameters. These are explored below, with examples of options chosen by different U.S. states and industries.

Evaluate Mission – Define the basic purposes for which the applied research institutional capacity would be created. This means answering the following questions:

- *Life Cycle Focus* – Which life cycle stage should R&D capacity be oriented toward: emerging, expanding, or transforming? Should the applied research institute favor those who are best able to make use of its capacity, such as the informatics sector? Should it be structured to reach out to industries with rapidly evolving needs, like food processing or manufacturing? Can these needs be differentiated in an institution's mission?
  - Michigan's Strategic Fund chose a focus on transforming sectors, such as agriculture and manufacturing, for the state's technology centers, and both emerging and transforming sectors for its industrial extension program.
  - Ohio's Edison Program chose a mix of emerging and transforming sectors, such as information techologies, chemicals, and manufacturing.
  - Pennsylvania's Ben Franklin Partnership chose emerging sectors, such as software and robotics, as its focus. Pennsylvania's PENNTAP program provides linkages between more mature companies and university technology information at a nonresearch level.
- *Technology Generation* – What stage of research should be emphasized, if any? Third generation (science), second generation (emerging technology), first generation (applications of existing technology)?
  - Michigan chose to have its research universities (University of Michigan) emphasize third-generation work on automation, materials, and computer science, and it targeted second-generation technology development, testing, and problem solving for its Industrial Technology Institute and new product development for its Biotechnology Center; however, the state decided to focus on first-generation technology for its complementary Technology Deployment Program.

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- Ohio selected third-generation technology for the Case Western component of its university-based Cleveland Advanced Manufacturing Program, second-generation problem-solving work at Cleveland State College, and first-generation technical training work at Cuyahoga Community College.

- Pennsylvania has emphasized a mixture of third- and second-generation product development work in all the research university activities at Pennsylvania State, Lehigh University, and Carnegie–Mellon.

- *Technology Capture vs. Technology Development*—What types of research activity should be emphasized? Should "technology capture" be stressed, with its focus on making existing technology work for each sector? Or should the focus be technology development, with a focus on innovation?

  - Michigan stresses technology capture in its technology center programs because it is there that the state can help bring second-generation technologies to sectors primarily using first-generation technology. However, new emphasis on technology development is evolving within the technology capture work (e.g., getting more out of existing technologies). Universities are where the third-generation work is carried out.

  - Ohio has a stronger emphasis on technology development but is still emphasizing breakthroughs that will advance the competitive position of Ohio industry, mainly from a new business formation standpoint.

  - Pennsylvania is also emphasizing technology development and new enterprise sectors, with the objective of stimulating growth in emerging sectors rather than existing ones.

- *Technology Fields*—What fields of technology should be provided to Karnataka industry? Advanced materials (composite materials, powdered metallurgy, ceramics); automated manufacturing (small- and large-scale computer-aided design, engineering, manufacturing systems development and integration; informatics (computer systems and software); biotechnology (industrial chemicals and agronomic applications)? Should the institution start with one area (such as informatics) and expand over time? Most emerging-sector firms are in the informatics sector, yet, as competitiveness becomes more central to the Karnataka economy, expanding and transforming sectors will increasingly require R&D assistance in fields such as chemicals and materials.

  - Michigan has decided that it needs centers of research excellence in each area described above and has created centers in advanced manufacturing and biotechnology, with a center in advanced materials in the planning stage.

  - Ohio has created programs in each technology area, using an approach that combines industry working with university staff as opposed to new technology centers. The technology focus is also more narrow than in the Michigan centers.

  - Pennsylvania has specialized in more multipurpose research centers,

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primarily emphasizing computer-aided design and engineering, software, and robotics. Broader capabilities exist, but with less of a specific structure than in other states.

Development Options—The richness of the Karnataka technology infrastructure and the seriousness of the mismatch between sectors suggests that the design of a potential applied research institution be carefully examined. The following questions need to be answered:

- *Sponsors*—Who should develop and sponsor the applied research institution? Should a public–private consortium be formed to provide balanced oversight to the development of this institution? Should business or the government of Karnataka play the lead role? What about organizations such as USAID?
  - Michigan's Centers of Research Excellence are sponsored by the Michigan Strategic Fund (MSF), which reports to the governor, has legislative financing, and has a public–private panel providing oversight and review.
  - Ohio's Thomas Edison Program was developed by the state's economic development agency, reports to the governor, has legislative financing, and has the active participation of industry.
  - Pennsylvania's Ben Franklin Partnership was developed with state economic development leadership as well as a strong industry and university advisory group.
- *Design*—Who should design the organizational structure? Should it designed by a committee or panel of experts? Should design be assigned by consensus to one institution, such as the Indian Institute of Science (IISc), Tata Consultancy, SRI?
  - Michigan had an extensive planning process for conceptualizing the design of each of its centers. There was considerable debate over what each center should do, how it should be organized, and where it should be. The state played a central role, with early conceptual input from university engineering faculty and industry; the state clearly shaped the final form.
  - Ohio had a similar process, but considerable emphasis was placed on industry and university shaping the design at all stages.
  - Pennsylvania emphasized the university role in shaping its programs (the programs are centered in universities) and listened to university and industry.
- *Structure*—Should the institution be independent and free-standing (e.g., a new institution), developed within an existing organization as improved services, or developed as a subsidiary? Should the applied research capacity be operated as a research brokerage service that is chartered to acquire needed research from the most appropriate source?
  - Michigan purposely elected to create free-standing, not-for-profit research

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centers, but near universities. This approach enabled having a non-academic structure for the centers.

- Ohio chose to have centers on multiple university campuses, with a strong emphasis on university–industry collaboration.

- Pennsylvania chose a program design that did not establish any formal centers, but provided support to technology development initiatives involving university and industry.

- *Operators* — Who should be designated as the operators of a possible applied research institution? Should the operators be selected by competitive bid, open to all qualified institutions in Karnataka, including CFTRI, CMTI, CPRI, ISRO, NAL, IISc, and so on? Should there be one or more centers, possibly specializing in different fields?

  - Michigan issued requests for proposals for each center. The selection and review process was very controversial, as political, economic, and technological issues entered into where the facility would be located, who would run it, and which, if any, university should be directly involved. Michigan empowered its centers to be operated by private not-for-profit organizations, with their own boards of directors, presidents or directors, and staff. The Industrial Technology Institute was located in Ann Arbor, on the campus of the University of Michigan (but as a separate organization) near the university's programs in advanced manufacturing; in contrast, the Michigan Biotechnology Institute was established in Lansing, on Michigan State University land, where Michigan's agricultural expertise is located (not its biotechnology capability).

  - Ohio also used a bid process, but it emphasized business and universities proposing center designs to the state. Ohio's centers are private corporations located on campus land, each with a different charter. Although not-for-profit, they are structured in such a way that private companies are involved with management and research at each center and stand to benefit from commercialization or use of technologies developed.

  - Pennsylvania's centers are not formal institutions, but are thematically defined groups at universities that are able to perform joint research with private companies who provide half the funding. Each university emphasizes its research skills and attracts industry with those particular interests.

- *Initial Capitalization* — How should the applied research institution be initially capitalized? Should initial funding come from Karnataka industry, declining as revenues from contracts increase? Should funding come from the state of Karnataka initially, declining over time, as well? Should there be matching seed capital from the Government of India or USAID? One scenario might show a 25% initial capitalization by each of these four groups.

  - Michigan centers were formed with core funding from the Michigan Strategic Fund for a set period of time (6 years). Funds were from a legislatively allocated gas revenue base that made it possible to give about $1 million a year per center. However, centers were not funded without having core funding or infrastructure loans from other sources. In Michigan, the Kellogg Foundation was a major source of these additional start-up revenues for two centers. There are no requirements for private-sector funds for the first two centers. However, the state has decided that it will not support a new center that is in the planning stage (for advanced materials) unless corporations provide core funding at a significant level. Importantly, Michigan university research is supported from separate sources: part by the $27-million-a-year Research Excellence Fund, and first-generation technology work is supported through the Commerce Department's legislatively supported Modernization Service budget.

- Ohio's Edison Program was initiated with a legislatively approved technology budget of about $1 million to $2 million per year per center. The program will be reviewed by the legislature for continuation.

- Pennsylvania's Ben Franklin Partnership is a matching grant program where individual university research teams, working with firms, receive matching grants for industry contributions. No specific start-up funds were provided because no specific new institutional settings were developed.

- *Financing*—How should the applied research institution be financed once established? How should this evolve over time (from initial founding to mature operation)? Should it operate on the basis of revenues generated from contract research, charging fees for services rendered? Should support come from state and Government of India contracts and grants as well? Should the institution accept contracts from industry outside of Karnataka? From outside of India (e.g., overseas-sponsored R&D)? One scenario might be a transitional financial structure in which the applied R&D institution moves from initial funding by business and government to complete support from contract research over a 5-year period.

  - Michigan's technology centers do not have a clear future. The state is evaluating their progress after 2 years of operation and is developing criteria for their continued support for another 4 years. The state may take the approach that these centers are like the state/USDA-funded Agricultural Experiment Stations and continue to support them as long as they focus on state technology capture objectives. However, if not, these centers are likely to shift to become purely market-driven facilities. They already have a significant degree of corporate funding as well as national grants (NSF). However, the state is concerned that if they become completely market driven, they will cease to serve the interests of Michigan's economy and turn toward those clients that provide the best revenue source. Finding a balance between outwardly oriented and

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inwardly turned will be an abiding issue for these centers.

- Ohio expects to continue to support its Edison centers, but also expects that they will increase their corporate contract level, as well as possible revenues from commercialized technologies. This view is the opposite of Michigan's, and emphasizes the importance of market-responsive, rather than state-centered technology capture.

- Pennsylvania will be likely to continue to support its Ben Franklin program, viewing it as a means of providing incentives to innovative university–industry work. The expectation is that the program will significantly enhance innovation in the state's emerging sectors over time and lead to more rapid formation of industry.

The completion of a mission and scope study that examines all these issues will have established the groundwork for creation of appropriate applied technology capabilities to serve the Karnataka economy. The information from this analysis will, in essence, constitute a feasibility analysis and can be used to guide implementation steps from that point forward.

Buyer–Supplier Initiative

The need for a buyer–supplier initiative complements the need for applied technology research among larger companies. A buyer–supplier initiative extends the chain of technology down from the second-generation level to the first-generation level. Applied technology may make Karnataka firms more innovative and able to compete, but moving the technology they are using to the supplier is equally essential. Thus, the buyer–supplier initiative is part of a larger modernization need of Karnataka, focusing on the historic difficulties that ancillaries and subcontractors have had in sustaining themselves, as well as growing and diversifying in Karnataka. Since the role of smaller businesses has been fundamental in the growth of industry in the United States, particularly in emerging technology sectors, efforts to enable suppliers to more effectively adopt technology would appear particularly warranted in India. Moreover, because Karnataka industries have traditionally expended minimal effort in establishing and supporting their own ancillaries, these suppliers have rarely been able to afford to expand their business activities at a pace that matches the changes in their parent or major buyer.

Unfortunately, there are few specific models for use in enhancing buyer–supplier relations in the United States. Most states and localities have depended primarily on major firms to take care of these issues. Programs for small businesses emphasize capitalization, and sometimes technology information. But what U.S. firms and governments are now realizing is that improving the linkage between different buyers and suppliers in the areas of technology and production is essential to broader competitiveness of all parties. This awareness is giving rise to new efforts by industry and government to work with suppliers. The majority of efforts focus on improving technology utilization by small-scale enterprise, often focusing specifically on suppliers as a group. This activity is clearly needed in Karnataka.

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Developing a buyer–supplier initiative will involve two main steps: assessment of the supplier structure and organizational development.

Assess Supplier Structure — Karnataka's public and private sectors need to examine the structure of the state's supplier system to determine which types of suppliers exist for different industrial segments of the Karnataka economy. This analysis should examine the following issues:

- *Supplier Life Cycle/Sector Characteristics* — Karnataka's business and government groups need to know the configuration of suppliers by both stage of life cycle and sector. There may be areas where there are more suppliers than others, particularly in the transforming sector. This imbalance might suggest a mismatch between the needs of buyers in other stages of development, or possible underutilization of suppliers. Karnataka needs to know enough about its supplier sectors to orient the next steps in a buyer–supplier initiative.

  - The state of California found that electronics manufacturers in the state could meet 85% of their part and component needs within the state, but that buyers were increasingly inclined to procure from overseas suppliers. The state has been trying to improve buyer perception of supplier quality in California through providing relevant supplier data to buyers. However, it is not clear that there is a sufficient match between the quality and cost requirements of electronics industry representatives in California and possible suppliers. This is a problem that the state would like to overcome.

- *Review Changing Buyer Requirements* — An analysis of changing buyer requirements should be carried out. This analysis should determine, by stage of life cycle and sector, what major technological changes in product materials and production are coming on line. In Karnataka, as in the United States, changing market conditions and new technology developments are placing greater pressure on companies to emphasize quality and efficiency, as well as innovation. Knowing these trends will help in a buyer–supplier initiative.

  - The state of Michigan initiated a study of changes in automobile industry technologies, as part of a larger analysis of the future of the industry in the state called "Auto-in Michigan" (AIM). The study brought together leading technologists, university analysts, and industry representatives to examine the future of different categories of parts, components, and fabrication technologies. The analysis pointed to major changes that would be confronting the automotive supply sector in the state.

  - Major buyers in the United States are now evaluating suppliers on the basis of their ability to meet comprehensive quality control program requirements. General Motors' Saginaw Division, for example, has the SPEAR program, which requires vendors to have their production audited by a GM team and also requires them to be able to self-certify quality levels (or pay a penalty) and meet just-in-time delivery requirements. To meet these requirements, vendors need sophisticated

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statistical process control techniques, precision calibration equipment, and production control and management capabilities (often software based). Moreover, to qualify for a long-term contract, suppliers have to be able to take downloaded computer-aided design data and work from these specifications, as well as provide design innovations in parts and components for GM. Thus, to remain a supplier to changing industry, a faster pace of adopting technologies is needed.

- *Evaluate Supplier Capabilities* — An analysis of a sample of suppliers in terms of their ability to utilize technologies and meet quality standards of major buyers should be carried out. This will establish the range of technical assistance requirements for Karnataka suppliers.

  - The AIM study involved several surveys of auto suppliers in the state of Michigan. The surveys were designed to identify what technologies were being used by suppliers. The emphasis was placed on first- and second-generation technologies, including personal computers, computer-aided design equipment, computer numeric controlled devices, flexible work stations, group technology, automated material handling, and other software for resource and production planning and control. The study showed that suppliers were using lower levels of technology than buyers and had difficulty meeting buyer requirements.

- *Identify Technology Assistance Opportunities* — Based on the size and structure of the supplier system, the changing requirements of major buyers, and the capabilities of current suppliers, Karnataka needs to identify technology services needed by suppliers.

  - Michigan did not develop a buyer–supplier center after its analysis of supplier problems. It first explored the concept of a Technology Deployment Service to assist small to medium-size companies in evaluating their own technology and in planning adoption of technologies that best fit their business plans. This often included, for example, meeting the performance specifications of defense procurement projects, as well as the automotive industry. Michigan implemented the Technology Deployment Service as part of the larger Michigan Modernization Service. The service also offers conferences for suppliers on how to compete and prepare for changing markets, and helps communities evaluate the technological capabilities of their manufacturing economy. This program is probably the most comprehensive supplier-oriented program in the United States.

  - Ohio, Pennsylvania, Georgia, North Carolina, and many other states have implemented industrial extension outreach programs that serve small business or manufacturers, but not specifically suppliers.

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- Ohio's program, the Ohio Technology Transfer Organization (OTTO), has staff in offices in local community colleges that make calls on local businesses, identify their individual problems, and broker technical assistance where it is available.

- Pennsylvania and many other states have data bases that identify supplier skills and production capabilities, and match them to federal procurement opportunities. Seminars on how to qualify for such procurement opportunities are frequently held. This service is intended to help increase business opportunities.

- A growing number of U.S. automobile, chemical, and electronic manufacturing companies are developing explicit programs to work with suppliers on explaining – and improving their ability to respond to – changing technology and quality assurance requirements. In the auto sector, companies like GM and Ford have periodic voluntary evaluation programs, where suppliers can come in and check out their own equipment and processes against company requirements. Similarly, chemical and electronic firms are both communicating requirements directly and providing limited technical guidance on meeting quality and performance requirements. Most of these programs are limited and do not involve extensive technical assistance, loans of equipment, or financial assistance, as has been the case in many Indian buyer–ancillary relations. However, these U.S. corporate programs are broad in focus and thus reach hundreds of suppliers.

Organizational Development – To develop a buyer–supplier initiative, possible sponsors need to be identified, as well as alternative organizational structures.

- *Sponsors* – Who should sponsor a buyer–supplier initiative? Should the government of Karnataka be the overall sponsor? Should the sponsors be a set of industries with shared concerns, such as the informatics sector? Which industries are most likely to agree to participate in a buyer–supplier initiative that requires provision of information on technical standards and quality assurance requirements? Perhaps some type of partnership in which government serves as intermediary to businesses who reach out to suppliers would be most appropriate.

  - U.S. experience does not suggest a single answer. However, states have become increasingly aggressive in organizing more effective outreach to smaller and medium-size manufacturing companies that may need direct assistance in assessing their capabilities and directions. States can often serve as a neutral intermediary for providing initial technical help or brokering linkages to the private sector. This function is more the tradition in the United States than direct delivery of subsidized services.

  - In Karnataka, resources for such activity exist, but they are demand responsive. For example, CMTI can help companies that request an evaluation of specific machines or machine systems but will not try to identify firms that require such assistance. TECSOC will evaluate a new business proposition but will not seek

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out existing firms to see whether they can produce better with new technology. The Government Productivity Council can evaluate a few industries a year but has limited staff, has expertise in a fairly narrow set of skills, and cannot reach out to examine technological competency and investment needs to any significant degree. Thus, existing programs are not attuned to the requirements of suppliers, nor are they large enough and outward looking enough to help any significant number of suppliers in the Karnataka economy.

- *Organizational Structure*—A medium-term initiative to improve buyer–supplier relations can be carried out in a number of ways. Karnataka's business and government sectors need to explore different approaches to reaching out, both to suppliers and to buyers, giving them common ground for working collaboratively. In addition, specific roles for staff of existing technology centers in Karnataka also need to be explored. Since most of the National Laboratories in Karnataka claim to be working with local industry, particularly ISRO (on aerospace parts and components), there may be a need to evaluate their potential contributions more systematically. Companies, technology centers, and the state of Karnataka may have the makings of a critical mass of resources needed to enhance buyer–supplier relations. If so, they have not been brought together in the best combination yet.

- *Design*—A specific organizational structure that provides different opportunities for buyer–supplier interaction is important. Individual subprogram activities may also be very critical. At the simplest level, a program might involve loaning calibration equipment and providing quality review on a neutral basis to suppliers. On a more sophisticated level might be an effort to develop production standards for suppliers based on a series of meetings between major buyers of parts and components. Perhaps most important might be an industrial extension service that reaches out to suppliers, helping them to evaluate their needs relative to buyer requirements (rather than only the suppliers' best judgment).

- *Finance Options*—Once Karnataka's business and government sectors have decided whether a buyer–supplier initiative needs extensive infrastructure, such as measurement equipment and pools of technical equipment to loan or lease, or whether it will emphasize human resources for appraisal of supplier capabilities and technical needs, the cost of the initiative can be estimated. Even if the initiative is capital intensive, many of the resources could be provided in-kind by companies or by other Karnataka technology centers. With core staff and in-kind corporate participation, the buyer–supplier initiative could become a viable public–private initiative that grows and changes with the needs of both sets of participants.

  - Michigan's Technology Deployment Service (TDS) is a small part of the Michigan Modernization Service, which is about a $4-million-a-year program. Once individual firms have received technical assistance plans, they must purchase further consultation and equipment at market rate from vendors. Thus, this program does not try to substitute for the end

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role of vendors and suppliers in the Michigan economy, but to facilitate the flow of information. TDS does subsidize training, however.

- U.S. supplier associations are beginning to find more common ground with major buyers. More and more conferences are being sponsored that provide better information to suppliers for their business planning. States like Michigan and others are helping to convene these conferences, and are holding special forums on more issues that face suppliers in either specialized or competitive areas (such as automation equipment). Closer ties between buyers and suppliers, including better flow of information and assistance in reducing the costs of adaptation, are likely to become more a part of U.S. business relations in the future.

Taking steps to learn more about the supplier economy in Karnataka, as well as about changing buyer needs, will help provide strong direction to the development of a buyer–supplier initiative. When the key stakeholders are understood, specific program elements will be easier to plan, whether they are purely informational or involve more direct technical assistance, as in the case of an industrial extension service. What is most important is the development of a stronger set of interactions between buyers and suppliers, so that the pace of adaptation in Karnataka will not be impeded by a lack of suitably qualified suppliers. Thus, as an intermediary and convenor, the state of Karnataka is an important figure in enabling this initiative. The technology centers and labs in the state also are likely to represent important technical resources for the buyer–supplier initiative once various program segments are designed.

REPORT ON POLICY ENVIRONMENT FOR THE CTR PROJECT

A. INDUSTRIAL DEVELOPMENT

A1 The National Environment

1. India has a centrally planned industrial strategy in which the Government of India (Centre) has a dominant role in shaping the overall policy environment for industrial development. The pursuit of multiple objectives has resulted in the creation of a complex system of overlapping policy mechanisms and controls, including industrial licences required to set up a plant, expand it, move it or change the product mix; additional monopoly or dominant clearances for the same purposes for large firms or industrial houses; control over mergers or closures; reservations of products or preferential treatment for small firms and the public sector; control over access to capital; controls on direct foreign investment in India; controls over foreign exchange payments including royalties for technology transfer; controls over a large proportion of imports and exports (via licensing, canalization, actual user policy, phased manufacturing programs, conditions in technology agreements, domestic purchase preferences, tariff barriers, etc); and through the system of taxes and administered prices.

2. While substantial progress has been made towards the achievement of policy objectives, productivity, output and employment performance have not always been commensurate with the resources invested, technologies having lagged behind and the policy instruments resulting in various inefficiencies. This is largely attributed to the lack of competition (and incentive to upgrade technologies and improve efficiences) due to protection in the domestic market (from internal competition as well as imports) and the lack of export rivalry (due to a combination of limited inducement to export, because of high profitability on domestic sales, as well as poor ability to compete due to outmoded technologies, inefficient capacities, etc.). Also, the complex nature of controls and their significance for profitability and growth has resulted in diversion of entrepreneurial attention to influencing/satisfying these requirements rather than to cost-cutting, innovation and quality improvement.

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3. These problems have been recognized by the Government, and a process of industrial policy reforms was initiated, which picked up speed after 1984 and continues to progress though somewhat cautiously. In general, the shift is from discretionary quantitative controls to non-discretionary fiscal controls, backed with an attempt to improve cost efficiency through increased domestic competition. Major policy changes have been in the relaxation of licensing constraints on entry in priority sectors (delicensing), allowing of greater freedom in responding to changing demand conditions (broad banding of licensing), relaxation of growth constraints through more liberal capacity re-endorsement, and encouragement of cost efficiency through reviewing/prescribing minimum scales of production. The administration of the control system has also been streamlined, and has speeded up noticeably.

4. The recently announced Import-Export Policy for 1988-91 carries forward the trade liberalization, while the Finance Act 1988 reintroduces Investment Allowance and extends substantial tax benefits for exports. More recent changes (June 1988) have eased licensing further for non-MRTP and non-FERA companies, raising the investment limit for general delicensing from Rs.50 million to 150 million in case of non-backward areas, and to Rs.500 million in backward areas; the number of industries requiring compulsory licensing has also been reduced from 56 to 26 industries. Further, for development of backward areas the government has decided to move away from "administrative regulations through licensing" to setting up and developing growth centres in 430 odd districts with substantial investment in providing good infrastructural facilities to meet industry requirements. The initial emphasis would be on developing about a hundred of these growth centres through an investment of Rs.250 million to 300 million in each such centre on infrastructural facilities, particularly power, water, telecommunications and banking. Another significant change has been the freeing of dominant undertakings from licensing curbs applicable to MRTP Companies in areas where they are not "dominant".

5. While the various reforms introduced have improved industry performance measurably (industrial growth accelerated to 8.8 per cent during 1984-85, 1985-86 and 1986-87, from an average growth rate of 6.4 per cent in the preceding three years[1]), a number of problems remain in the regulatory system. The process of liberalisation is slow. There are instances of backtracking (e.g. withdrawal of the delicensing of 82 bulk drugs and intermediates for MRTP and FERA Companies in 1987) and a slowness (or default) in acting on certain announced policy measures. Eligibility conditions and new controls have also limited the impact of recent changes. A large number of concessions do not extend to MRTP and FERA companies, while these are often the only ones who can muster the resources required to take advantage of the liberalisation (e.g. raising of delicensing limits in June 1988 to Rs.500 million in backward aras). Similarly, the easing of licenses for increases in capacity have been limited to forms outside standard urban limits. Broadbanding is often confined to products of a narrow product range and the procedure for obtaining permission to broadband is similar to obtaining a licence. An entrepreneur entering into a delicensed field is still required to approach the Government for approval of foreign collaboration agreement, import of capital goods, phased manufacturing programme and environmental clearances. Even the requirement of registration (meant for statistical purposes) in delicensed areas is a fairly cumbersome and time consuming process.

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1. Economic Survey 1987-88, Government of India; page 35.

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6. Overall, there is a significant improvement in the policy environment for industrial development, and the Government appears committed to this course. The need for further change has been recognised by both independent analysts and within the Government (e.g. the Mid-Term Appraisal of the Seventh 5-Year Plan). While the pace and scope of change may have been faster, concern with easing of the transition have necessitated a more cautious approach.

A2 Situation in Karnataka

7. Karnataka state must necessarily function within the framework of the national policies. The Industrial Policy Resolution of the State (July 1983) and the State's revised package of incentives and concessions for industry (June 1988) bring out the State's priorities. These must, however, be viewed in the context of Karnataka's acute energy crisis, tight financial position and infrastructural problems due to heavy concentration of industry around Bangalore city.

8. Karnataka sees the role of the State as one of a catalyst in promoting industrial development in desired areas through provision of improved infrastructural facilities, rather than through direct investment or budgetary support. Major incentives under the revised package are sales tax exemption (for tiny and small scale industries) or deferment (for medium and large scale industries) for five to seven years, and a state investment subsidy of 15 to 20 per cent of the value of fixed assets, subject to monetary limits.

9. The State's industrial policy emphasises dispersal of industry and provides for development of industrial estates at various growth centres to provide the necessary infrastructure. The package of incentives and concessions is also linked to the location of the industry, no incentives being generally available in Zone I (developed areas), with differential rates and limits being applied to Zone II (developing areas) and Zone III (industrially backward areas).

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10. The Industrial Policy also emphasised the development of small and tiny industries[2] (1,000 additional units to be set up every month), other industries based on human and natural resources available, and industries which are not power intensive. The electronics industry (already drawn to the State due to climatic factors, availability of qualified technical personnel and location of similar units, scientific and research institutions, and other infrastructural facilities) is treated on a special footing and allowed full scope for development throughout the state, including the developed areas. The Karnataka State Electronics Development Corporation Limited (KEONICS) has developed India's first 'Electronics City' (a 345 acres integrated complex of small, medium and large scale electronic units, supported by requisite infrastructural facilities) about 10 miles out of Bangalore city. This is proposed to be expanded by 200 acres, while another similar complex is also planned to come up near Mysore city. The revised package of incentives (1988) treats telecommunications, food processing and biotechnology industries on par with the electronics industry, extending to them the package of incentives normally available to units in the industrially backward areas (Zone III) even when these are located in the developed areas. Twentynine specified industries have been excluded from the purview of the new package of incentives, including power intensive units, wood based industries, State and Central undertakings, and any industry with an investment in fixed assets of more than Rs.200 million. Local employment is sought to be encouraged through insistence on provision of at least 80 per cent of jobs in new units to local people for entitlement to State incentives.

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2. Tiny industries are defined as units with investment in plant and machinery not exceeding Rs.200,000; small industries are defined as units with investment in plant and machinery not exceeding Rs.3.5 million (Rs.4.5 million in case of ancillaries).

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11. Karnataka state is one of the first to have introduced the concept of single window agency for granting clearances required by industry at the state level as well as the district level. This agency meets once a fortnight and takes care of all aspects concerning an industrial venture, so that industrialists do not have to deal separately with a number of agencies to get all the sanctions and clearances required in the setting up of a unit.

12. A major constraint to industrial development within the State is the acute scarcity of power (the power deficit in Karnataka[3] being estimated at around 30.6 per cent in 1987-88). Relatively high State taxes (incidence of state sales tax in Karnataka is the third highest in the country[4] and the State has a 2 per cent entry tax on industrial inputs as well as a turnover tax) are also regarded as a impediment to the development of industry and trade.

13. In general, while in overall terms the Karnataka state has moved down in an inter-state comparison of industrialization[5], the rate of growth is very good in electronics and in other high technology industries which are not power intensive. The State provides an excellent environment for these industries largely due to its infrastructure of scientific and research organizations (Bangalore is known as the 'Science City'), and has recognized their strategic importance for the State by freeing them of locational constraints.

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3. CMIE, Monthly Review of the Indian Economy, April 1988.

4. As per Reserve Bank of India figures quoted by the Commissioner of Commercial Taxes, Karnataka State, in a personal interview.

5. From third place to sixth place as per a statement made by the Industry and Power Minister, J.H.Patel, in the State Legislative Assembly on June 3, 1988 (Source:Hindu, June 4, 1988_).

E. THE INTRODUCTION OF NEW TECHNOLOGY

14. A critical factor in the Indian policy environment which had been holding back the introduction of new technology was the high degree of protection to industry. With the recent and ongoing opening up to competition, and a greater thrust to exports, a more favourable environment is being created for technology upgradation. While increased necessity due to market factors is the strongest motivational factor for introduction of new technology, specific policies influencing this development are the policies relating to foreign collaborations (financial and/or technical), import of capital goods and indigenous research and its commercialization.

15. To help in the acquisition of appropriate technology from abroad[6], the Government of India is operating a scheme called the "National Register of Foreign Collaborations" (NRFC). This covers the compilation of data on foreign collaborations and specific analytical studies on different aspects of technology acquisition such as choice and source of technology, alternative means of acquisition, analysis of imported technologies from various angles such as financial, economic, legal and technological, and a study of the unpackaging of technology components to avoid their repetitive imports. Another scheme, the "Technology Absorption and Adaptation Scheme" (TAAS) strives to improve the level of imported technology in use in the country by providing catalytic support for accelerated absorption and adaptation of technologies by the industrial units.

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6. A discussion on the foreign collaborations policy is contained in the next section.

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16. With regard to import of capital goods, the Import-Export Policy 1985-88 introduced some degree of liberalisation by placing on Open General Licence (OGL) selected items of machinery and equipment not domestically available but required to improve the quality of production and to upgrade technology. These items, however, related mainly to a few industries assessed to have significant export potential. Further, the Union Budget 1985-86 reduced protection by lowering duty on project imports to 55%, on fertiliser machinery to zero, and on power plants to 25%. Protests by indigenous manufacturers resulted in some backtracking in 1987 with project imports duty being raised to 85%, fertiliser machinery duty to 15%, and power plants (below 50 MW capacity) to 35%. Modernisation in capital goods industries has been encouraged through a notification of 120 items of capital equipment which could be imported at a concessional import duty of 35 per cent under IDBI's Technology Upgradation Scheme.

17. The recently announced (March 1988) Import-Export Policy (1988-91) carries forward the trade liberalisation, within the constraints of domestic and external resources. Permissible imports under OGL have been increased by 745 items, including 99 items of capital goods most of which relate to the electronics, tea and silk industries. Another bold step is the formulation of a scheme permitting, for the first time, import of selected capital goods without clearance from the angle of indigenous availability. This scheme is restricted to manufacturer exporters of a certain minimum size, and the Government hastened to contain the political fallout by clarifying that the permissions would be given only on a case by case basis. However, the scheme is a significant departure from the practice of restricting imports to particular items of machinery not available in the country. The Technical Development Fund Scheme, allowing import of technology and capital goods by existing industrial units, has been further liberalised in April 1988.

18. The expenditure of recognized in-house R&D units in industry is estimated to have increased from Rs.2 billion in 1980-81 to Rs.6 billion in 1987-88.[7] To encourage R&D activities the Government allows liberalised import facility to all recognised R&D units for importing their full requirements of technical and professional equipment, raw materials, components and spare parts on OGL (subject to actual user condition). Import of know-how, design, consultancy etc. upto a value of Rs.10 million is also allowed to in-house R&D units meeting certain conditions. Public funded R&D units are further allowed customs duty exemption on their imports upto specified limits. Fiscal incentives for scientific research earlier provided through weighted tax deductions have been discontinued, but expenditure on in-house research and contributions to not-for-profit scientific research associations continue to be tax-deductible, while the income of the scientific research associations is exempt from tax (subject to certain conditions).

19. To encourage commercialisation of R&D efforts, and to assure businesses that they would be able to obtain an industrial licence to commercialise the results of their R&D effort, the Government allows preferential treatment in licensing for commercial exploitation of in-house R&D results to non-MRTP and non-FERA companies. There is also a provision for delicensing of industries set up on the basis of knowhow developed by the applicant's in-house R&D unit, or obtained from a National Laboratory or an approved R&D unit (though this does not also extend to MRTP and FERA companies or for items reserved for the public sector or the small scale). A higher than normal depreciation allowance is also allowed in tax computation on plant and machinery installed for manufacture of goods based on indigenous technology.

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7. Annual Report 1987-88, Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India, page 42.

20. The financial institutions have a number of schemes to provide finances for technology upgradation and modernisation. Notable among these are concessional loans from the Technical Development Fund (TDF), Modernisation Assistance Scheme, Technology Upgradation Scheme (TUS) and Textile Modernisation Fund Scheme. There is a Technical Assistance Fund (TAF) to finance a wide range of promotional activities like preparation of techno-economic surveys, entrepreneurialship development programmes, research projects and research institutions in the field of industrial economics, support to Technical Consultancy Organizations and for upgradation of the skills of State-level institutions concerned with industrial development. There is also an interest subsidy scheme for encouraging the adoption of indigenous technology as well as a concessional loan scheme for assisting in development of technology through in-house R&D efforts.

21. While funds for commercialisation of laboratory research are scarce, recently a number of schemes have been set up by institutions to tackle this problem. These include assistance provided by the National Research Development Corporation (tasked with transfer of technology from public funded laboratories and research institutions), the Risk Capital and Technology Finance Corporation, the Technology Devélopment and Information Company of India, and the IDBI's Venture Capital Fund.

22. For improved information flow the National Information System for Science and Technology (NISSAT) programme envisages promotion and support to the development of a compatible set of information systems on science and technology and interlinking of these into a network.

23. In order to provide a stimulated environment for converting basic research findings into commercially viable products and for creating a facility nucleated around academic or research institutions, Science and Technology Entrepreneurs Parks (STEPs) are being set up on the lines of Science Parks in USA and UK. Six such parks are coming up in Ranchi (Bihar), Tarapur (Maharashtra), Tiruchirapalli (Tamil Nadu), Kanpur (Uttar Pradesh), Mysore (Karnataka) and Calcutta (West Bengal), while 5 other institutions are getting support for promotional and pre-operative expenses for the establishment of STEPs.

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24. A significant factor in shaping the policy environment for introduction of new technology is the law relating to proprietory rights protection. India is not a signatory to the Paris Convention and the salient features of the patent laws in India are:

- Term of Patent, which is 15 to 20 years in most countries, is 14 years from date of patent in India (Except for "food, medicine or drug substance" where it is 7 years from date of patent or 5 years from date of sealing, whichever is shorter); there is no provision in Indian law enabling extension of term.

- In India, only process patents are allowed in case of "food, medicine or drug" substance, and "other substance prepared or produced by chemical process";also, burden of proof of infringement is on the patentee though this is difficult to prove in case of process patents. This makes patent protection substantively weaker in these cases.

- What is patentable under Indian law may also be more restrictive as Indian patent authorities and courts continue to apply the 'vendable product' test which has undergone much change in the technologically more advanced countries.

- Wide provisions exist in Indian law for compulsory licensing, granting of licence of right, deemed endorsement with licences of right and right to use by Government. In practice, however, these provisions are very rarely invoked.

- Granting of patents normally takes around 3 years from the date of filing to the date of sealing (still fairly long but a considerable improvement over the 4 to 5 years period till a few years back). Confidentiality of information with patent office before acceptance of complete specifications is very high.

- Remedy for infringement is through court process which is fair and reasonable to the patentee, but time consuming.

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While statutory protection is less than in developed countries, the degree of practical protection is widely perceived to be considerably more than provided in law, as the general state of technology does not permit firms to set up production facilities for medium or high-technology products without having full details of drawings/designs and technical assistance in putting up the project.

25 There are very few specific measures within the State's ambit with the potential for directly influencing the policy environment for introduction of new technology. The large number of leading research and educational institutions in Karnataka State, and the encouragement being given to electronics and other high technology industries, are the main ways in which this effort is supported in Karnataka. The technology transfer/industry interface departments of the Indian Institute of Sciences, the Central Food Technology Research Institute, Indian Space Research Organisation, National Aeronautical Laboratory etc. provide the potential for extending research findings to industry and using research institutions to meet industry needs. The setting up of the Technology Development and Information Company of India with national headquarters in Bangalore should aid the effort by facilitating availability of funds as well as technical information. An earlier State scheme for subsidising procurement of knowhow by industry has been discontinued in the newly announced package of incentives, but is unlikely to be missed as it had reportedly not been used much.

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C. FOREIGN COLLABORATIONS

26. The policy relating to foreign collaborations (investment and technical knowhow) is determined entirely by the Centre. Foreign investment is allowed on a selective basis, in a wide range of sectors, and equity participation is normally restricted to less than 40 per cent. Higher equity is however permitted in areas of high technology or where there is a special contribution to exports. Companies with foreign equity participation below 40 per cent are generally treated on par with wholly Indian companies; companies with foreign equity in exces of 40 per cent (commonly known as FERA companies) are only permitted to grow in specified sectors.

27. Royalty payment rates depend on the nature of technology, but are normally not allowed to exceed 5 per cent of production value (net of excise duty, standard bought outs and imports). Lumpsum payments are permitted to be made for import of knowhow, technical designs and drawings, the amount together with royalty payments normally not being allowed to exceed 8 per cent of the value of production over the period of the agreement. The high Indian income tax rates to which royalty income and technical knowhow fee is subjected (30 per cent of gross amount except where lower rates are specifically provided in double taxation avoidance agreements), and the 5 per cent R&D cess imposed on these payments from December 1987, increase the cost of foreign technology to the Indian party while reducing the amount flowing to the collaborator.

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28. While there is little change in the basic policy, recent years have seen a more liberal attitude on the part of the Government towards foreign collaborations in terms of permitting imports of technology and simplification in procedures. The number of foreign collaboration approvals have gone up sharply from around 300 per year till 1980, to 590 in 1982 and 1024 in 1985. There has been a marginal decline to 957 in 1986 and 853 in 1987. While the time consuming process for taking on record of foreign collaboration agreements have been dispensed with, and other administrative simplifications have been introduced, the Prime Minister has promised that further simplification in processes, and speeding up of procedures, would be effected.

29. Recently (July 1988), the Government decided to extend the period of royalty payments from the existing five years to seven years. A higher period of royalty payments could also be considered where the foreign collaboration proposals pertain to high technology areas and in cases where the technology adoption would invariably take a longer time. Also, the Government has decided not to insist on strict compliance with the phased manufacturing programme (PMP) where import content has already been reduced to 30 per cent (as against the earlier requirement of reduction to 10 per cent). Another significant change is the Government decision to encourage foreign equity partcipation as part of the foreign collaboration proposal, rather than to opt for outright purchase of technology or components for executing projects on PMP basis. This is being done to facilitate a rapid transfer of technology and to ensure continued flow of technology upgradations carried out by foreign collaborators.

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D. POTENTIAL FOR POLICY DIALOGUE/POLICY CHANGE

30. The role of the CTD project in policy dialogue/policy change is strategic but must necessarily be subtle. The activities sponsored by USAID during the project development phase seem to have influenced Karnataka State's policy formulation, with the recently announced package of industrial incentives/concessions according special treatment to the high technology industries identified as having special potential in the State's developmental context.

31. On a continuing basis, the specific areas in which the CTD would seek to influence policy dialogue/policy changes have not been pre-identified. These are expected to emerge out of the activities of the CTD, such as the national seminars proposed to be organized annually in each focus area. The CTD is also expected to influence policy through the members of its Governing Board, Steering Committees and Focus Groups. The position of these members in Government and in industry would enable CTD to exercise this influence without a formal mandate to cover this activity.

32. While the Government's insistence on the CTD assuming a national character may possibly dilute the regional focus of the project, it does place it in an advantageous position for taking policy initiatives at the Centre which, as the preceding analysis shows, may be required due to the federal structure and centrally planned nature of the Indian economy.

ANNEX "R"

IN THE NEWS

A VENTURE IN ITSELF

File

The TDICI is clopping away at a good lick.

The Bangalore-based Technology Development & Information Co. of India Ltd. (TDICI) is now in business. In fact, it has been clopping away at a good lick since it kicked off on 1 July. Promoted by the Industrial Credit & Investment Corporation of India (ICICI), the TDICI's mandate goes beyond financing technology ventures to include techno-managerial support services, particularly for its venture capital clients in the small and medium sectors. Technology support services will include guidance on marketing, general and finance management — areas where first-generation entrepreneurs tend to be weak.

"It will not be the usual one-time, one-shot consultancy but a 'hand-holding' form of support to the entrepreneur until the new technology starts functioning in the market-place," says TDICI's president P. Sudarsan, earlier head of technology transfer and industry cooperation at the Indian Space Research Organisation.

What TDICI proposes to do is to assign a part-time team comprising, typically, a technologist, a professional management consultant and its own executive coordinator, to provide the necessary support to such entrepreneurs. TDICI is also planning to set up a technology information network whose ultimate aim will be to help any prospective user of a particular technology to carry out a fairly comprehensive evaluation without going through the tedious and time-consuming process of search and evaluation.

The accent in TDICI's venture capital scheme, says Sudarsan, is on technology venture financing and on indigenous technology development. In other words, TDICI is not a mere venture capital financing company and is thus different from the venture capital funds proposed or instituted by outfits like Canbank Financial Services, SBI Capital Markets, Grindlays' India Investment Fund and the Risk Capital and Technology Finance Corporation. Or, so it claims.

Forging links. According to Sudarsan, TDICI's technology information and consultancy service will primarily complement its technology venture capital finance activities and, in course of time, also serve an independent clientele: industry, R&D organisations, and other institutions. In support of its activities, TDICI has started forging links with R&D establishments, industry associations, financial institutions in India and abroad, and promotional agencies at the state and central level.

TDICI's origins date back to 1986 when the ICICI set up a venture capital division at Bombay. The experience gained over a short period in operating both the venture capital and the Program for Advancement of Commercial Technology (PACT — a scheme for promoting Indo-US joint ventures in R&D in India) showed there was both a need and a vast potential for technology financing. This prompted ICICI to form a separate company to pursue this activity more fully. The result: TDICI.

SUDARSAN: ENCOURAGING RESPONSE

The TDICI has presently an authorised capital of Rs 20 crores and a paid-up capital of Rs 2 crores. The authorised capital will, in due course, be raised to Rs 40 crores to Rs 50 crores. Apart from ICICI, the TDICI is likely to secure equity participation from the Industrial Development Bank of India, the World Bank, the Asian Development Bank, KFW (a West German Development Bank), and the Commonwealth Development Corporation. Out of TDICI's equity, 40% will be offered to about 2,500 small, medium and large Indian companies in the industries sector. "These institutions (listed earlier) along with the government of India will also be sources of borrowed funds/grants to TDICI for its technology venture finance activities," says Sudarsan. The TDICI's board boasts of people of eminence like Professor C.N.R. Rao, A.S. Ganguly, Ratan Tata, Rahul Bajaj, Sam Pitroda, M.S. Patwardhan, and Professor S. Ramachandran. The board is being strengthened from 12 to 15.

At present, the TDICI's upper limit for sanctions is Rs 3 crores and the minimum is Rs 15 lakhs, though it may go lower in exceptional cases. Financing may take three forms. The first is minority equity participation, retained for five to eight years. Once the project proves a success, TDICI may sell its holding, offering the first-purchase option to the promoter. The second is a conditional loan which carries a charge (not interest) linked to the revenues generated by the project on commercialisation. Lastly, it could be conventional interest-bearing loans.

Blend of instruments. Usually, however, it will be a blend of two out of the three financial instruments. According to Sudarsan, TDICI's target for venture capital funding during 1988-89 is Rs 20 crores to Rs 30 crores, rising to Rs 75 crores to Rs 100 crores in 1989-90. This would roughly correspond to 30 projects in 1988-89 and 70 in 1989-90. TDICI will also be handling a part of the processing operations under PACT.

Sudarsan opines that for venture financing to take firm root in the country, there is need for creating a window for trading in unlisted shares; tax incentives; access to mutual funds; and institution of syndicated venture financing.

It is too early to say how far TDICI will succeed in its mission, though the response has been encouraging. Characteristically, Sudarsan calls TDICI a "venture in itself." That says it all.

■ *N. Raghavan*

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5C(1) - COUNTRY CHECKLIST

Listed below are statutory criteria applicable to: (A) FAA funds generally; (B) (1) Development Assistance funds only; or (B) (2) the Economic Support Fund only.

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FY 1988 Continuing Resolution Sec. 526 Has the President certified to the Congress that the government of the recipient country is failing to take adequate measures to prevent narcotic and psychotropic drugs or other controlled substances which are cultivated, produced or processed illicitly, in whole or in part, in such country or transported through such country, from being sold illegally within the jurisdiction of such country to United States Government personnel or their dependents or from entering the United States unlawfully?

   No

2. FAA Sec. 481(h). (This provision applies to assistance of any kind provided by grant, sale, loan, lease, credit, guaranty , or insurance, except assistance from the Child Survival Fund or relating to international narcotics control, disaster and refugee relief, or the provision of food or medicine.) If the recipient is a "major illicit drug producing country" (defined as a country producing during a fiscal year at least five metric tons of opium or 500 metric tons of cocoa or marijuana) or a "major drug-transit country" (defined as a country that is a significant direct source of illicit drugs significantly affecting the United States, through which such drugs are transported,or through which significant sums of drug-related profits are laundered with the knowledge or complicity of the government), has the President in the March 1 International Narcotics Control Strategy report (INSCR) determined and certified to the Congress

(without Congressional enactment, within 30 days of continous session, of a resolution disapproving such a certification), or has the President determined and certified to the Congress on any other date (with enactment by Congress of a resolution approving such certification), that (a) during the previous year the country has cooperated fully with the United States or taken adequate steps on its own to prevent illicit drugs produced or processed in or transported into the United States, and to prevent and punish drug profit laundering in the country, or that (b) the vital national interests of the United States require the provisions of such assistance?

(a) Yes

(b) N/A

3. Drug Act Sec. 2013. (This section applies to the same categories of assistance subject to the restrictions in FAA Sec. 481 (h), above.) If recipient country is a "major illicit drug producing country" or "major drug-transit country" (as defined for the purpose of FAA Sec 481 (h), has the President submitted a report to Congress listing such country as one (a) which, as a matter of government policy, encourages or facilitates the production or distribution of illicit drugs; (b) in which any senior official of the government engages in, encourages, or facilitates the production or distribution of illegal drugs; (c) in which any member of a U.S. Government agency has suffered or been threatened with violence inflicted by or with the complicity of any government officer; or (d) which fails to provide reasonable cooperation to lawful activities of U.S. drug enforcement agents, unless the President has provided the required certification to Congress pertaining to U.S. national interests and the drug control and criminal prosecution efforts of that country?

(a) No

(b) No

(c) No

(d) No

4. FAA Sec. 620(c). If assistance is to a government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) the debt is not denied or contested by such government?

No

5. FAA Sec. 620(e)(1). If assistance is to a government, has it (including any government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?

No

6. FAA Sec. 620(a), 620(f), 620D; FY 1988 Continuing Resolution Sec 512, Is recipient country a Communist country? If so, has the President determined that assistance to the country is vital to the security of the United States, that the recipient country is not controlled by the international Communist conspiracy, and that such assistance will further promote the independence of the recipient country from international communism? Will assistance be provided directly to Angola, Cambodia, Cuba, Iraq, Libya, Vietnam, South Yemen, Iran or Syria? Will assistance be provided to Afghanistan or Mozambique without a waiver?

Recipient is not a Communist country. Assistance will not be provided to other countries cited. Assistance will not be provided to Afghanistan without a certification.

7. FAA Sec. 620(j). Has the country permitted or failed to take adequate measures to prevent the damage or destruction, by mob action, of U.S. property?

No

8. FAA Sec. 620(l). Has the country failed to enter into an investment guaranty agreement with OPIC?

N/A. No such agreement is known to exist, however.

9. FAA Sec. 620(o); Fishermen's Protective Act of 1967, as amended, Sec.5. (a) Has the country seized or imposed any penalty or sanction against, any U.S. fishing vessel because of fishing activities in international waters? (b) If so, has any deduction required by the Fishermen's Protective Act been made?

(a) No

(b) N/A

10. FAA Sec. 620(q); FY 1988 Continuing Resolution Sec. 518 (a) Has the government of the recipient country been in default for more than six months on interest or principal of any loan to the country under FAA? (b) Has the country been in default for more than one year on interest or principal on any U.S. loan under a program for which the FY 1988 Continuing Resolution appropriates funds?

(a) No

(b) No

11. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the percent of the country's budget and amount of the country's foreign exchange or other resources spent on military equipment? (Reference may be made to the annual "Taking Into Consideration" memo: "Yes, taken into account by the Administrator at the time of approval by of Agency OYB." This approval by the Administrator of the Operational Year Budget can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur).

N/A. Assistance furnished will be from neither source

12. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have relations been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?

No

N/A

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13. FAA Sec. 620(u). What is the payment status of the country's U.N. obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget? (Reference may be made to the Taking into Consideration memo).

India is not in arrears on its U.N. obligations

14. FAA Sec. 620A. Has the President determined that the recipient country grants sanctuary from prosecution to any individual or group which has committed an act of international terrorism, or otherwise supports international terrorism?

No

15. FY 1988 Continuing Resolution Sec. 576 Has the country been placed on the list provided for in Section 6(j) of the Export Administration Act of 1979 (currently Libya, Iran, South Yemen, Syria, Cuba, or North Korea)?

No

16. ISDCA of 1988 Sec. 552(b) Has the Secretary of State determined that the country is a high terrorist threat country after the Secretary of Transportation has determined, pursuant to section 1115(e)(2) of the Federal Aviation Act of 1958, that an airport in the country does not maintain and administer effective security measures?

No

17. FAA Sec. 666(b) Does the country object, on basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. who is present in such country to carry out economic development programs under FAA?

No

18. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered to any other country or received nuclear enrichment or reprocessing equipment, materials or technology, without specified arrangements or safeguards

No such action is known to have occurred.

and without special certification by the President? Has it transferred a nuclear explosive device to a non-nuclear weapon state, or if such a state, either received or detonated a nuclear explosive device? (FAA Sec. 620E permits a special waiver of Sec. 669 for Pakistan) — No

19. FAA Sec. 670 If the country is a non-nuclear weapon state, has it, on or after August 8, 1985, exported (or attempted to export) illegally from the United States any material, equipment, or technology which would contribute significantly to the ability of a country to manufacture a nuclear explosive device? — No

20. ISDCA of 1981 Sec. 720. Was the country represented at the Meeting of Ministers of Foreign Affairs and Heads of Delegations of the Non-Aligned Countries to the 36th General Assembly of the U.N. on September 25 and 28, 1981, and failed to disassociate itself from the communique issued? If so, has the President taken it into account? (Reference may be made to the Taking into Consideration memo). — Although the GOI failed to disassociate itself from the communique, the Administrator has taken this into account in the OYB allocation process.

21. FY 1988 Continuing Resolution Sec. 528. Has the recipient country been determined by the President to have engaged in a consistent pattern of opposition to the foreign policy of the United States? — No

22. FY 1988 Continuing Resolution Sec. 513 Has the duly elected Head of Government of the country been deposited by military coup or decree? If assistance has been terminated, has the President notifiied Congress that a democratically elected government has taken office prior to the resumption of assistance? — No

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23. FY 1988 Continuing Resolution Sec. 543
Does the recipient country fully cooperate with the international refugee assistance organizations, the United States, and other governments in facilitating lasting solutions to refugee situations, including resettlement without respect to race, sex, religion, or national origin? — Yes

B. FUNDING SOURCE CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria

FAA Sec. 116. Has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights? — We are not aware of such a determination.
If so, can it be demonstrated that contemplated assistance will directly benefit the needy? — N/A

FY 1988 Continuing Resolution Sec. 538
Has the President certified that use of DA funds by this country would violate any of the prohibitions against use of funds to pay for the performance of abortions as a method of family planning to motivate or coerce any person to practice abortions, to pay for the performance of involuntary sterilization as a method of family planning, to coerce or provide any financial incentive to any person to undergo sterilizations, to pay for any biomedical research which relates in whole or in part, to methods of, or the performance of, abortions or involuntary sterilization as a means of family planning? — No

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5C (2) PROJECT CHECKLIST

isted below are statutory criteria applicable to projects. This Section is divided into two parts. Part A. includes criteria applicable to all projects. Part B. applies to projects funded from specific sources only: B.(1) applies to all projects funded with Development Assistance.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP-TO-DATE? Yes.

HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT? Yes.

A. GENERAL CRITERIA FOR PROJECT

1. FY 1988 Continuing Resolution Sec. 523; FAA Sec. 634A. If money is sought to be obligated for an activity not previously justified to Congress, or for an amount in excess of the amount previously jusitified to Congress, has Congress been properly notified? — Yes

2. FAA Sec. 611(a)(1); Prior to an obligation in excess of $500,000 will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance? — (a) Yes (b) Yes

3. FAA Sec. 611(a)(2); If legislative action is required within recipient country, what is the basis for a reasonable expectation that such action will be completed in time to permit orderly accomplishment of the purpose of the assistance? — N/A

4. FAA Sec. 611(b); FY 1988 Continuing Resolution Sec. 501; If project is for water or water-related land resource construction, have benefits and costs been computed to the extent practicable in accordance with the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See A.I.D. Handbook 3 for guidelines). — N/A

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5. FAA Sec. 611(e); If project is capital assistance (e.g., construction), and total U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability to maintain and utilize the project effectively?

N/A

6. FAA Sec. 209; Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.

Project is not susceptible to executi
as part of a regional project.

7. FAA Sec. 601(a); Information and conclusions whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c)encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce and (f) strengthen free labor unions.

(a) Yes.
(b) Yes. (CTD is a private non-profi
Organization).
(c) Yes. Credit Institutions such as
ICICI, will be involved.
(d) Yes.
(e) Yes.
(f) No.

8. FAA Sec. 601(b); Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).

This project will likely stimulate
Indo-US Joint Venture, in areas suc
as food processing, information etc
A wide range of US exports of soft-
ware, instrumentation, etc. is like
to occur as a result of project
activities.

9. FAA Sec. 612(b); Sec. 636(h); Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars

The Karnataka govt. & private sector
industries will contribute Rs. 60,00
(equivalent to $428,571) and $15.4 Mi
is available for venture capital
through ICICI. PPC reaffirmed at AE
reviews that project can finance loc
cost from FX rather than utilizing U
owned excess rupees to cover their c

10. FAA Sec. 612(d); Does the U.S. own excess foreign currency of the country and if so, what arrangements have been made for its release?

Yes, such funds will not be used t
finance project related costs but
will be used for other appropriate
jointly agreed purposes.

11. FY 1988 Continuing Resolution Sec. 521; If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity.

The new joint ventures promot by CTD might produce commodi for export; however, they wil not compete with US suppliers

12. FY 1988 Continuing Resolution Sec. 553; Will the assistance (except for programs in Caribbean Basin Initiative countries under U.S. tariff Schedule "Section 807" which allows reduced tariffs on articles assembled abroad from U.S. made components) be used directly to procure feasibility studies, prefeasibility studies, or project profiles of potential investment in, or to assist the establishment of facilities specifically designed for, the manufacture for export to the United States or to third country markets in direct competition with U.S. exports, of textiles, apparel, footwear, handbags, flat goods (such as wallets or coin purses worn on the person), work gloves or leather wearing apparel?

No.

13. FAA Sec. 119(g)(4)-(6); Will the assistance (a) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity; (b) be provided under a long-term agreement in which the recipient country agrees to protect ecosystems or other wildlife habitats; (c) support efforts to identify and survey ecosystems in recipient countries worthy of protection; or (d) by any direct or indirect means significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas?

(a) No

(b) No.

(c) No

(d) No

14. FAA 121(d); If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (either dollars or local currency generated therefrom)?

N/A

15. FY 1988 Continuing Resolution; If assistance is to be made to a United States PVO (other than a cooperative development organization) does it obtain at least 20 percent of its total annual funding for international activities from sources other than the United States Government?

N/A. Assistance will not be m available to a U.S. PVO.

16. FY Continuing Resolution Sec. 541; If assistance is being made available to a PVO, has that organization provided upon timely request any document, file, or record necessary to the auditing requirements of A.I.D., and is the PVO registered with A.I.D.?

N/A. Assistance will not be m available to a U.S. PVO.

17. FY 1988 Continuing Resolution Sec. 514; If funds are being obligated under an appropriation account to which they were not appropriated, has prior approval of the Appropriations Committee of Congress been obtained?

N/A

18. FY Continuing Resolution Sec. 515; If deob/reob authority is sought to be exercised in the provision of assistance are the funds being obligated for the same general purpose, and for countries within the same general region as originally obligated, and have the Appropriations Committees of both Houses of Congress been properly notified?

N/A

19. State Authorization Sec. 139 (as interpreted by conference report); Has confirmation of the date of signing of the project agreement, including the amount involved, been cabled to State L/T and A.I.D. LEG within 60 days of the agreement's entry into force with respect to the United States, and has the full text of the agreement been pouched to those same offices? (See Handbook 3, Appendix 6G for agreements covered by this provision).

The date of signing has not y been confirmed. However, app priate notifications and copi of texts will be forwarded to STATE L/T & AID/LEG within 60 days of signing.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

N/A

a. FAA 1988 Continuing Resolution Sec. 552 (as interpreted by conference report); If assistance is for agricultural development activities (specifically, any testing or breeding feasibility study, variety improvement or introduction, consultancy, publication, conference, or training), are such activities (a) specifically and principally designed to increase agricultural exports by the host country to a country other than the United States, where the export would lead to direct competition in that third country with exports of a similar commodity grown or produced in the United States, and can the activities reasonably be expected to cause substantial injury to U.S. exporters of a similar agricultural commodity; or (b) in support of research that is intended primarily to benefit U.S. producers?

b. <u>FAA Sec. 102(B), 111, 113, 281(a); Describe the extent to which activity</u> will (a) effectively involve the poor in development by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology dispersing investment from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis using appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward a better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries.

Many of the studies & activit. etc. that are to be financed under the project may lead tc efforts which will comply wit the requirements of (a), (b) (c), (d) and (e).

c. <u>FAA Secs. 103, 103A, 104, 105, 106, 120-21;</u> Does the project fit the criteria for the source of funds (functional account) being used?

Yes.

d. FAA Sec. 107; Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small business, and small incomes of the poor)?

Yes.

e. FAA Sec. 110, 124(d); Will the recipient country provide at least 25 percent of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement . been waived for a "relatively least developed country)?

Yes.

f. FAA Sec. 128(b); If the activity attempts to increase the institutional capabilities of private organizations or the government of the country, or if it attempts to stimulate scientific and technological research, has it been designed and will it be monitored to ensure that the ultimate beneficiaries are the poor majority?

Even though direct beneficiaries the project will be private ente prises including small and medi ones & the scientific community Karnataka, the project will be monitored to ensure that the ult mate beneficiaries are the poor majority.

g. FAA, Sec. 281(b); Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.

The project is basically an ins tutional development effort to promote local need based R & D in relevant sectors such as foo processing, information etc., with a special component of in- degenous technology development

h. FY 1988 Continuing Resolution Sec. 538; Are any of the funds to be used for the performance of abortions as a method of family planning or to motivate or coerce any person to practice abortions?

No.

Are any of the funds to be used to pay for the performance of involuntary sterilization as a method of family planning or to coerce or provide any financial incentive to any person to undergo sterilizations?

No.

Are any of the funds to be used to pay for any biomedical research which relates in whole or in part, to methods of, or the performance of, abortions or involuntary sterilization as a means of family planning? | No.

i. FY 1988 Continuing Resolution; Is the assistance being made available to any organization or program which has been determined to support or participate in the management of a program of coercive abortion or involuntary sterilizaton? | No.

If assistance is from the population functional account, are any of the funds to be made available to voluntary family planning projects which do not offer, either directly or through referral to or information about access, a broad range of family planning methods and services? | No.

j. FAA Sec. 601 (e); Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise? | Yes.

k. FY 1988 Continuing Resolution; What portion of the funds will be available only for activities of economically and socially disadvantaged enterprises, historically blackcolleges and universities, colleges and universities having a student body in which more than 20 percent of the students are Hispanic Americans, and private and voluntary organizations which are controlled by individuals who are black Americans, Hispanic Americans, or Native Americans, or who are economically or socially disadvantaged (including women)? | No portion of the project funds have been specifica set aside for these purpo however prior to awarding contracts there will be a appropriate review of suc sources to see if they ca provide the required serv If so the award will be r ved for such sources.

l. FAA Sec. 118(c); Does the assistance comply with the environmental procedures set forth in A.I.D. Regulation 16? Does the assistance place a high priority on conservation and sustainable management of tropical forests? Specifically, does the assistance, to the fullest extent feasible: (a) stress the importance of | N/A conserving and sustainably managing forest resources; (b) support activities which offer employment and income alternatives to those who otherwise would cause destruction and loss of forests, and help countries identify and implement alternatives to colonizing forested areas; (c) support training programs educational efforts,and the establishment or strengthening of institutions to improve forest management; (d) help end destructive slash-and-burn agriculture by supporting stable and productive farming practices; (e) help conserve forests which have not yet been degraded by helping to increase production on lands already cleared or degraded; (f) conserve forested watersheds and rehabilitate those which have been deforested; (g) support training, research, and other actions which lead to sustainable and more environmentally sound practices for timber harvesting, removal and processing; (h) support research to expand knowledge of tropical forests and identify alternatives which will prevent forest destruction, loss, or degradation; (i) conserve biological diversity in forest areas by supporting efforts to identify, establish, and maintain a representative network of protected tropical forest ecosystems on a worldwide basics, by making the establishment of protected areas a condition of support for activities involving forest clearance or degradation, and by helping to identify tropical forest ecosystems and species in need of protection and establish and maintain appropriate protected areas; (j) seek to increase the awareness of U.S. government agencies and other donors of the immediate and long-term value of tropical forests; and (k) utilize the resources and abilities of all relevant U.S. government agencies?

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m. FAA Sec. 118(c) (13); If the assistance will support a program or project significantly affecting tropical forests (including projects involving the planting of exotic plant species), will the program or project (a) be based upon careful analysis of the alternatives available to achieve the best sustainable use of the land, and (b) take full account of the environmental impacts of the proposed activities on biological diversity? N/A

n. FAA Sec. 118(c)(14); Will assistance be used for (a) the procurement or use of logging equipment, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner and that the proposed activity will produce positive economic benefits and sustainable forest management systems; or (b) actions which will significantly degrade national parks or similar protected areas which contain tropical forests, or introduce exotic plants or animals into such areas? N/A

o. FAA Sec. 118(c)(15); Will assistance be used for (a) activities which would result in the conversion of forestlands to the rearing of livestock; (b) the construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands; (c) the colonization of forest lands; or (d) the construction of dams or other water control structures which flood relatively undegraded forest lands, unless with respect to each such activity an environmental assessment indicates that the activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development? N/A

p. FY 1988 Continuing Resolution; If assistance will come from the Sub-Saharan Africa DA account, is it (a) to be used to help the poor majority in Sub-Saharan Africa through a process of long-term development and economic growth that is equitable, participatory, environmentally sustainable, and self-reliant; (b) being provided in accordance with the policies contained in section 102 of the FAA; (c) being provided, when consistent with the objectives of such assistance, through African, United States and other PVOs that have demonstrated effectiveness in the promotion of local grassroots activities on behalf of long-term development in Sub-Saharan Africa; (d) being used to help overcome shorter-term constraints to long-term development, to promote reform of sectoral economic policies, to support the critical sector and natural resources, health, voluntary family planning services, education, and income generating opportunities, to bring about appropriate sectoral restructuring of the Sub-Saharan African economies to support reform in public administration and finances and to establish a favorable environment for individual enterprise and self-sustaining development, and to take into account, in assisting policy reforms, the need to protect vulnerable groups; (e)being used to increase agricultural production in ways that protect and restore the natural resource base, especially food production, to maintain and improve basic transportation and communication networks, to maintain and restore the natural resource base in ways that increase agricultural production, to improve health conditions with special emphasis on meeting the health needs of mothers and children, including the establishment of selfsustaining primary health care systems that give priority to preventive care,to provide increased access to voluntary family planning services, to improve basic literacy and mathematics especially to those outside the formal educational system and to improve primary education, and to develop income-generating opportunities for the unemployed and underemployed in urban and rural areas? N/A

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2. Development Assistance Project Criteria (Loans only);

N/A

a. FAA Sec. 122 (b); Information and conclusion on capacity of the country to repay the loan at a reasonable rate of interest. N/A

b. FAA Sec. 620(d); If assistance is for any productive enterprise which will compete with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan or has the requirement to enter into such an agreement been waived by the President because of a national security interest? N/A

c. FY 1988 Continuing Resolution; If for a loan to a private sector institution from funds made available to carry out the provisions of FAA Sections 103 through 106 will loan be provided, to the maximum extent practicable, at or near the prevailing interest rate paid on Treasury obligations of similar maturity at the time of obligating such funds? N/A

d. FAA Sec. 122 (b); Does the activity give reasonable promise of assisting longrange plans and programs designed to develop economic resources and increase productive capacities? N/A

3A(3) - STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. PROCUREMENT

1. FAA Sec. 602 (a) Are there arrangements to permit U.S. small business to participate equitably in the furnishing or commodities and services financed?	Yes
2. FAA Sec. 604(a) Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him?	The Project Agreement authorizes procurement of Goods & services both from the US & the Host country
3. FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company?	Yes
4. FAA Sec. 604(e). ISDCA of 1980 Sec. 705(a). If non-U.S. offshore procurement of agricultural commodity or product thereof is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.).	N/A
5. FAA Sec. 604(g). Will construction or engineering services be procured from firms of advanced countries which are otherwise eligible under Code 941 and which have attained a competitive capability in international markets in one of these areas? (Exception for those countries which receive direct economic assistance under the FAA and permit United States firms to compete for construction or engineering services financed from assistance programs of these countries).	N/A

6. FAA Sec. 603. Is the shipping excluded from compliance with the requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 percent of the gross tonnage of commodities (computed separately for dry bulk carriers, dry crgo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extend such vessels are available at fair and reasonable rates? — N/A

7. FAA Sec. 621 (a). If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? — Yes
Will the facilities and resources of other Federal agencies be utilized, when they are particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs? — Yes

8. International Air Transportation Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U.S. carriers be used to the extent such service is available? — Yes

9. FY 1988 Continuing Resolution Sec. 504. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States? — Yes

10. FY 1988 Continuing Resolution Sec. 524. If assistance is for consulting service through procurement contract pursuant to 5 U.S.C. 3109, are contract expenditures a matter of public record and available for public inspection (unless otherwise provided by law or Executive order)? — Yes

B. CONSTRUCTION

1. FAA Sec. 601 (d). If capital (e.g., construction) project, will U.S. engineering and professional services be used? — N/A

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2. FAA Sec. 611 (c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — N/A

3. FAA Sec. 620(K). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million (except for productive enterprises in Egypt that were described in the CP), or does assistance have the express approval of Congress? — N/A

C. OTHER RESTRICTIONS

1. FAA Sec. 122 (b). If development loan repayable in dollars, is interest rate at least 2 percent per annum during a grace period which is not to exceed ten years, and at least 3 percent per annum thereafter? — N/A

2. FAA Sec. 301 (d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — N/A

3. FAA Sec. 620(h). Do arrangement exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries? — yes

4. Will arrangements preclude use of financing:

   a. FAA Sec. 104(f); FY 1987 Continuing Resolution Secs. 525, 538: (1) To pay for performance of abortions as a method of family planning or to motivate or coerce persons to practice abortions; (2) to pay for performance of involuntary sterilization as method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization; (3) to — (1) Yes (2) Yes (3) Yes

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pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning; or (4) to lobby for abortion? — (4) Yes

b. FAA Sec. 483. To make reimbursements, in the form of cash payments, to persons whose illicit drug crops are eradicated? — Yes

c. FAA Sec. 620 (g). To compensate owners for expropriated or nationalized property, except to compensate foreign nationals in accordance with a land reform program certified by the President? — Yes

d. FAA Sec. 660. To provide training, advice, or any financial support for police, prisons, or other law enforcement forces, except for narcotics programs? — Yes

e. FAA Sec. 662. For CIA activities? — Yes

f. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained? — Yes

g. FY 1988 Continuing Resolution Sec. 503. To pay pensions, annuities, retirement pay, or adjusted service compensation for prior or current military personnel? — Yes

h. FY 1988 Continuing Resolution Sec. 505. To pay U.N. assessments, arrearages or dues? — Yes

i. FY 1988 Continuing Resolution Sec. 506. To carry out provisions of FAA section 209 (d) (transfer of FAA funds to multilateral organizations for lending)? — Yes

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j. FY 1988 Continuing Resolution Sec. 510: To finance the export of nuclear equipment, fuel, or technology? — Yes

k. FY 1988 continuing Resolution Sec. 511: For the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights? — Yes

l. FY 1988 Continuing Resolution Sec. 516; State Authorization Sec. 109: To be used for publicity or propaganda purposes designed to support or defeat legislation pending before Congress, to influence in any way the outcome of a political election in the United States, or for any publicity or propaganda purposes not authorized by Congress? — Yes

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DO NOT REMOVE FROM BACKING SHEET UNTIL

ANNEX "T"

3172131 AID IN

3172131 AID IN

8458057 NGEF IN

TLX MSG NO. CONSULTANT/PCN/8930 OF 16/8/88

-:- KIND ATTN MR BECKMAN/MR RK BERRY/MR A PURI

08/16/1988
ACTION:
TDE
INFO:
D
CHRON

DIRECTORATE OF TECHNL+ TECHNOLOGY DEVELOPMENT AND ENTERPRISES
USAID, N.DELHI KINDLY REFER TO OUR DISCUSSIONS ALST WEEK STOP
FURTHER INFORMATION ON CTD AS DESIRED IS GI+ GIVEN BELOW:

I. FINANCIAL ACCOUNTING:

1. THE CTD WILL HAVE NO CASH TRANSACTIONS STOP ALL TRANSACTIONS INCLUDING RECEIPTS AND DISBURSEMENTS WILL BE CONDUCTED THROUGH BANKS

2) THE PROGRAMME ASSISTANT WILL BE KEEPING A DAY BOOK GIVING DETAILS OF CHEQUES ISSUED AND CHEQUES RECD

3. A SMALL ACCOUNTANT'S FIRM IN BANGALORE WILL BE APPOINTED ON CONTRACT BASIS WHO WILL SEND THEIF STAFF EVERY WEEK TO WRITE THE ACCOUNT BOOKS

4. THE GOVERNING BODY WILL BE MEETING EVERY QUARTER STOP W+ QUARTERLY ACCOUNTS WILL BE DRAWN UP BY THE ACCOUNTING FIRM STOP THIS WILL BE AUDITED BY THE AUDITORS OF CTD STOP CTD WILL APPOINT A REPUTED AUDITING FIRM IN BANGALORE SAYSKBRD RHODES AND PARK OR ANY EQUIVALENT FIRM TO AUDIT ON A QUARTERLY BAIS+ BASIS AND GIVE THEIR AUDIT COMMENTS TO THE GOVERNING BODY STOP IRUSI THUS, THE CTD WILL BE HAVING QUARTERLY, 6-MONTHLY, 9-MONTHLY AND ANNUAL ACCOUNTS AND REPORTS, ALL OF WI+ WHICH WILL BE AUDITED BY THE [illegible]DITORS STOP

IT IS ALSO PROPOSED THAT ICICI CAN ALSO DO THE AUDIT OF ANY TRANSACTION OF ZHE USAID FUNDS STOP THE ACCOUNT BOOKS OF THE PROJECTS ASSISTED BY USAID WILL ALSO BE OPEN TO USAID AUTHOIT+ AUTHORITIES FOR INSPECTION, CHECKING AND AUDIT STOP

5. UNDER THE SOCIETIES REGISTRATION ACT, CTD'S ANNA+ ANNUAL YEAR WILL BE THE CLA+ CALENDER YEAR FOR WHICH ACCOUNTS WILL HAVE TO BE APPENDED TO THE ANNUAL REPORT STOP FOR PURPOSES OF TAX AUTHORITIES, THE ACCOUNTS WILL HAVE TO BE PREPARED ON AN ANNUAL BASIS FOR THE PERIOD APRIL-MARCH STOP IF SO DESIRED BY USAID, ACCOUNTS CAN ALSO BE PREPARED FOR THE PERIOD OCTOBER-SEPTEMBER STOP FOR PURPOSES OF THE GOVERNING BODY, THE AUDITING FIRM APPOINTED - SAY FORD, RHODES AND PARK AT BANGALORE, WILL PREPARE AUDIT REPORT OF ANNUAL ACCOUNTS FOR PRESENTATION TO THE MEMBERS OF THE SOCIETY STOP IT IS PROPOSED TO REQUEST ICICI AUI+ AUDITORS TO DO AUDIT FOR THE PERIOD APRIL-MARCH AND FOR PURPOSES OF USAID, IF NECESSARY ACCOUNT S CAN ALSO BE AUDITED FOR THE PERIOD -?+ SEPTEMBER STOP

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BANGALORE, WILL PREPARE AUDIT REPORT OF ANNUAL ACCOUNTS
FOR PRESENTATION TO THE MEMBERS OF THE SOCIETY STOP IT IS
PROPOSED TO REQUEST ICICI AUI+ AUDITORS TO DO AUDIT FOR THE
PERIOD APRIL-MARCH AND FOR PURPOSES OF USAID, IF NECESSARY
ACCOUNT S CAN ALSO BE AUDITED FOR THE PERIOD -Z+ SEPTEMBER STOP
IF THE GOVERNING BODU+ BODY SO DESRIR+ DESIRES, AND ESPECIALLY WHEN T
HE
TRANSACTIONS OF THE CTD INCREASE WITH FUNDS COMING FROM OTHER
DONORS ALSO, SUCH AS BRITISH AID, CACADIAN AID, ETC., THE
CTD WILL HAVE A SEPARATE PROGRAMME ASSISTANT WHO WILL BE A
QUALIFIED ACCOUNTANT, WHO CAN. WITH SUCH SUPPORTING STAFF
AS AMY BE NECESSARY, KEEP ACCOUNTS FOR THE CTD STOP

II. CONTRACT

USAID PROCEDURES MEANT FOR CONTRACTS WILL BE SCRUPULOUSLY
FOLLOWED STOP THE SECRETARY OF THE COMPANY WILL HEAD THE CELL
FOR CONTRACTS STOP THE STAFF OF THE CTD WILL ALSO BE TRAINED
FOR THIS PURPOSE STOPT+ STOP THE USAID AT DELHI WILL BE REQUESTED
TO CONDUCT A BRIEF TRAINING SESSION IN USAID PROCEDURES STOP
THE SECRETARY AS WELL AS THE PROGRAMME SISSTANT ALREADY
APPOINTED ARE EXPERIENCED GOVERNMENT SA+ STAFF STOP THEY ARE
WELL VES+ VERSED WITH THE GOVT. OF INDIA, GOVT. OF KARNATAKA
CONTRACTING PROCEDURES STOP THE EC+ TECYNICAL SPECIFICATIONS
FOR GOODS AND SERVICES REQUIRED FOR THE CTD PROGRAMMES
WILL BE DRAWN UP BY EXPERTS IN THE FOCUS GROUP WITH SUCH
NEE+ NECESSARY ASSISTANCE WHEREVER MAY BE REQUIRED FROM
KSIIDS/KSFC/GOVT. OF KARNATAKA STAFF IN A COMMITTEE SET
UP STOP THE PROPOSALS FOR THE CONTRACTING CELL WILL BE
FINALISED BEFORE THE END OF DECEMBER 1988 AND GOT APPROVED
BYLTHE GOVERNINGLBODY STOP THIS ATAFF WILL BE IN A POSITION
AND FULLY TRAINED BEFORE THE END PF MARCH ++ OF MARCH 18+ 1989 STOP

AS AND WHEN WORK GETS BUILT UP, THE CONTRACTING CELL
WORKING DIRECTLY UNDER THE SECRETARY OF THE CTD WILL BE
BEEFED UP TO MEET THE NECESSARY REQUIREMENTS STOP
NO WORK-LOAD I + IS ENVISAGED WHERE THE USAID AT DELHI AND
USAID AT WASHINGTON WILL HAVE TO SHOULDER CONTRACTING
WORK OF THE CTD STOP

III. MONOTORING AND DATA-BASED MANAGEMENT

THE ENTIRE DATA OF CTD WILL BE COMPUTERISED STOP FROM THE
PERIOD OCTOBER '88 TO END OF MARCH '89, THE FOCUS GROUPS
WILL PREPARE THE BASE-LINE STUDIES/AGAINST WHICH THE
IMPACT OF THE CTD PROGRAMMES CAN BE JUDGED, EHEREVER
+ WHERVER + WHEREVER NECESSARY F+ WITH THE HELP OF INIA+ INDIAN
CONSULTANTS STOP NECESSARY FORMS WILL BE GOT PREPARED ON THE
LINES OF DISCUSSIONSHELD WITH MD.L+ K. ANDERSON OF THE
WASHINGTON CION+ CONSULTING GROUP WHO VISITED BANGALORE IN JULY'88
Z+ STOP PROGRESS REPORTS OF ACTIT+ ACTIVITIES WILL BE MONOTORED

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WHEREVER NECESSARY F+ WITH THE HELP OF INIA+ INDIAN

CONSULTANTS STOP NECESSARY FORMS WILL BE GOT PREPARED ON THE

LINES OF DISCUSSIONSHELD WITH MD.L+ K. ANDERSON OF THE

WASHINGTON CION+ CONSULTING GROUP WHO VISITED BANGALORE IN JULY'88

Z+ STOP PROGRESS REPORTS OF ACTIT+ ACTIVITIES WILL BE MONOTORED

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MONOTORED BY THE DIRECTOR AND THE SECRETARY WITH THE COORDINATES+

COORDINATORS OF THE FC+ FOCUS GROUPS ONA MONTHLY BSIS STOP

QUARTERLY PROGRESS REPORTS WILL BE PUT UP TO THE BOARD OF

GOVERNORS STOP SINCE THE CHAIRMAN OF ICICI IS ON THE GOVERNING

BODY, ICICI WILL AUTOMTI+ AUTOMATICALLY GET THESE QUARTERLY

PROGRESS REPORTS DONE BY THE CTD WITH RESPECT TO THEIR PROJET+

PROJECTS STOP USAID AT NEW DELHI WILL ALSO BE SUPPLIED THE

MONOTORING DAY+ DATA ON A QUARETRLY + QUATERL+ QUARTERLY

BASIS, SHCE+ SCHEMEWISE STOP

PC NAYAK, DIRECTOR, CENTRE FOR TECHNOLOGY DEVELOPMENT,

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PROPOSAL APPROVAL/FUNDING PROCESS

AID PROJECT OFFICER

1. Administrative Review of proposals for

   - satisfaction of criteria
   - coordination with other AID programs
   - agreement with general AID policies
   - completion of a technical review if non-center proposal

2. Execute

   - send concurrence letter (PIL) to ICICI (copy to CTD)
   - if direct contract, initiate contracting documentation in coordination with RCO.

3. Monitor/Evaluate

   - monitor CTD Staffing capabilities, obtain assistance if necessary (e.g., contracting help)
   - site visits to review CTD activities, identify problems
   - oversee CTD monitoring system, obtain assistance if necessary (e.g., questionnaire design)
   - coordinate midterm and final evaluations
   - assist in preparation of Action Plan

GOVERNING BOARD

- Provides guidance to Secretariat on Action Plan
- Review and Approve Proposals presented by Secretariat

TECHNICAL CONSULTANT

- one technical consultant assigned to each Focus Group to perform technical review of proposals that have had no outside assistance in preparation.

  ex 1.) Equipment Purchase -- is desired purchase most appropriate?
  -- is method of procurement/financing/ servicing most efficient?

  ex 2.) Orientation Tour -- are appropriate people going?
  -- do they propose to visit best, most relevant sites?

- if review judges proposal unsatisfactory, sent back to Focus Group for revision

SECRETARIAT

1. Administrative Review

   - attention to AID criteria
   - coordination with strategic Action Plan

2. Execute

   - if host country contract, negotiate and enter into contract (copy AID and ICICI)
   - make payment
   - claim reimbursement from ICICI

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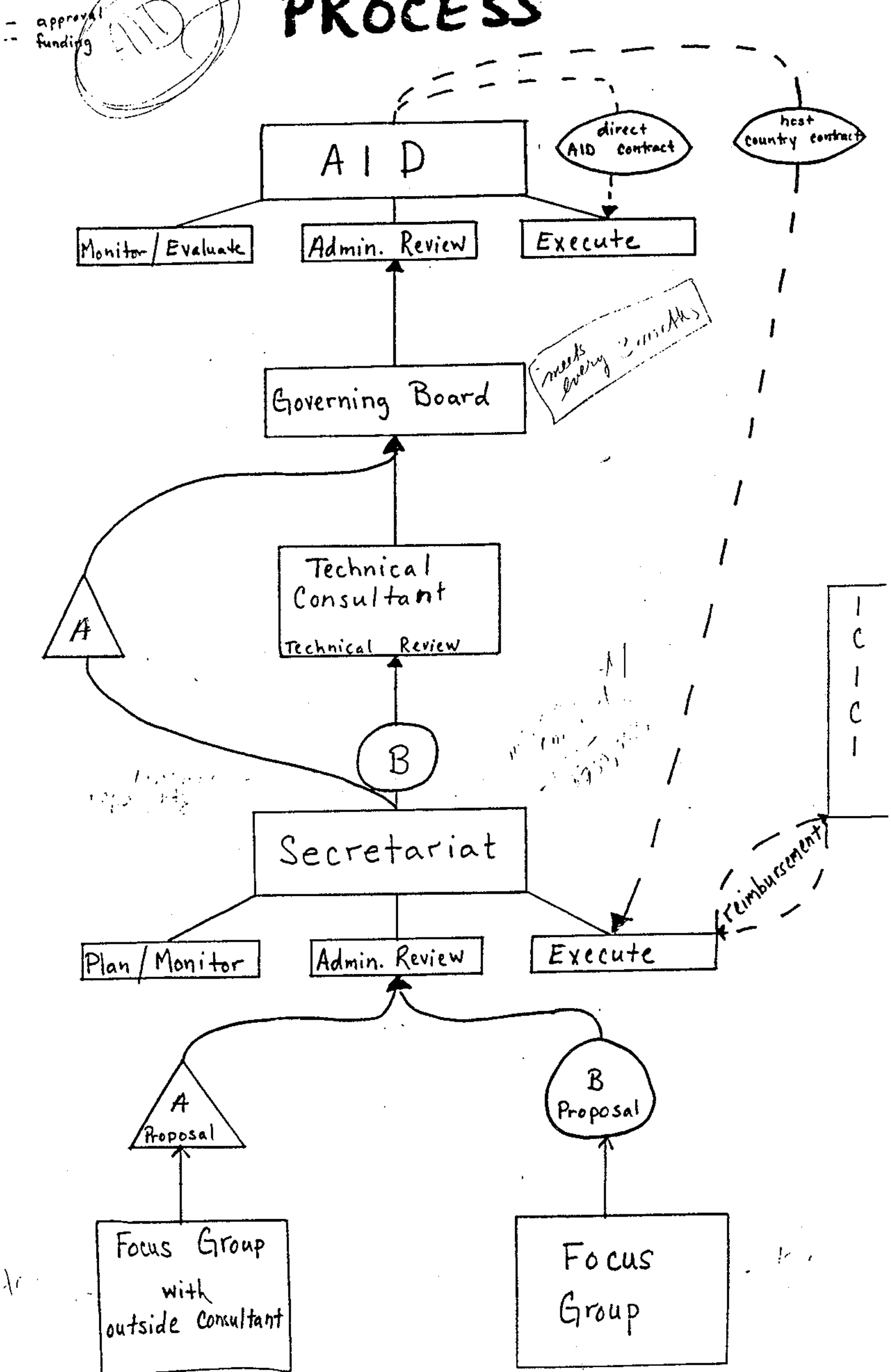
PROPOSAL APPROVAL/FUNDING PROCESS



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ANNEX "V"

UNITED STATES AGENCY for INTERNATIONAL DEVELOPMENT

NEW DELHI, INDIA

June 2, 1989

Shri Rajan Katoch
Deputy Secretary
Department of Economic Affairs
Ministry of Finance
North Block
New Delhi-110001

SUBJECT: Center for Technology Development (CTD) - (386-0507)

Dear Shri Katoch:

We had transmitted to you, vide our letter of February 15, 1989, the draft Project Agreement, concerning the subject project for your clearance. To facilitate project implementation soon after the aforesaid ProAg is signed between ICICI and AID, we have prepared the enclosed Project Implementation Letter (PIL) in draft for your review and concurrence before its final issuance.

We look forward to receiving your early "No Objection" to our signing the subject Project Agreement with ICICI. We would further appreciate receiving your comments/clearance of the draft PIL for its final issuance to commence project implementation soon after the signing of the Project Agreement.

Sincerely,

Kailash Chand Kapoor

K.C. Kapoor
Director (A)
Office of Projects

Encl : A/s

CC: Mr. N. Vaghul, Chairman & Managing Director, The Industrial Credit & Investment Corpn. of India, 163 Backbay Reclamation, Bombay - 400 020

D R A F T

May , 1989

Mr. N. Vaghul
Chairman
The Industrial Credit and Investment
Corporation of India
163, Backbay Reclamation
Bombay - 400 020

SUBJECT: Center for Technology Development (CTD), (386-0507)
Project Grant Agreement dated
Project Implementation Letter No. 1
Guidelines for Implementing the Project

Dear Mr. Vaghul:

This letter sets forth procedures for utilizing the proceeds of the subject Project Grant Agreement and provides information and guidance regarding certain provisions of the subject Project Grant Agreement dated ______________ between the Industrial Credit and Investment Corporation of India (ICICI) and the United States of America, acting through the Agency for International Development (A.I.D.). The Center for Technology Development (CTD), a non-profit society registered under the laws of the State of Karnataka, has been designated to implement this project. This letter and its attachments may be supplemented or modified by subsequent Project Implementation Letters (PILs).

I. The Project - Article 2

The Project, Center for Technology Development (CTD) is an experimental undertaking designed to develop and improve technology infrastructure resources that are essential for economic growth in India. The project purpose is to accelerate the pace and quality of technology development and its application to product and production process development to bring about commercial exploitation of technology in India. The project will, as described in Annex 1 of the subject Project Grant Agreement, strengthen the capacity of technical institutions by funding the

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technical assistance, training of human resources and the procurement of physical resources with the objective of improving the economic infrastructures ability to respond to market demand for technology development, under the overall direction of the CTD. The A.I.D. grant will support the growth and maturation of the CTD organization and specific initial activities of the CTD. The ICICI will disburse grant funds received under the A.I.D project to CTD for financing of approved sub-projects and related activities. It should be noted that A.I.D. grant funds shall not be used to finance any identifiable taxes/tariff imposed under any of the Central, State, city or municipal laws in effect in India.

The A.I.D. grant of $10 million, over a six-year period, will finance: an estimated $3.0 million of technical assistance; an estimated $2.5 million of human resource training; an estimated $3.8 million of commodity procurement; an estimated $0.4 million for other costs including development of publicity materials for technical information exchange; and an estimated $0.3 million for project monitoring, evaluation and audits of project activities by chartered accountants. The details of these activities are as follows:

1. Technical Assistance (TA): The Project provides for an estimated 75 person-months of U.S. and Third Country TA and 375 person-months of local TA. TA will cover the cost of long as well as short term U.S./Third Country consultants throughout the life of the project. In effect, in the early years, project funds will be used to provide technical assistance for preparation of "Mission and Scope Studies" to leverage other donors' contributions. For example, in the first year the CTD may use project funds to finance a Mission and Scope Study (MSS) that will result in a detailed implementation plan for an Informatic Applied Technology Center (IATC). The CTD can then present this MSS to foreign donors who have expressed an interest in funding such an IATC to develop software applications for the railways, banking, and telecommunication industries.

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2. Training: The project provides for 80 person-months of U.S. and third Country training and 425 person-months of local training. The long term and short term training will continue throughout the project's six year life. Training funds can also be used to finance the visits of foreign faculty members to provide in-country training and participate in workshops/seminars. The number of such workshops/seminars to be conducted in different focus areas will have to be determined collaboratively as events unfold over the life of the project. Training costs will include expenses incurred on honorarium, tuition, per diem, transportation, and training materials.

3. Commodities: Commodity procurement will consist of equipment for Applied Technology Centers, training programs, computer hardware and software. It will also cover cost of Procurement Services Contracts, and other associated costs, such as, clearing, warehousing, and transport.

4. Project Evaluation, Monitoring and Audit: Monitoring and evaluation of the CTD project will be achieved through a system of ongoing data collection and reporting designed to track project progress and results. Information on CTD activities will be collected by the industry-oriented "Focus Groups" comprising Food Processing, Dryland Agriculture, Industrial Machinery and Equipment, and Chemical Systems Suppliers/ Fabricators, and the like and recorded and summarized by the Secretariat of the CTD on quarterly basis. These "Focus Groups" are technical working groups made up of leaders from the local industry, academia, and financial institutions. The "Focus Groups" are expected to meet at least once a month throughout the life of the project.

Project evaluations will be conducted during the project's years three and six as stated in the amplified project description of the Project Agreement (Section V of Annex I) and further enumerated in item IV.A of this PIL. These evaluations will be implemented through contracts with appropriate institutions and/or through Personal Services Contracts. The evaluation team will consist of foreign and local consultants, representatives of A.I.D. and CTD. The total cost of such Project Evaluations is estimated at $300,000, of which $200,000 will be in foreign exchange, contracted directly by A.I.D. The remaining $100,000 in local currency includes funding for any required Non-Federal Audit of the CTD.

5. Other Costs: An important output of the project is Technical Information Exchange (TIE). Funding in this category will be available to obtain technical and commercial information from libraries, universities, and other organizations in the U.S. and exchange research findings/updates through satellite communication channels. The project envisages utilization of a satellite network on a time-sharing basis. Accordingly, this category of funding shall also include satellite time charges, royalties/fees payable to obtain copyrights and printing and distribution costs of these materials and development of publicity materials for TIE.

II. Financing - Article 3

The total cost of the project over its six year life is estimated at $17.450 million. This will be borne by A.I.D. to the extent of a grant of $10.0 million and the remaining $7.450 million by participating entities such as State Government(s), industry associations, and private industrial concerns. Various entities including the State Government will provide the equivalent of $450,000 to meet the cost of managing and administering the grant. Private Sector Organizations will make over the life of the project "in-kind" contribution of the equivalent of $7.0 million.

A.I.D. will provide the grant funds of $10.0 million under this project through incremental funding. A.I.D. has obligated through the initial agreeement dated ____________, 1989 $3.0 million to finance the foreign exchange and local currency cost of the project. This PIL earmarks/commits $1.380 million pertaining to local currency cost of the project. The foreign exchange cost of $1.620 million will be earmarked through issuance of separate implementation documents. An illustrative summary of project costs funded with $3.0 million obligated under the initial agreement is attached (Attachment 'A').

III. Conditions Precedent to Disbursement - Article 4

Conditions Precedent (CPs) as specified under sections 4.1 and 4.2 of the Project Grant Agreement dated ______, 1989 are self explanatory and do not require any further elaboration. To enable A.I.D. to make the first disbursement of grant funds, ICICI should furnish to A.I.D. through DEA the required documentation in form and substance satisfactory to A.I.D. Unless otherwise agreed by A.I.D. the CPs under section 4.1 must be satisfied by ________, 1989 and those under section 4.2 by ______, 1989.

IV. Special Covenants - Article 5

A. Evaluations - Section 5.1

It is agreed that an evaluation program, satisfactory to A.I.D. will be established and financed as part of the Project. This program will comprise of annual reviews of various activities under the Project, an in-depth Mid-Term Evaluation in the third year of the project, and a Final Evaluation at the end of the Project. The Evaluation Program will include:

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a) Annual reviews of progress towards attainment of Project objectives;

b) The identification and evaluation of problem areas of constraints which may inhibit such attainment;

c) Assessment of how such information may be used to help overcome such problems; and

d) Evaluation of the overall results of the Project as a positive influence on the development of Research and Development (R&D) in the Enterprise Sector.

The content, scope and terms of reference of the above project evaluation will be, except as CTD and A.I.D. may otherwise agree in writing, in accordance with the details given in the attached Monitoring and Evaluation Plan (Attachment E).

B. Duties and Import Licences - Section 5.2

It is agreed that CTD is responsible for financing all import duties and/or securing in a timely manner, the requisite exemptions from GOI concerning these import duties. CTD will obtain all import licenses and/or other GOI clearances required for the importation of any goods to be financed under the Project.

C. CTD Governing Board - Section 5.3

Presently, the CTD Governing Board has six members, representing the business, financial, academic and government communities. Out of these, three are drawn from the private sector and non-government organizations. CTD will either maintain or increase the exisitng level of representation of the private sector and/or non-government organizations on its Governing Board. It is agreed that an additional member representing the Department of Economic Affairs shall be appointed on the CTD Governing Board of six members thus raising the total number of Board Members from six to seven.

V. Procurement Source - Article 6

A. Foreign Exchange Costs - Section 6.1

Pursuant to this section the source and origin of U.S. dollar procurement of grant funded goods and services will be the United States and selected free world countries (codes 000 and 941 of the A.I.D. Geographic Code Book) as in effect at the time orders are placed or contracts entered into for such goods or services. Individual transactions the value of which do not exceed $5,000 are eligible provided that the source and origin is within code 935 of the A.I.D. Geographic Code Book. Attachment B provides the list of A.I.D.'s Geographic Codes.

B. Local Currency Costs - Section 6.2

Pursuant to this section, the source and origin of local currency grant funded goods and services shall be India.

C. Definitions

1. Source and Origin: With respect to equipment and materials, "source" is the country from which such equipment and material is shipped to India or India itself if the equipment and materials are located therein at the time of purchase. However, where the equipment and materials are shipped to India from a free port or bonded warehouse in the form in which received therein, "source" means the country or territory from which the equipment or materials were shipped to such free port or bonded warehouse. "Origin" is the country in which such equipment or material

is mined, grown or produced. A commodity is produced when through manufacturing, processing, or assembly, a commercially recognized new commodity results that is substantially different in basic characteristics, or in purpose, or utility from its components.

2. Goods and Services: Goods are considered as a produced commodity. Services are primarily identified with professional, technical and procurement and construction service contracts. Services are also commodity-related such as insurance, ocean freight and/or incidental services. Insurance means a policy of insurance including marine liability, or any performance or other bond eligible for financing. Incidental services could be for such items as equipment installation and personnel training in connection with equipment.

The application of "source" and "origin" criteria to the three types of commodity-related services is as follows. In the case of insurance, the "source" and "origin" is the country in which such insurance is placed. In the case of incidental services the "source" and "origin" is the country to which the personnel or firm providing the services belong. In the case of ocean freight the "source" and "origin" is the country of the flag registry of the vehicle.

3. Componentry: Rules on components assure that the benefit of the "origin" rule accrues to the producing country. "Components" are the goods that go directly into the production of a produced commodity. A.I.D. componentry rules for commodities produced in eligible source countries are as follows:

(i) If the commodity contains no imported component, it meets A.I.D.'s componentry requirements.

(ii) If the commodity contains components imported from countries included in Geographic Code 935 which are not included in the authorized geographic code for the procurement, the components are limited according to the following rules:

(a) They are limited only if they are acquired by the producer in the form in which they were imported.

(b) The total cost of such components to the producer of the commodity (delivered at the point of production of the commodity) may not exceed 50 percent of the lowest price (excluding the cost of occean transportation and marine insurance) at which the supplier makes the commodity available for export sale (whether or not financed by A.I.D.).

(c) A.I.D. may prescribe percentages other than 50 percent for specific commodities. The percentage of allowable foreign componentry may be decreased for a specific procurement by A.I.D. at the request of the cooperating country. Other changes in the percentage of allowable foreign componentry may be authorized by the Director of the Office of Procurement in certain circumstances or may be authorized as source/origin waivers.

(d) Components from the cooperating country may be used in unlimited amounts whenever any geographic code other than Code 000 is authorized.

(iii) Any component from a non-Free World country makes the commodity ineligible for A.I.D. financing.

4. Indigenous Goods: The definition of indigenous goods includes:

(a) Goods that have been mined, grown or produced in India through manufacture, processing, or assembly are eligible for financing.

(b) Goods produced with imported components, in order to qualify as indigenous, must result in a commercially recognized new commodity that is substantially different in basic characteristics or in purpose or utility from its components. Any imported component from a non-Free World country makes the indigenous commodity ineligible for A.I.D. financing.

5. Shelf Item Procurement: The definition of Shelf Items is as follows:

a. Goods which are normally imported into India and kept in stock in the form in which imported for commercial resale to meet a general demand in India shall be deemed to be of Indian source for purposes of financing under this Agreement, subject to the following:

(i) Shelf Items Imported from Code 941 Countries

Shelf items are eligible for financing under this Grant, if they have their origin in the United States or in a country included in Code 941. Attachment B describes Code 941 countries.

(ii) Shelf Items Imported from Other Free World Sources

Shelf Items having their source and origin in countries included in Geographic Code 899 (any area or country in the Free World, excluding the Cooperating Country itself) but not in Geographic Code 941, are eligible for financing if the price of one unit does not exceed $5,000. For goods sold by units of quantity, e.g, tons, barrels, etc., the unit to which the local currency equivalent of $5,000 is applied is that which is customarily used in quoting

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prices. The total amount of imported shelf item purchases from Free World Countries (Attachment B) other than Code 941 may not exceed ten percent of total local costs financed by A.I.D. for the project, or $25,000, whichever is higher. However, in no case may the total amount of such purchases from free world countries other than Code 941 exceed $250,000 without first obtaining a specific geographic source waiver.

(iii) Shelf Items Imported from Non-Free World Sources

a. Imported shelf items produced in or imported from countries not included in Geographic Code 899 are ineligible for A.I.D. financing.

b. Any imported component from a non-Free World country makes the imported shelf item ineligible for A.I.D. financing.

VI. Disbursements - Article 8

A. Disbursements for Foreign Exchange Costs

Foreign Exchange Costs are eligible under all the five components of the Project, i.e. 1) Technical Assistance, 2) Training, 3) Commodities, 4) Project Evaluation, Monitoring and Audits, and 5) Other Costs.

Three mechanisms, as described below, are available to defray the foreign exchange costs of goods and services procured from U.S.A. Of these, the first two are applicable to Host Country Contracts, and the third mechanism is applicable to direct A.I.D. Contracts.

Under the first mechanism, A.I.D. will issue a Letter of Commitment to a U.S. bank for the required amount showing ICICI/CTD as the beneficiary. Under the Letter of Commitment, ICICI/CTD will issue Letters of Credit for the required amount in favor of the U.S. suppliers. The initial Letter of Commitment will be for $1 million and will be replenished as necessary. After the goods are shipped (and/or the services performed) by a U.S. supplier, he can claim payment from the U.S. bank by submitting to the bank necessary documentation as described in the Letter of Commitment. The U.S. bank will claim reimbursements for these payments from A.I.D. and A.I.D. will charge such payments to the Project.

Under the second mechanism, A.I.D. may issue direct Letters of Commitment to U.S. suppliers of goods and services. The payments will be made by A.I.D. directly to the suppliers of goods and services on receipt of invoices and supporting documents.

Under the third mechanism, when it is not possible to open a Letter of Commitment/Letter of Credit to procure the requested services or goods, A.I.D. will contract directly for these services or goods. For example, A.I.D. may be requested to acquire the services of a U.S. Government laboratory and A.I.D. may do so by entering into a Participating Agency Services Agreement (PASA). Payments under the PASA will be made directly by A.I.D. and charged to the subject Project.

Regarding all other eligible foreign exchange costs, ICICI will submit to A.I.D./New Delhi Voucher SF-1034 in original and three copies (Attachment C) accompanied by a summary statement (Attachment D Annexes) showing the details of the payments to be made by A.I.D. directly to the concerned persons/institutions. This voucher should be supported by supplier's invoices and related documents duly certified by an authorized official of ICICI and may be submitted quarterly or as often as necessary. Attachment C is a sample SF-1034, and Annex 1 and 2 to Attachment D are sample statements showing details of payments to be made by A.I.D. The first voucher should be numbered AID-FX-1, and subsequent voucher AID-FX-2 and so on.

B. Disbursement for Local Currency Costs

Local currency costs can be disbursed under all the five components of the Project. Local currency costs cover payments through CTD to Indian suppliers for equipment/services and costs related to technical assistance, seminars/workshops, training, monitoring and evaluation, Non-Federal Audits and costs related with TIE.

1. Initial Payment: Based on the request from CTD, ICICI will make a request to A.I.D./New Delhi for an advance of funds to meet its requirement for a 90-day period in carrying out the project activities. This request for advance will be made on SF-1034 in original and three copies supported by a Summary Statement indicating funds required for each of the five components under the subject Project. A.I.D. will accordingly disburse the amount to ICICI in accordance with the standard procedures and ICICI will pass on the amount to CTD. ICICI will ensure that A.I.D. funds will not be comingled with other ICICI/CTD owned or controlled funds or any other funds. CTD will deposit all A.I.D. advances in a separate bank account and shall make all disbursements for eligible project costs from this account. Any interest earned on advances must be returned to A.I.D.

2. All Subsequent Payments:

(a) Based on the information provided by CTD, ICICI will prepare a Quarterly Payment Status Report (Attachment D) showing actual expenditure for the current quarter (expenditure incurred for each of the five cost component) and an estimate of expenditures for the next quarter. The actual expenditures of current quarter plus an estimate of expenditure for the next quarter less the previous advance will be the amount to be claimed by ICICI as a new advance. ICICI will submit to A.I.D./New Delhi, SF-1034 (original and three copies) alongwith the above Quarterly Payment Status Report, and certified by an authorized official of the ICICI. Attachment D is a sample of the Quarterly Payment Status Report. ICICI will also show on SF-1034 requesting a new advance and the amount of expenditure to be adjusted against the previous advances.

(b) A.I.D./New Delhi will disburse the amount to ICICI in accordance with its standard procedure and ICICI will pass on the amount to CTD.

(c) Any interest earned by ICICI on funds advanced by A.I.D. will be refunded to A.I.D. promptly.

VII. Procurement and Contracting Procedures

It is anticipated that most of the procurement required under the project will be accomplished by ICICI/CTD. Host Country Contracting, as defined in A.I.D. Handbook 11, copies of which have been given to ICICI will be utilized for such procurements when sources outside of India are considered. When only Indian sources are considered, Local Cost Financing procedures will be followed. When specifically requested by ICICI, a limited amount of U.S. and other foreign technical assistance, training and commodities will be contracted by A.I.D. on behalf of ICICI.

Handbook 11 which sets forth all requirements for Host Country Contracting is divided into three sections covering:

- Professional and technical services
- Commodities, and
- Construction services.

procurement practice and accepts the most advantageous offer, price and other pertinent factors considered such as quality of the goods and services, delivery time, transportation costs, payment terms, availability of spare parts, installation and repair services. For procurement through formal competitive bidding, the lowest responsive and responsible bid normally will be accepted as meaning the lowest available price. When competitive offers are not available, as in the case of sole source procurements, some form of cost or price analysis should be used to establish the reasonableness of price.

Direct A.I.D. contracting will be accomplished at the request of ICICI/CTD by the USAID Regional Contracting Officer or by A.I.D./Washigton contracting officers. The Regional Contracting Officer will be pleased to explain the requirements of A.I.D. direct contracting.

VIII. Terminal date for Request for Disbursement - Article 3, Section 3.3

Final date for receipt of request for claiming disbursement is ________________ (i.e. nine months after the Project Assistance Completion Date________________).

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In addition to A.I.D. requirements, Handbook 11 sets forth a great deal of guidance that is useful but not mandatory. Sample RFPs, IFBs and Contract Formats are included as are many optional clauses that can serve to protect the interest of ICICI/CTD. Among the specific requirements are the following:

1. Competition: specific requirements for competition are set forth in each chapter. Specific circumstances are also defined under which less competition may be authorized by A.I.D.

2. Advertising: all contracts for services exceeding $100,000 (except those directly with individuals) must be advertised in the Commerce Business Daily. In addition, all commodity procurements exceeding $25,000 must be advertised in the appropriate A.I.D. bulletin.

3. A.I.D. approvals: A.I.D. must formally approve all solicitations and contracts exceeding $100,000 or its equivalent in local currency.

4. Contract clauses: the mandatory clauses listed therein must be included in all Host Country contracts.

The procedures for Local Cost Financing are the same as those for Host Country Contracting except:

- they do not require advertising, and

- they are subject to less stringent competition requirements. The only requirement for competition is that the buyer shall pay no more than the lowest available price, including transportation. This will be satisfied if the buyer has followed sound

IX. General Covenants - Annex 2

A. Utilization of Goods and Services - Article B, Section B.3

Goods and services under the project may not be used to promote or assist a foreign aid project or activity associated with or financed by a country not included in Code 935 of the A.I.D. Geographic Code Book. Code 935, as in effect on the date of this Project Implementation Letter, includes all countries in the Free World, including the Cooperating Country itself (Please see Attachement B).

B. Taxation - Article B, Section B.4

Any identifiable taxes, tariffs, or duties charged by the Cooperating Country on any locally procured commodities (equipment, materials, or other goods) or services or on such commodities and services that are imported into India and financed by A.I.D. are for the account of the Cooperating Country and are not eligible for financing under the Grant Agreement.

C. Reports, Records, Inspection, Audit - Article B, Section B.5

Section B.5 of the Project Grant Agreement reserves for A.I.D. the right to monitor project activities (including subprojects) at any reasonable time, to visit sites where project activities (including subprojects) have been or will be underway and to engage in inspection of project (including subprojects) books, records and activities. These rights are crucially important to the effective conduct of A.I.D. financed projects and to the exercise of mandatory responsibilities imposed on all A.I.D. Missions abroad by U.S. statute and by world wide A.I.D. regulations. It is imperative, therefore, that ICICI facilitate all reasonably requested arrangements pursuant to the exercise of these responsibilities.

The type of reports required and the frequency at which these are required will be as mutually agreed between A.I.D. and ICICI/CTD.

D. Information and Marking - Article B, Section B.8

ICICI will provide appropriate publicity to the project and the United States contribution thereto. A.I.D. emblems should be displayed on all items financed under the project. Sample emblems will be provided to ICICI so that ICICI can get an adequate quantity of these printed and distributed to subproject participants.

E. Commodities which are not authorized for financing under the Grant - Article C, Procurement Provisions

The following commodities are not authorized for financing under the Grant:

1. Commodities for which Prior A.I.D. Approval Required

(a) Certain Agricultural Commodities - wheat, rice, corn, soyabeans, sorghums, flour, meal, beans, peas, tobacco, hides and skins, cotton, vegetable oils, and animal oils and fats;

(b) Motor Vehicles--defined as self-propelled vehicles with passenger carriage capacity such as highway trucks, passenger cars and buses, motorcycles, scooters, motorized cycles and utility vehicles;

(c) Pharmaceuticals;

(d) Pesticides;

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(e) Rubber Compounding Chemicals and Plasticizers;

(f) Used Equipment;

(g) U.S. Excess Property; and

(h) Fertilizer.

2. Ineligible Commodities

(a) Military Equipment;

(b) Surveillance Equipment;

(c) Commodities and Services for Support of Police and Other Law Enforcement Activities;

(d) Abortion Equipment and Services;

(e) Luxury Goods and Gambling Equipment; and

(f) Weather Modification Equipment.

F. Transportation by Air of Property and Persons - Article C Section C.1(d)

The Grant funds will be available to defray the cost of transportation of property and persons by air only when the air carriers holding United States Certification are used. For international travel, the transportation costs will be reimbursed under the Grant only for economy class on a U.S. flag air carrier. However, in the event a non-U.S. flag carrier is selected, the Grantee will provide a certificate which is essentially as follows:

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"Certification of Unavailability of U.S. Flag Air Carriers

I hereby certify that transportation service for personnel or property by certified U.S. air carrier was unavailable for the following reasons:................."

It may be noted that passenger service by a certified air carrier will be considered to be "unavailable" when:

(a) certified air carriers offer only first class service, and less than first class service is available from non-certified air carriers, or

(b) the traveller, while en route has to wait 6 hours or more to transfer to a certified air carrier to proceed to the intended destination, or

(c) any flight by a certified air carrier is interrupted by a stop anticipated to be 6 hours or more for refuelling, reloading, repairs, etc., and no other flight by a certified air carrier is available during the 6 hour period, or

(d) by itself or in combination with other certified or non-certified air carriers (if certified air carriers are "unavailable") it takes 12 or more hours longer from the original airport to the destination airport to accomplish the Agency's Mission then would service by a non-certified air carrier or carriers, or

(e) the elapsed travel time on a scheduled flight from original airport to destination airport by certified air carrier(s) would involve twice as much the scheduled travel time.

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G. Eligibility Date - Article C, Section C.2

No goods or services may be financed pursuant to orders or contracts firmly placed or entered into prior to ___________.

We look forward to working with you and to assist in every way we can to assure a successful program.

Sincerely yours,

G.C. Thompson
Director
Office of Projects

Attachments:

1. Attachment A: Illustrative Summary of Project Buoget (Initial Agreement)
2. Attachment B: A.I.D.'s Geographic Codes
3. Attachment C: Standard Form 1034
4. Attachment D: Quarterly Payment Status Report
5. Annex 1 to Attachment D: Statement snowing Details of Disbursements
6. Annex 2 to Attacnment D: Statement snowing Projected Disbursements
7. Attachment E: Monitoring and Evaluation Plan

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Attachment 'A'

ILLUSTRATIVE SUMMARY OF PROJECT BUDGET
(Initial Agreement Funding)

($000)*

Component	A.I.D. FX	A.I.D. LC	Total	Coop.Country Contribution ICICI LC	State Govt. LC	PSIA** LC	Total	Project Grand Total
Technical Assistance	450	450	900	0	0	0	0	900[1]
Training	240	510	750	0	0	0	0	750
Commodities	780	360	1,140	0	0	0	0	1,140
Project Evaluation, Monitoring & Audit	60	30	90	0	0	0	0	90
Other Costs	90	30	120	0	0	0	0	120
CTD Mgt. & Adm.	0	0	0	0	68	1,067#	1,135	1,135
TOTAL	1,620	1,380	3,000	0	68	1,067	1,135	4,135

NOTE:

- The (*) indicates that the rate of exchange used in developing these estimates was $1.00 = Rs.14.00
- LC represents the Local Currency Costs of the project.
- FX represents the Foreign Currency Costs of the project.

** Private Sector Industry Associations

Out of this the equivalent of $1,000,000 is estimated as "in-kind" contributions

1. Includes $150,000 for initiating activities to develop other centers and/or subcenters of excellence in India.

Attachment 'B'

A.I.D.'S GEOGRAPHIC CODES

000 UNITED STATES

941 SELECTED FREE WORLD

Any independent country in the Free World a/ except the cooperating country itself and the following:

Europe

Andorra
Austria
Belgium
Denmark
Finland
France
Federal Republic of Germany (Including West Berlin)
Ireland
Italy
Iceland
Liechtenstein
Luxembourg
Malta
Monaco
Netherlands
Norway
Portugal
San Marino
Spain
Sweden
Switzerland
United Kingdom
Vatican City
Yugoslavia

Other

Angola
Australia
Bahamas
Bahrain
Canada
China, Republic of (Taiwan)
Cyprus
Gabon
Greece
Hong Kong
Iraq
Japan
Kuwait
Mozambique
New Zealand
Qatar
Saudi Arabia
Singapore
South Africa
United Arab Emirates

899 FREE WORLD

Any area or country in the Free World a/ excluding the participating country itself, when used as a possible source of purchases.

935 SPECIAL FREE WORLD

Any area or country in the Free World a/ including the participating country itself.

a/ Free World excludes the following areas or countries:

Afghanistan, Albania, Bulgaria, Cambodia, Cuba, Czechoslovakia, Estonia, German Democratic Republic, Hungary, Iran, Laos, Latvia, Libya, Lithuania, Mongolia, North Korea, People's Democratic Republic of Yemen (South Yemen or Aden), People's Republic of China, Poland, Romania, Syria, Union of Soviet Socialist Republics, Vietnam.

Attachment 'C'

Standard Form 1034 Revised January 1980 Department of the Treasury 1 TFM 4-2000 1034-119	**PUBLIC VOUCHER FOR PURCHASES AND SERVICES OTHER THAN PERSONAL**	VOUCHER NO

U.S. DEPARTMENT, BUREAU, OR ESTABLISHMENT AND LOCATION		SCHEDULE NO
The Mission Director U.S. Agency for International Development American Embassy Chanakyapuri New Delhi	DATE VOUCHER PREPARED CONTRACT NUMBER AND DATE REQUISITION NUMBER AND DATE	PAID BY
PAYEE'S NAME AND ADDRESS: ICICI		DATE INVOICE RECEIVED DISCOUNT TERMS PAYEE'S ACCOUNT NUMBER
SHIPPED FROM / TO / WEIGHT		GOVERNMENT B/L NUMBER

NUMBER AND DATE OF ORDER	DATE OF DELIVERY OR SERVICE	ARTICLES OR SERVICES (Enter description, item number of contract or Federal supply schedule, and other information deemed necessary)	QUANTITY	UNIT PRICE COST	UNIT PRICE PER	AMOUNT
AID Project No. 386-0507 Project Agreement dated ______		Request for payments to various persons listed in Annex 1, pursuant to Section 8.1 or 8.2 of the Center for Technology Development Project Agreement dated ____________. I certify that the payment claimed herein is just and correct and that payment thereof has not been received. Signature Date Title				
(Use continuation sheet(s) if necessary)		(Payee must NOT use the space below)		TOTAL		

PAYMENT	APPROVED FOR	EXCHANGE RATE	DIFFERENCES
☐ PROVISIONAL ☐ COMPLETE ☐ PARTIAL ☐ FINAL ☐ PROGRESS ☐ ADVANCE	= $ BY ² TITLE	= $1.00	Amount verified: correct for (Signature or initials)

Pursuant to authority vested in me, I certify that this voucher is correct and proper for payment

(Date) (Authorized Certifying Officer)² (Title)

ACCOUNTING CLASSIFICATION

PAID BY			
CHECK NUMBER	ON ACCOUNT OF U.S. TREASURY	CHECK NUMBER	ON (Name of bank)
CASH $	DATE	PAYEE ³	

¹ When stated in foreign currency, insert name of currency.
² If the ability to certify and authority to approve are combined in one person, one signature only is necessary; otherwise the approving officer will sign in the space provided, over his official title.
³ When a voucher is receipted in the name of a company or corporation, the name of the person writing the company or corporate name, as well as the capacity in which he signs, must appear. For example: "John Doe Company, per John Smith, Secretary", or "Treasurer", as the case may be.

PER

TITLE

Attachment 'D'

QUARTERLY PAYMENT STATUS REPORT

A. Period covered by this report:
From (Month, day, year)________
To (Month, day, year)________

Period covered by the next report:
From (Month, day, year)________
To (Month, day, year)________

B. Advance Payment Use and Needs

1. Advance on hand at the beginning of this report — Rs. ________________

2. Advance(s) received during this this reporting period — Rs. ________________

3. Interest earned on advance during this reporting period — Rs. ________________

4. GROSS advance available during this reporting period (lines 1,2, & 3) — Rs. ________________

5. LESS interest remitted to A.I.D. during this reporting period — Rs. ________________

6. NET advance available during this reporting period (line 4 minus line 5) — Rs. ________________

7. Total disbursements during this reporting period (Statement showing details of these disbursements by cost categories under the five project elements is attached Annex 1) — Rs. ________________

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8. Amount of advances available at the end this reporting period (line 6 minus line 7) Rs. ______________

9. Projected disbursements for the next reporting period (Statement showing projected Disbursement by Cost Categories under the five project elements is attached Annex 2) Rs. ______________

10. Additional advance requested for the reporting period (line 9 minus line 8) Rs. ______________

11. Total interest on advances from the start of the Grant to end of this reporting period, but not remitted to A.I.D. Rs. ______________

12. Total disbursements to subgrantees, as of the end of this reporting period Rs. ______________

C. Certification

The undersigned hereby certifies: (1) that the report in para B.9 above represents the best estimates of funds needed for the disbursements to be incurred over the period described, (2) that appropriate refund or credit to the grant will be made in the event of disallowance in accordance with the terms of the Grant, (3) that appropriate refund or credit to the Grant will be made in the event funds are not expended, and that any interest accrued on the funds made available herein will be refunded to A.I.D.

By______________________

Title______________________

Date______________________

WK

Annex 1 to Attachment 'D'

Statement showing Details of Disbursements for the Quarter Ended ______

(Item No. 7 of Quarterly Payment Status Report)

A. Technical Assistance

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to prev. Quarter	Amount paid under this report Quarter
Sub-total:					

B. Training

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to prev. Quarter	Amount paid under this report Quarter
Sub-total:					

C. Commodities

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to prev. Quarter	Amount paid under this report Quarter
Sub-total:					

D. Monitoring and Evaluation

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to prev. Quarter	Amount paid under this report Quarter
Sub-total:					

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E. Other Costs

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to prev. Quarter	Amount paid under this report Quarter
Sub-total:					
Total:					

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Annex 2 to Attachment 'D'

Statement showing Projected Disbursements for the Quarter Ending ______
(Item No. 9 of Quarterly Payment Status Report)

A. Technical Assistance

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to Quarter ended	Exp. projected for the next Quarter ending
Sub-total:					

B. Training

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to Quarter ended	Exp. projected for the next Quarter ending
Sub-total:					

C. Commodities

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to Quarter ended	Exp. projected for the next Quarter ending
Sub-total:					

ors

D. Monitoring and Evaluation

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to Quarter ended	Exp. projected for the next Quarter ending
Sub-total:					

E. Other Costs

Activity/ Subproject	Description	Name of Supplier/ Consultant	Total Est. Budget	Amount already paid up to Quarter ended	Exp. projected for the next Quarter ending
Sub-total:					
Total:					

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Attachment 'E'

CENTER FOR TECHNOLOGY DEVELOPMENT PROJECT

MONITORING AND EVALUATION PLAN

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PURPOSE OF THE MONITORING AND EVALUATION PLAN

The monitoring and evaluation plan for USAID/India's Center for Technology Development Project has three principal purposes: (1) to outline a plan for supplying A.I.D. and CTD managers with the information regarding project inputs, outputs, and progress toward achievement of the project purpose and goal which they need for decisionmaking; (2) to describe the data collection necessary to permit assessment of the project's effectiveness, impact, efficiency and sustainability in future evaluations; and (3) to provide a vehicle for capturing lessons learned in the project which will aid in efforts to replicate its activities elsewhere in India.

This paper outlines the key questions and issues which should be monitored during project implementation and serve as a basis for interim and final evaluations. It then suggests a methodology for collecting the data necessary to address those questions.

KEY MANAGEMENT QUESTIONS

The CTD's monitoring and evaluation system should provide for a steady flow of information to CTD and A.I.D managers regarding the status of project implementation. These information flows should be designed to answer managers' probable questions relating to levels of project inputs, outputs, purpose and goal. Summarized below is a preliminary set of questions which may be used as a basis for data collection, along with a few key indicators corresponding to each project level.

The goal of the CTD project is to accelerate the pace and quality of technology innovation for products and production processes in industries important for economic development in India. Thus, at the goal level, monitoring and evaluation will seek to provide information to answer the following questions: Has the rate of commercialization of new products by businesses in target sectors increased? Has the application of state-of-the-art technical tools by these businesses expanded? Key indicators to address goal-related questions will be the numbers of products commercialized and sold by beneficiary businesses, and the number of firms assisted by the CTD which have succeeded in commercializing products.

The purpose of the project is to develop and improve the technology resources needed for economic growth in India, taking Bangalore as an initial model. To determine the project's progress in achieving its purpose, the monitoring system should provide information to answer questions such as the following: Has the CTD established itself as an operationally effective agency for identifying and supplying components missing from the technology infrastructure? Has CTD assistance provided industry, including small- and medium-scale enterprises, increased access to needed technology? Has the assistance contributed to businesses' ability to produce and commercialize new products? Has the training provided through CTD programs increased the trainees' capacity to contribute to the application of technology in their businesses and industries? How many joint ventures and start-up firms have been established with assistance from the CTD's brokering activities? Has the CTD succeeded in increasing productive interaction among industry, academic institutions and government regarding technology development and application? Key indicators to measure in addressing purpose-level questions will include the numbers of joint ventures and start-up firms established with CTD assistance; the number of contacts established among key groups (committees, meetings, etc.); the number of facilities available to assist businesses in their production processes; the number of industry-oriented courses available in target fields; the numbers of businesses and individuals reporting benefits from CTD assistance; and the percentage of CTD activity costs paid by industry.

Project outputs will include a range of activities intended to enhance industry's access to technology: establishment of applied technology centers; training programs; assistance in production testing, scale-up and market analysis; curriculum development; and other activities. A.I.D. will provide technical assistance to the project, through inputs to include funding for consultancies, training, and equipment. Questions regarding project inputs and outputs will include the following: Are applied technology centers being established in the time frames anticipated? Are industry-oriented training programs and curriculum development activities being established? Is equipment needed for technology application being procured? How many individuals are being trained? How many individuals have participated in study tours? How many businesses are being assisted, and through what types of activities? What are project expenditures for A.I.D.-supplied inputs, and how do they compare to planned expenditures? Key indicators will include the numbers of businesses and individuals assisted, the number of courses and curriculum development activities established, and records of procurement and usage of equipment.

During the project's initial stages, managers should be provided feedback documenting the progress of the CTD's start-up process and identifying any problem areas which arise. Questions to be answered will include the following: Are proposals for activities being submitted to the CTD according to expected time frames? Is the quality of these proposals proving sufficient for their acceptance? In cases where technical assistance is provided for proposal preparation, has that assistance proven adequate? Key indicators will include the numbers of focus group meetings, numbers of proposals reviewed and accepted, and percentage of favorable reports from focus groups regarding technical assistance.

Monitoring and evaluation should also provide information regarding project impacts on significant socioeconomic indicators, although these are not specified as explicit project objectives. Related questions may include the following: How have CTD activities impacted on employment in participating businesses, including employment of women? How have project activities contributed to agricultural production through research applications in areas such as dry-land farming? Has the project contributed to decreasing food wastage and to labor-saving for women as a result of the application of food processing technologies?

DATA COLLECTION PLAN

Oversight of the CTD's monitoring system within A.I.D. will be the responsibility of the designated CTD project officer in the Office of Technology Development and Enterprise. Within the CTD, the Secretariat will be responsible for coordinating data collection and reporting through the focus groups, and transmitting the products of these efforts to A.I.D. The focus groups will act as channels for data from the individual activities carried out under their sponsorship, delegating responsibility for provision of data to managers of each activity as appropriate. The A.I.D. project officer will work with the CTD Secretariat and focus group representatives to develop the monitoring system and its component mechanisms, and to adapt them as necessary to fit changing activities and information needs during the life of the project. The A.I.D. project officer will perform periodic site visits to review and identify any problem areas in the data collection process. It is also recommended that the project officer periodically verify project achievements and reassess needs of target industries through informal surveys of beneficiary businesses.

The data collection plan for the project is outlined below.

Baseline Survey

As noted in the project implementation plan, proposals submitted to the CTD will include analyses of the existing sources of supply of the services to be provided. These surveys can be supplemented and corroborated by independent assessments commissioned from local research institutions. Activity-specific baselines can then be established to cover the key conditions which each CTD initiative is intended to affect.

Before attempting to establish a project-wide baseline, A.I.D. and CTD project managers should consider a number of factors. The potential costs, in time and resources required for gathering baseline data, should be weighed against the estimated benefits of providing a resource for measuring project impacts. A crucial factor to be considered is the degree to which a causal relationship can be reasonably traced between CTD activities and changes in the conditions to be measured.

One possible set of project-wide baselines could be created through measurement of selected data regarding status of target industries in Karnataka: (1) the number of foreign collaborations (joint ventures) approved in target fields, such as food processing and informatics; (2) the number of industrial licenses issued for products and processes in target fields; (3) product sales levels in target fields. Statistics for product and process sales may not be available at the degree of specificity required to relate them to CTD activities. In that case, the baseline survey will need to identify and investigate sources of raw data. Such an effort may be considerably time-consuming, and the feasibility of drawing causal relationships between CTD activities and changes in the data will be limited. Another methodology would involve survey of randomly selected businesses in the target sectors, to be followed up with repeat interviews during the project's interim and final evaluations. This sample would serve as a control group against which the performance of A.I.D.-assisted businesses might be compared. An important caveat to consider is that government policy changes constitute the principal determinant of change in numbers of foreign collaborations and industrial licenses. This increases the difficulty of isolating and attributing impacts to CTD assistance.

An alternative set of indicators can be studied for a baseline survey which may entail less expenditure of time and effort. These indicators are listed below, with principal data sources suggested for each indicator. Project managers will wish to define the data to be sought in greater detail.

Indicator	Suggested Data Source
Number of industry-related courses offered in target fields	Survey of polytechnic/institute/university syllabi; interviews with staff and faculty
Number of existing facilities for assistance with production testing, scale-up, market testing	Interviews with industry associations
Number of existing mechanisms (meetings, committees, etc.) for interaction among industry, scientific organizations, and government to coordinate technology development	Interviews with representatives of key agencies in industry, academia, and government

Follow-up data collection incorporated in interim and final project evaluations, including interviews with key informants, should seek to identify and describe the role of project activities in effecting changes in these conditions.

Reporting Plan

The CTD Secretariat will coordinate a system of ongoing reporting using data provided by each focus group. The focus group will report on its own activities, and summarize activities of each project carried out under its sponsorship. The Secretariat will submit reports to A.I.D. on a quarterly basis, according to a schedule and format to be agreed upon between the CTD and A.I.D. at project inception. These reports should contain concise and timely records of the status of project achievements in terms of the key indicators, which may include the following:

-- number of focus group meetings
-- number of proposals reviewed/accepted
-- number of businesses assisted (break down by activity: number assisted in product testing, market analysis, etc.)
-- number of individuals trained (disaggregate by gender)
-- number of study tour participants (disaggregate by gender)
-- number of person/days of consultant services provided
-- number of courses offered
-- number of curriculum development activities
-- numbers of conferences, seminars, and other activities to promote industry/academia/government interaction
-- number of joint ventures/start-up firms formed
-- number of new products commercialized with CTD assistance
-- record of equipment procured
-- record of equipment usage
-- summary of post-activity questionnaire responses
-- expenditures for each activity (budget and actual)
-- total expenditures in quarter (budget and actual)
-- cumulative disbursements
-- percentage of activity costs paid by industry

In addition to quarterly reporting of disbursement levels, the CTD Secretariat has planned to employ independent auditing and accounting concerns to oversee and report on the Center's accounts. Data submitted quarterly on costs of each project activity may be measured against outputs to provide a basis for assessing cost-effectiveness and efficiency, including comparisons across project activities. Quarterly reports will also contain a brief narrative describing planned activities, any problem areas which have arisen, and follow-up on corrective action taken regarding previously reported problem areas. Changes in membership of focus groups, the CTD Secretariat and Governing Board should also be noted.

It is suggested that the CTD produce a descriptive annual report suitable for wide distribution after its activities have reached the implementation stage. As well as serving as a feedback mechanism for the various donor agencies, such a report would assist in disseminating "lessons learned" for use in replication of the CTD's activities.

Beneficiary Databases

The CTD will establish standardized databases to provide a record of businesses and individuals assisted through its programs. These databases will be supplied with information collected by the managers of each activity prior to or at the outset of assistance. The databases will serve as a basis for measuring project impacts over time, and have the potential to serve additional purposes for the CTD and for industries participating in the project. For example, they can eventually be used as a means of identifying individuals trained in specific fields, or businesses capable of supplying a specific component. The databases will contain a set of a few key data on each individual and business assisted, which may include the following:

For individuals: name; address; gender; place of employment; position; salary, if possible; type and duration of training or other assistance provided; cost of assistance to individual or employer.

For businesses: name; location; type of business; types of products produced; production levels; some measure of income (sales, net income/profit, value added); number of employees, disaggregated by gender; nature and source of assistance; cost of assistance to business.

Post-Activity Questionnaires

Where feasible, managers of CTD programs and activities should administer brief questionnaires to individuals and businesses assisted, following completion of the training program or other activity. This feedback will assist the CTD in modifying its programs in response to participant reactions and needs. Questionnaires may include the following types of questions:

-- How would you assess the quality of the course or technical assistance (excellent, good, fair, or poor)?
-- Did the course/assistance meet your needs and expectations?
-- How will the training/assistance received help you in your work/business? What changes do you expect?
-- (For trainee) Was the material presented new to you, or did it repeat something you already knew?

-- (For business) Is the assistance you received through the CTD available to you from any other sources? If so, what are they? How would you compare the quality and cost of alternate sources' assistance to that of CTD services?
-- Do you have any suggestions for improvement of the course or assistance?

For cases in which technical assistance is provided to the CTD itself or to one of the focus groups, the individuals assisted should complete a similar questionnaire.

Responses to these questionnaires should be summarized in the CTD's quarterly reports, e.g., 70% of trainees rated the course as good to excellent, etc.

Evaluations

Independent evaluations of the CTD's operations and individual project activities will be scheduled at two interim points during the project, and following its completion. Timing of the first evaluation will depend upon the progress of project implementation, but it should be conducted approximately two years after the project's inception. The second interim evaluation should take place between the third and fourth years of the project. A final evaluation will be performed following project completion. To the extent feasible, these evaluations will be collaborative, involving participation by the CTD's management, members of focus groups, and managers of representative project activities, along with A.I.D. representatives and consultants.

Evaluations will seek to answer the key questions regarding the project's achievement of its goal and purpose, and its effectiveness in delivery of inputs and outputs. Information drawn from the administrative records outlined above will provide the basic empirical foundation for these assessments. Project databases can be used to identify a sample of beneficiaries for case study. The sample should provide representative selection from the full range of CTD activities, including: (1) different categories of activities, e.g., training programs and centers for applied technology; (2) activities employing various technological "tools", such as biotechnology and informatics; and (3) key industries signalled for CTD activity, such as food processing and computer hardware and software. The sample should also be selected to illustrate impacts on small- and medium-scale industry and on women.

Providing answers to goal- and purpose- level questions should constitute a special focus of these evaluations. For example, assessment of training programs should examine the effectiveness of the training provided in increasing trainees' capacity to contribute to application of technology in their businesses. This assessment will utilize interviews with trainees' employers as well as the trainees themselves, and examine responses to post-training questionnaires. Evaluation of assistance to businesses (e.g., through applied technology centers) will use information provided by project databases, with follow-up case studies to track changes in business sales, profits, product lines, etc. Case studies will seek to determine if and how businesses' access to the technology needed for their production processes has increased following the CTD's assistance. Tracing levels of industry support for CTD activities will aid in assessment of the project's sustainability.

Evaluations will also provide follow-up study of conditions measured for project-wide and activity-specific baselines. For example, interviews with representatives of target groups in industry, academia, government, and financial institutions will seek to gauge the CTD's impact on levels of productive interaction among those groups.

Special Studies

Special studies may be scheduled when needed to provide in-depth information on issues of particular interest, or as a means of spot-checking problem areas. Some possible topics might include the following:

-- studies of constraints (if any) to entry of women in particular industries, job categories, or management positions within industries;

-- case studies to examine the impact of project activities on socioeconomic conditions, e.g., effects of biotechnology research applications for dry-land agriculture on food production and employment;

-- study of project impacts on buyer-supplier linkages and other problems of small- and medium-scale enterprises in target sectors.

Coordination of the CTD Monitoring System

It is suggested that the CTD consider hiring one person, either full- or part-time, to coordinate the flows of information described above. The CTD will suggest, subject to A.I.D. approval, the most effective means of producing quarterly reports and databases. A low-cost computerized system utilizing simple computerized spreadsheet and database and/or word processing programs will most likely be sufficient for project needs. Technical assistance in carrying out monitoring activities may be accessed through the A.I.D. project officer and Evaluation Office.

Evaluation Budget

The estimated budget for monitoring and evaluation activities is $300,000, representing 3 percent of the project budget of $10 million. This amount will cover three evaluations, monitoring assistance to the CTD as needed, and procurement of basic computer hardware and software for the computerized management information system.

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