PP-AAR-412

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UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

PROJECT PAPER

THAILAND

Science and Technology for Development

(493-0340)

JUNE 1985

UNCLASSIFIED

PD-AAR-412

40567

SCIENCE AND TECHNOLOGY FOR DEVELOPMENT
(493-0340)

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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: Thailand

3. PROJECT NUMBER: 493-0340

4. BUREAU/OFFICE: ANE/ASIA — 04

5. PROJECT TITLE (maximum 40 characters): Science and Technology for Development

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 92

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)

A. Initial FY 85 B. Quarter [X] C. Final FY 89

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

A. FUNDING SOURCE	FIRST FY 85 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total						
(Grant)	( )	( )	( )	(3,000)	(5,500)	(8,500)
(Loan)	( )	( )	( )	(9,000)	(17,500)	(26,500)
Other U.S. 1.						
Other U.S. 2.						
Host Country					14,000	14,000
Other Donor(s)						
TOTALS				12,000	37,000	49,000

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) 103	154	870	870					500	14,500
(2) 104								500	1,500
(3) 105									
(4) 106									
TOTALS								7,500	10,500
								8,500	26,500

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 871 | 872 | 873 | 874 | 839 | 334

11. SECONDARY PURPOSE CODE

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

A. Code	RGEN	BL	INTR	LAB	TNG	
B. Amount	18,000					

13. PROJECT PURPOSE (maximum 480 characters)

The purpose of this Project is to enhance the effectiveness and extent of public and private sector application of Science and Technology to Thailand's development.

14. SCHEDULED EVALUATIONS

Interim MM 10 YY 88 | MM YY | Final MM 01 YY 92

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.)

17. APPROVED BY

Signature: Revised by ANE/ASIA/PD per Bangkok 25340 of

Title: May 2, 1985

Date Signed: MM 05 DD 14 YY 85

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM 05 DD 14 YY 85

AID 1330-4 (8-79)

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ACRONYMS AND ABBREVIATIONS

A/AID	Administrator, Agency for International Development
AA/ASIA	Assistant Administrator/Asia Bureau/AID
ACO	Area Contracting Office/AID
AGR	Office of Agriculture/USAID
AID	Agency for International Development
AID/W	AID/Washington
AIT	Asian Institute of Technology
APR	Annual Percentage Rate
ASEAN	Association of Southeast Asian Nations
ASIA/PD	Project Design Office/Asia Bureau/AID
ATI	Association of Thai Industries
B	Baht
B/G	Borrower/Grantee
BIFAD	Board of International Food and Agricultural Development
BOB	Bureau of the Budget
BOI	Board of Investment
BOT	Board of Trade
CDSS	Country Development Strategy Statement
CFTE	Center for Technology Exchange
CIF	Cost, Insurance, and Freight up to Port of Entry
CN	Congressional Notification
COSTAT	Council of Science and Technology Associations of Thailand
CP	Conditions Precedent (to disbursement of funds)
CSC	Civil Service Commission
DIR	Office of Director/USAID
DMCO	Department of Weights and Measures/MOC
DMR	Department of Mineral Resources/MOI
DSS	Department of Science Services/MOSTE
DTEC	Department of Technical and Economic Cooperation
EDP	Electronic Data Processing
EEC	European Economic Commission
EPD	Emerging Problems in Development
ESCAP	Economic and Social Commission for Asia and Pacific
FAA	Foreign Assistance Act
FIN	Office of Finance/USAID
FOB	Freight on Board
FX	Foreign Exchange Cost
FY	Fiscal Year
GDP	Gross Domestic Product
HPN	Office of Health, Population and Nutrition/USAID

IBRD	International Bank for Reconstruction and Development
IESC	International Executive Service Corps
IFCT	Industrial Finance Corporation/Thailand
ISEC/NIDA	Information System Education Center/NIDA
KMIT	King Mongkut Institute of Technology
LC	Local Cost
LDC	Less Developed Country
M	Million
M.D.	Medical Doctor
M.S.	Master of Science Degree
MOC	Ministry of Commerce
MOF	Ministry of Finance
MOI	Ministry of Industry
MOPH	Ministry of Public Health
MOSTE	Ministry of Science, Technology and Energy
NAS	National Academy of Sciences
NDC	National Documentation Center/TISTR/MOSTE
NEA	National Energy Administration
NESDB	National Economic and Social Development Board
NIC	Newly Industrializing Country
NIDA	National Institute of Development Administration
NRC	National Research Council
OJC	Office of the Juridical Council
PACD	Project Assistance Completion Date
PERE	Office of Private Enterprise and Rural Employment/USAID
PID	Project Identification Document
PIL	Project Implementation Letter
PPC/E/PES	Policy and Planning Coordination/Evaluation Office/Project Evaluation Staff
PPP	Public Relations, Publicity Promotion Office (STDB)
PROG	Office of Program/USAID
PSC	Personal Service Contract
PSL	STDB/Private Sector Liaison Office
PSTC	Program in Science and Technology Cooperation
Ph.D.	Doctor of Philosophy Degree
QC	Quality Control
R&D	Research and Development
RCMO	Regional Commodity Management Office/USAID
RD&E	Research Development and Engineering
RI	Rural Industries
RTG	Royal Thai Government

S&T	Science and Technology
SMEs	Small and Medium Scale Enterprises
STDB	Science and Technology Development Board
STQC	Standards, Testing and Quality Control Office (STDB)
TA	Technical Assistance
TAC	Technical Advisory Committee (STDB)
TDRI	Thailand Development Research Institute
TIAC	Technology Information Access Center
TISI	Thai Industrial Standards Institute/MOI
TISTR	Thailand Institute of Scientific and Technological Research/MOSTE
TSTPAC	Thailand Science and Technology Program Advisory Council
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
US	United States
USAID	United States Agency for International Development
VITA	Volunteers in Technical Assistance

PROJECT PAPER

Thailand

Science and Technology for Development
(493-0340)

I. SUMMARY AND RECOMMENDATIONS

A. Recommendations

It is recommended that a loan of $27 million of FAA Sections 103, 104 and 106 and a grant of $8 million of FAA Sections 103 and 105 be authorized for the Science and Technology for Development Project. The Kingdom of Thailand shall repay the Loan to AID in US dollars within forty (40) years from the date of first disbursement of the Loan, including a grace period of not to exceed ten (10) years. The Kingdom of Thailand shall pay to AID in US dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years, and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

B. Host Country Contributions

The Royal Thai Government (RTG) budgetary and in kind contributions will be at least $9.5 million. The contributions from private sector companies are expected to be $4.5 million. Thus the host country contributions will total $14 million towards the life of Project costs.

C. Summary Project Description

Introduction

With the virtual closing of the land frontier, and the gradual restructuring of industrial expansion into more skill and technology intensive product composition, Thai economic growth is reaching a stage which requires increasing technological application to agriculture and industry. Thailand now has a cadre of highly trained scientists and technologists whose potential contributions to this process remains underutilized, largely due to institutional constraints. Incentive systems and linkages that create effective relationships between the RD&E community and the industrial sector in advanced industrial economies need yet to be constructed in Thailand.

This Project is the first comprehensive effort to assist the Thais in government and the private sector to reach newly industrialized country (NIC) status by expanding the contribution of S&T to the development process. It follows on the agreement between the US and Thailand of April 13, 1984, calling for close cooperation in S&T. The Project is seen as a potentially significant contributor to the process of structural adjustment, normally conceived within the framework of economic incentives, public sector

efficiency and fiscal and monetary policies.

Goal and Purpose

The goal of this Project is Thai self-reliance in science and technology. The purpose of this seven-year (7) Project is to enhance the effectiveness and extent of public and private sector application of S&T to Thailand's development. In so doing, the Project will attempt to solve specific technology related problems in three broad high priority technical areas; bioscience/biotechnology, material technology and applied electronic technology. The Project is consistent with the RTG's goal and objectives in the area of Science and Technology as stated in the Fifth Five-Year Plan and also as proposed in the upcoming Sixth Five-Year Plan covering the period from 1987 to 1991. These development plans recognize Thailand's need to integrate modern technology into its production processes at this stage in its economic development if it is to reach "NIC" status.

Project Description

The four main elements of activity are: 1) strengthening the existing institutional framework; 2) review of S&T policy and practice; 3) research, development and engineering; and 4) industrial development support.

1. Strengthening the Existing Institutional Framework - this critical component is needed to bring about more opportunities for interaction between the users and the producers of RD&E. New and effective linkages between industry, the RD&E community and the RTG policy makers and regulators are needed to change the resource allocation process for S&T, to focus existing Thai RD&E capabilities and resources on priority problems impeding Thai industrial growth and productivity, and to enhance Thai RD&E competence in key subject areas, thereby lessening local dependence on foreign technology.

The Science and Technology Development Board (STDB), to be established under the Project, structured to operate with greater flexibility than any other Thai organization that administers government funds in the area of S&T, and managed with significant participation from the private sector, is expected to make a unique contribution in the establishment of these linkages. Private industry leaders and technical professionals, university and other public sector RD&E investigators, government administrators and policy makers will be induced to interact through the STDB. It will promote the use of indigenous RD&E and market the results of its products under an active publicity and sales program. It will support the RTG efforts in improving the overall policy environment to make it more conducive to investment in S&T activities. Briefly, this activity is designed to facilitate the establishment of a framework which provides and expands opportunities for public and private sector cooperation.

The seven-year costs for STDB, are $5,965,000 of which operating expenses are $3,065,000 and program costs are $2,900,000.

2. Review of S&T Policy and Practice - the Project will assist the Thai public and private sectors develop a more systematic approach to policy planning and more effective S&T practice. This activity is based on the assumption that careful analysis of problems and the alternate choices of actions leads to sound and reasonable policy decisions. The activities to be financed hereunder will: a) strengthen the capacity of Thai organizations to carry out necessary policy studies; b) analyze pressing current policy problems through specific studies; and c) support professional exchanges which will be directly applicable to policy examination. A total of $900,000 is budgeted for this activity.

3. Research, Development and Engineering - the largest component of the Project, representing almost two-thirds of the resources provided ($30 million out of $49 million), will finance problem-solving RD&E in three priority technical areas of concentration: bioscience/biotechnology; material technology; and applied electronic technology.

Bioscience/biotechnology represents the use of a biological system to produce a product, the use of a biological system as a product; or the use of advanced biological techniques to indirectly provide a product, process or service. This area of concentration brings contemporary and emerging technologies to bear on some traditional as well as new problems in Thailand. The relevant technologies are based on the fundamental abilities of living organisms as well as the bioengineering or advanced technological principles embodied in bio-product processing or packaging. The methodologies have direct relevance to plant, animal, marine or aquaculture, and chemical or health-related industries. They include tissue culture, cloning, protoplast fusion or embryo transplant for plant, fish or animal product improvement; and genetic engineering for vaccine and diagnostic development. They also include bio-product processing (thermal, frozen, extrusion, extraction, or fermentation) or bio-product packaging techniques to enhance the development of higher valued commercial products.

Material technology represents the extraction, refinement, and high temperature processing and polymerization of inorganic and organic based natural resources. It includes existing and emerging methodologies to address some traditional as well as new problems in Thailand. The relevant material technology methodologies, therefore, focus on ceramics (classical and industrial), metallurgy (tools), mining (mineral refinement), and polymers (rubber, wood and plastics). They include preparation of high quality raw materials and the economically feasible conversion of raw materials to higher value states. Material technology was selected for priority focus because of Thailand's natural resource base, its potential for making qualitative improvements in industrial processing, and its available human resources.

Applied electronic technology represents the application and use of computers and the practical application of electronic principles for industrial improvements. Unlike the other two areas, it is not based on natural resources, but it is important to help the natural resource based industries achieve competitive status, by improving their controls, producing

to standards and quality, and increasing productivity. The country must be fully-capable of storing and using information for increased/quality production as well as gaining access to export markets.

Three different types of RD&E activities are to be funded in each of the technical areas above. These types are designated, competitive and company-directed.

Designated RD&E (problems and institutions) activities will provide resources for work on known, high priority problems. The conduct of the work itself will simultaneously build the capacities of the designated institutions in areas deemed essential to support present and future industry growth. These activities will enhance the development of state-of-the-art technologies, or absorb emerging technologies, in various areas and solve crucial problems. All work will be of generic interest for industry, and also be aimed at strengthening the S&T infrastructural base so as to help sustain industrial growth. The sum of $12,000,000 has been allocated to finance approximately 48 RD&E activities.

Competitive RD&E will have problem-solving as a primary objective. The selection of specific problems and institutions will be made in consultation with the private sector over the life of the Project. The Project funds will be used to bridge the gap between the RD&E institutions, and the continuing generic needs of industry. In the process of carrying out competitively funded RD&E activities, each activity will also contribute towards capacity building in Thai RD&E institutions. The sum of $9,000,000 has been allocated to finance approximately 60 competitive RD&E activities.

Company-Directed RD&E activities will represent the most advanced stage of progression toward the self-sustaining commercialization of RD&E. A company, or a combination of companies, may undertake a self-directed and self-financed RD&E activity from a special fund to be established under the Project. The Fund is proposed on the assumption that the return on investment in company and industry directed RD&E is adequate to allow for the recovery of RD&E costs, and that establishment of a credit facility to finance a portion of the "front end" development costs and reduce the risk of failure is an effective means of encouraging Thai industry to undertake RD&E for its own technical problem solving. It is expected that this Project element will encourage private sector companies to utilize university laboratories to perform RD&E work for them and to establish or enhance their in-house RD&E capabilities. It leverages AID funding on a one to four basis, by combining $2.25 million in AID resources with those of the RTG and the private sector to finance a total of $9 million in RD&E over the life of the Project.

In addition, certain technical assistance and training costs in support of the foregoing RD&E activities will also be financed.

4. Industrial Development Support is comprised of the following three activities:

a) Standards, Testing and Quality Control

This Project activity is designed to support the RTG's efforts to establish and strengthen a national program for improvement in Thai products for export and domestic use. The program will strengthen standards, metrological capability for calibration service, and modern quality control systems to improve efficiency and reliability in producing quality products. The main thrust will be to enhance the quality control awareness and capabilities of industrial leaders, professionals and workers so as to help them produce quality products, as well as follow a reasonable detection system to monitor performance. A sum of $3,850,000 has been allocated to finance long and short-term technical assistance, U.S. training, workshops, certain promotional activities and testing equipment.

b) Technical Information Access Center (TIAC)

A Technical Information Access Center (TIAC) will be established to serve two primary sets of clients; the RD&E community and the business and investment community. It will build on and supplement existing facilities and services to create a modern information service to provide reliable, low cost, high speed technical and scientific information to Thai decision makers, whether they be in the private sector, in the academic RD&E community or in government.

The existing TISTR National Documentation Center (NDC), will be modernized by utilizing digital and microfilm technology for storage and retrieval of information. It will be linked through an EDP and communication network with Thai university libraries, to serve the RD&E community. University science/technology libraries will be similarly modernized and integrated into the data network.

The Technical Information Access Center will be located at and managed by the "Association of Thai Industries" (ATI) as an agent for STDB to serve the business and investment community. It will be linked electronically to the US/ASEAN Center for Technology Exchange in New York which would service requests from TIAC Bangkok and the National Documentation Center for S&T information available in the US or other ASEAN countries.

Total budgeted cost of this activity, to supplement the fees estimated to be collected from users, is $2,650,000.

c) Diagnostic/Research Design Service

Diagnosing technical problems encountered by Thai producers, and designing methodology for RD&E to solve those problems, is a major deficiency in Thailand today. This activity is intended to rationalize and speed up the development of the technical service industry in Thailand. As the competence of Thai RD&E facilities is upgraded through other activities of this Project (i.e. designated RD&E), it becomes important to make the results of that competence available to the productive sector. Industrial

consultancy services, drawing in part on the personnel of these upgraded facilities, could bring about quality improvement of Thai products. The service will help Thai manufacturers identify production problems that do not require new technologies but can be solved by applying technical or managerial knowledge that is already available. Important areas in which Thai industry requires RD&E support will be identified leading to the design of well conceived RD&E activities for financing under this Project.

A small service unit, offering well publicized low cost services to industry by providing local and foreign short-term technical advisors will be established to help producers diagnose technical problems, identify technical needs, structure feasibility studies and design RD&E projects to solve those problems. The service unit will have only a skeleton staff, but will draw on qualified Thai technical RD&E personnel at universities, government research laboratories (enhanced through designated RD&E activities), and private consulting firms. These indigenous capabilities will be supplemented as needed with foreign technical advisors.

This activity is budgeted at $ 950,000 to supplement estimated collections of user charges over the seven year Project life.

Table 1
Summary Costs of Project Elements by Funding Sources
(in $000)

Elements	AID		Host Country			Total
	Loan	Grant	RTG	DTEC	Private Sector	
1) STDB						
Operating Costs	100	1,145	420	1,400		3,065
Program Costs		2,900				2,900
2) S&T Policy & Practice		900				900
3) RD&E						
Designated RD&E	9,000		3,000			12,000
Competitive RD&E	6,750		2,250			9,000
Company-Directed RD&E	2,250		2,250		4,500	9,000
RD&E Support	1,150	1,500				2,650
4) Industrial Dev. Support						
Standards, Testing & QC	3,600	250				3,850
TIAC	2,375	275			1/	2,650
Diagnostic/RD&E Design	950				1/	950
5) Contingency & Evaluation	825	1,030	180			2,035
Total	27,000	8,000	8,100	1,400	4,500	49,000

1/ Table does not include user fees.

D. Analyses - Summary Findings

This Project is considered economically, technically, administratively feasible, and socially sound without negative environmental impact. The cost estimates are reasonable and the Project meets all applicable statutory criteria.

E. Waivers

A/AID is requested to waive the competitive requirements for the procurement of technical services from the National Academy of Sciences (NAS) and the US/ASEAN Center for Technology Exchange in the US as part of the Project Authorization. Similarly, a Source and Origin Waiver for the procurement of Project support vehicles has also been included therein.

II. Project Rationale

Thai economic development is entering a period of increasing technological advancement in agriculture and industry. As explained in Annex H, this comes after over two decades of unusually rapid and sustained economic growth, and a substantial shift in sectoral composition as agriculture as a percentage of GDP dropped from 40% in 1960 to 25% in 1980. However, the failure of Thai agriculture to make a major shift from an extensive to an intensive development pattern over this period has emerged as a critical problem with the virtual closing of the land frontier.

The dynamism and the increased use of sophisticated technology in Thai agriculture should not be understated. The agricultural sector has demonstrated its ability to respond quickly to new market opportunities by expanding production of goods that were previously minor export components. Thai farmers can learn quickly and respond rapidly to changes in relative prices and returns. The food processing industry, though small in size and a long way from being fully developed, also responds quickly to new market opportunities and has been able, in many cases, to adapt processing technologies sufficiently to meet export market specifications and thereby capture a significant market share.

Important as these developments and capabilities have been, substantial areas of Thai agriculture still remain below international standards in terms of technologies applied and yields and returns obtained. These problems have not been unattended. Over the years, USAID, World Bank and other donors have joined with the RTG in numerous programs in agricultural research and extension, while much policy analysis and attention has gone into various related aspects of the marketing and incentive structures that must be supportive of technology diffusion among farmers. Work on all these aspects continues. What has yet to be applied is a whole range of new technologies that can bring powerful techniques to bear on yields, resistance, and alteration of plant characteristics, to complement the more traditional approaches that must continue to be pursued. As explained in the Technical Analysis, there is a fortunate congruence between these technologies and the professional manpower required to apply them. That is to say, Thailand has highly-trained biotechnology scientists, although their potential contribution to these problems remains largely unharnessed for institutional and other reasons explained below. This Project is designed to help launch processes that will mobilize these intellectual resources for fresh approaches to these problems using the latest techniques. Other aspects of bio-engineering will be applied to problems and processes in the associated food processing industries, aimed at developing new packaging and other products and processes that can enhance the commercial prospects of selected Thai agricultural products.

In industry, several important changes in structure are underway; a) the diversification and recent shift from import-substitution to export-orientation as the basis of Thai industrial development strategy, b) the opportunities for Thailand to move into more technology-based exports as rising wages force the other Asian newly industrializing countries (NIC) to

shift out of some industries and move up to still more skill-intensive and technology-intensive product composition, and c) the opportunities for chemical industry development based on the country's off-shore gas production. These changes by nature will require much more powerful scientific and technological support and capabilities than the Thai industrial sector has required before. To a considerable extent the human resources for such support already exist but are not well mobilized. In addition, the incentive systems and linkages that create effective relationships between the scientific and industrial communities in advanced industrial economies have yet to be constructed in Thailand.

While further development of basic and advanced education in science will have to take place in Thailand to create a larger basis for technological upgrading across all sectors of economic activity, the country already possesses a fairly diverse and well-trained stock of scientific and technical personnel. Thailand invested heavily in education in the past few decades. The scientific capabilities of the older universities have been greatly strengthened while several new universities have been established including regional ones. Over five thousand Thais have obtained advanced degrees in the areas of science and technology, including large numbers from abroad, mainly in the US. At today's costs it would require over $300 million to obtain the equivalent number of degrees from abroad for the faculties of agriculture, science, engineering and medicine at Thailand's seven major universities. The country also has an adequate supply of trained technicians capable of performing research at its main institutions of higher learning. The great weakness in this picture lies in the institutional structure in which these cadres work, i.e. the inadequacies of funding, programs, coordination, and regulations.

These problems are well recognized in Thailand. They have begun to be addressed by the creation of the Ministry of Science, Technology and Energy in 1979, and also in the Fifth National Economic and Social Development Plan (1982-1986) in order to raise the priority and effectiveness of public sector attention to S&T. Much remains to be done to set the stage for more rapid and vigorous exploitation of the potentialities of applying these cadres and technologies to an economy entering NIC status. This Project is the first effort to take a comprehensive look at the role and situation of S&T in Thailand and to assist the government and the private sector to do the same and to begin a rapid expansion of their scientific and technological base. This Project is designed to mesh with RTG plans and activities in S&T, and follows on the agreement between the two governments of April 13, 1984 calling for close cooperation in S&T.

USAID sees this Project as a significant contributor to the process of structural adjustment within the framework of economic incentives, public sector efficiency, and fiscal and monetary policies. Reorientation of the economy towards export competitiveness in more highly processed agricultural commodities, and in manufactures, is a central aspect of the structural adjustment policy that is central to the current (5th five-year) plan, and will continue through the next. Many aspects of the activities under the rubric of S&T can and must play a critical role in this export orientation.

Product testing, development of internationally recognized standards, research on local materials for development of new or improved manufactures in which Thailand can develop comparative advantages, improved packaging, cost-reducing applications of new techniques, and development of potential new uses of commodities facing severe barriers to further export growth, are all examples of specific lines of activity that (depending on scientific viability and costs under Thai production conditions) will be pursued under this Project and that can provide new product and process composition to complement the policy measures being introduced to enhance the effectiveness of the fiscal and trade regime incentive structure.

This Project is primarily designed to assist the Thai public and private sectors develop a more systematic approach to S&T policy planning, identify the key needs of the S&T infrastructure, initiate some innovative services particularly aimed at activating greater use of existing S&T capabilities and creating more modern and systematic linkage systems for technological knowledge generation and transmission. In the process of working towards these objectives, the Project will be helping to finance RD&E that will: a) address particular technological problems with significant potential economic and public health benefits, b) help cement permanent relationships and working arrangements between scientific and professional institutions and the Thai industrial community, and c) continue to foster professional networks between the Thai and US scientific communities. The areas chosen for designated RD&E are bioscience/biotechnology, material technology, and applied electronic technology. These areas for initial concentration were identified through extensive technical exchanges among a wide group of US and Thai scientific professionals and with senior Thai officials concerned with S&T development and Thai development policy in general.

Other Project components focus on creation of new linkages between the scientific and industrial sectors, and developing new mechanisms for promoting the access to and utilization of commercially useful technological resources. As explained in Annex H, the focus of these information and skill resource "mobilization" activities, is on technology identification and acquisition, and on the process of technology mastery (the E in RD&E) which has been shown in other countries (e.g. Korea and Brazil) to be an equally powerful source of technological growth as the prior step of simple acquisition of a new technology through licensing or the importation of new plant and equipment. Thus, in the industrial application of S&T, the Project hopes to focus with an appropriate balance, on this stage of Thai manufacturing development, between the technology learning processes (including testing, standards, quality improvement, consultancy trouble-shooting, learning-by-doing, etc.) and improved choice and acquisition on the one hand, and new knowledge generation (R&D) on the other.

The diagram in Figures 1 and 3 illustrates how this Project fits into the overall structure of Thai S&T as it now exists, and how it proposes to address critical components and linkages of that structure, by matching the elements of the Project against the current structure. Figure 1 is a simplified version of Figure 3 in the Economic Analysis, Annex H.

Significant sources of technology acquisition and mastery typically operating in industrially more advanced countries (including LDCs at a more advanced stage of industrial development and of general S&T attainment) are shown on the right hand side of the figure, divided among the acquisition, application and adaptation processes. A number of these sources are either absent in Thailand or are operating only incipiently and at a low level. Information and documentation services, especially useful for identifying non-proprietary S&T knowledge, are virtually absent. This serious infrastructure hiatus would be filled by the proposed Technology Information Access Center (TIAC). Domestic engineering and consulting firms have been developing in Thailand, but do not perform RD&E or technical trouble-shooting for processes of mastery on any meaningful scale. The proposed diagnostic service is designed to create effective linkages between industry and the engineering sector so these processes may begin to operate.

The left hand side of the figure illustrates the weak linkages that now characterize the relationships between technology users and the Thai professional S&T community. Internal RD&E by enterprises is virtually non-existent. The Project's RD&E financing, the establishment of STDB and support mechanisms are designed to initiate linkage processes and encourage enterprise RD&E funding. In addition, by focusing on the three general areas of research described herein, these mechanisms will help mobilize RD&E resoures, now scattered and without systematic allocation, on an adequate scale in the various research endeavors.

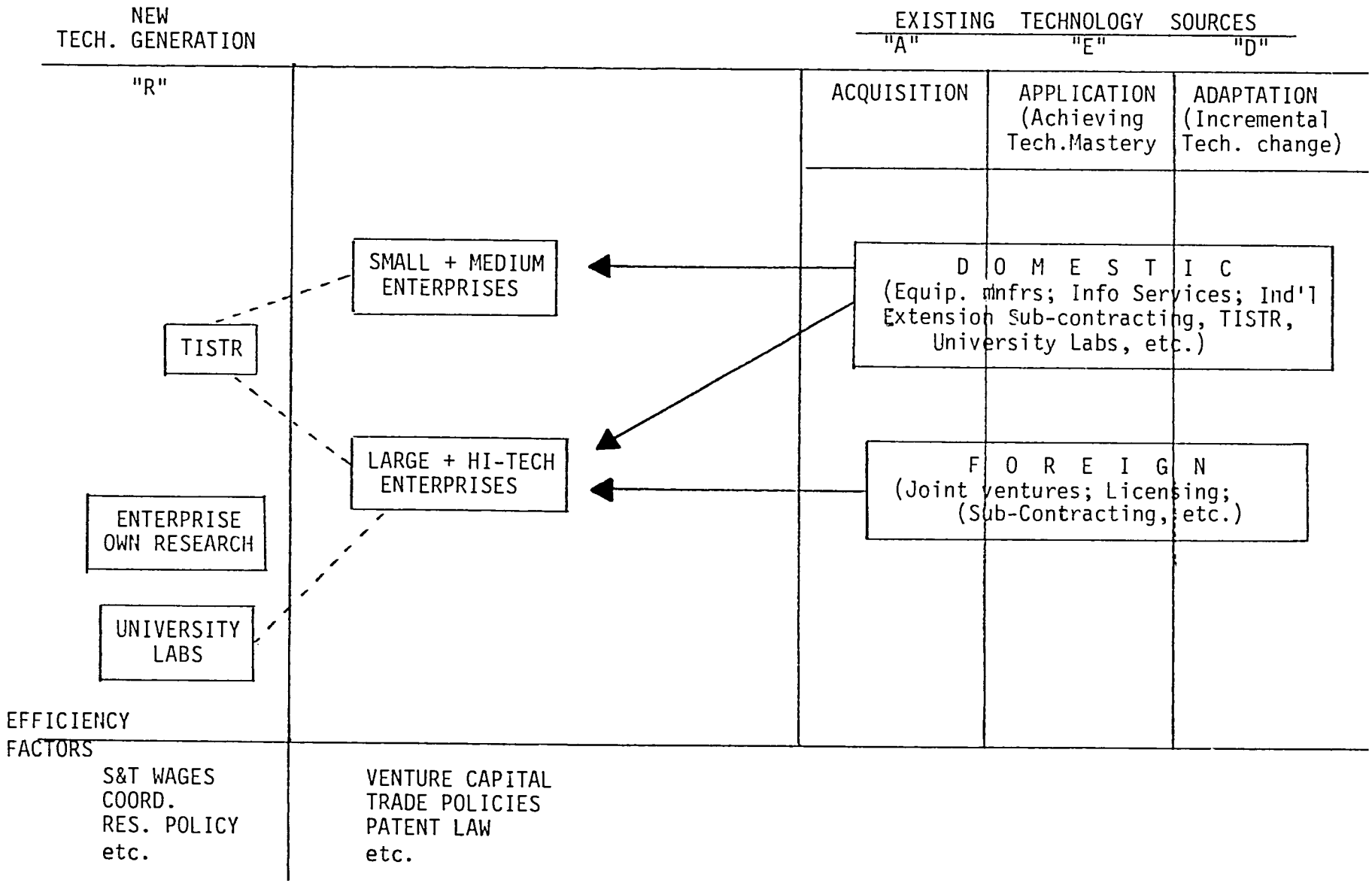
Finally, at the bottom of Figures 1 and 3, is a list of economic, regulatory and administrative factors affecting the efficiency of the whole S&T infrastructure and its processes. The Project's policy studies component will help S&T planners develop a comprehensive assessment of the status and trends respecting these factors and analyze the alternatives for future policy directions.

The strengthening of Thai S&T can be expected to have a significant impact on incomes, employment in various sectors, and development in provincial areas. A few general observations should be made at this point on the subject of employment effects, given the importance of employment generation over the next decade as reflected in the CDSS.

At one level, the employment implications of this Project are very extensive. In the agricultural sector any one of the specific research lines on the first agenda for designated RD&E could, if successful, expand employment and income opportunities for large numbers of farm families. As was the case with earlier yield-increasing breakthroughs of the green revolution in other countries, research outcomes (combined with appropriate policies on prices, other inputs, etc.) had complex chains of employment effects, land ownership patterns, labor market operations for landless or small-holder agricultural workers, female labor force participation patterns, etc. In general the impact on farm output, employed days, agricultural wages, and employment in ancillary transport and other linked activities, has been substantial.

FIGURE 1

INDUSTRIAL TECHNOLOGY STRUCTURE - SOURCES AND LINKAGES



On the level of individual RD&E projects, the magnitude of employment outcomes cannot be predicted and will depend on scientific explorations, the results of which are uncertain beforehand. It is clear though that the first agenda includes a number of objectives with substantial income and employment implications, e.g. the substitution of cowpeas for some cassava areas or the development of new product uses from cassava that could absorb some production which will otherwise simply disappear (along with the income and labor absorption) as supply is cut back to meet shrinking EEC demand. The contribution of the fruit and vegetable packaging areas could also be substantial, strengthening the technological basis for one of Thailand's most competitive production sub-sectors. The industrial RD&E subjects have been similarly chosen with a view to potential wide impact.

In the final analysis, the employment implications of the Project must be seen beyond the specific potential effects of the first round of designated RD&E. One of the objectives of the Project is to help establish business-science linkages, RD&E processes and information systems that must underlie any industrializing economy's ability to apply science and technology to its production activities.

III. PROJECT DESCRIPTION

A. Goal

The goal of this Project is Thai self-reliance in S&T.

Self-reliance in knowledge does not mean autarchy. The greatest flows of S&T are between the world's most advanced science-based economies. Instead, self-reliance comprises the following capabilities: 1) to make deliberate, rational choices between acquiring specific technologies from abroad or developing them domestically; 2) to acquire suitable foreign technologies (locate, choose and purchase on favorable terms); 3) to adapt acquired technologies to domestic conditions; 4) to generate new products and processes through domestic RD&E in areas more suitable for local development than external acquisition; 5) to achieve technological mastery in application of these technologies; and 6) to sustain and advance all these capabilities from one technical and professional generation to the next, through education and training and through the maintenance and development of the S&T institutional infrastructure. The degree to which a country depends on "making or buying" its technology in any sector or discipline depends on factors such as economic size, natural resource base, human capital stock, comparative advantages in trade, etc.

B. Project Purpose

The purpose of the Project is to enhance the effectiveness and extent of public and private sector application of S&T to Thailand's development. It reflects the long term objective of the Thai S&T program of institutionalizing a process which promotes the use of indigenous RD&E and helps S&T organizations become more responsive to the development needs of Thailand.

This will be accomplished by focusing on the development, adaptation and application of technologies to solve specific priority problems facing Thailand.

The Project Design Team examined the levels of development now reached in Thailand by industry (the users of technology), by Thai universities, engineering institutes and public sector research institutions (the sources of indigenous technology), the poor linkages for interaction between them, and the policy framework within which they must operate. It considered what sort of approach was needed to effect the system so as to bring about a rapid acceleration in the rate of technological improvement by producers, a more effective application of available local resources and a lessening of their dependence on foreign technology.

The establishment of the Science and Technology Development Board (STDB), will address this development problem by creating linkages between the public and private sectors and thereby shifting RD&E priorities towards market/development needs. STDB, structured to operate with considerable flexibility and managed with significant participation from the private sector, is expected to make a unique contribution in the establishment of these linkages. These new linkages generated by STDB activities between technical personnel in RD&E, and investors/producers will encourage the utilization of available human resources to meet the technical needs of the economy.

C. End of Project Status

By the end of this Project the following will have been achieved:

1. Institutional and financial mechanisms in place for the private and public sectors to collaborate in RD&E activities.

2. Meaningful, working relationships formed between the private and public sectors, both domestic and US, and between local universities, government agencies and private sector industries.

3. Demonstrable resolution of specific problems addressed by RD&E.

4. RD&E institutions in priority technical areas capacities improved.

5. RD&E activities are problem focused and demand driven.

6. Improved policy framework for the enhancement of RD&E activities and enterprises, designed to achieve the RTG's stated objective of 0.5% of GNP invested in RD&E (0.22% as of 1983).

7. RTG development planning process and objectives fully take into account, in all economic sectors, the relevance of S&T to the achievement of development targets and is allocating resources accordingly.

8. Private sector industries/companies use and application of RD&E significantly increased (increase includes all aspects of technology transfer including direct investment, licensing fees, and other means of acquiring or developing know-how).

9. Enhanced investments in RD&E based industries will be measurable and documentable.

10. Private sector industries' and RD&E institutions' capacity to correctly diagnose technical problems and identify the appropriate technology to address given problems demonstrably increased.

11. Standards, testing and quality control activities operating efficiently, e.g., with reduced turnaround time and enhanced utility.

12. Increased number and improved quality of RD&E researchers, faculty and students in key public and private institutions and industries, including universities, in three major subject areas (bioscience/biotechnology; material technology; and applied electronic technology).

D. Project Elements

The Project Paper is the outcome of a lengthy preparation process. Over a period of 12 months, a number of studies were undertaken and numerous conferences and workshops held with Thai and US (approximately thirty) scientists, government and business leaders, and science policy planners and administrators. The technical and economic aspects in particular are covered only in summary form in the body of the Project Paper, but are covered in detail in the Annexes to the Project.

The four main areas of activity are: (1) strengthening of the existing institutional framework; (2) review of S&T policy and practice; (3) research, development and engineering; and (4) industrial development support. A description of each of these activities follows:

1. Strengthening the Existing Institutional Framework

One key objective of this Project is to institutionalize a process in which users and producers of scientific and technological knowledge directly interact with one another to solve the relevant development problems of Thailand. The basic implementing components of the framework are in place, however, a means of strengthening the interaction processes is needed. An organization, the Science and Technology Development Board (STDB), will, therefore, be established to fill a necessary critical gap in accomplishing this objective (see Annex J).

The establishment of STDB is intended to change the institutional framework by which RD&E projects are selected, resources are allocated and the results of successful RD&E efforts are commercialized, by causing the suppliers and users of technology to interact more constructively

with each other. It is intended that private industry leaders and technical professionals, university and other public sector RD&E personnel, and government administrators and policy makers will be induced to interact through the STDB to create the broader institutional framework discussed above.

STDB will finance such RD&E as is identified by Thai producers and is consistent with Thailand's development priorities. It will upgrade the capabilities of existing Thai institutions to perform RD&E, provide opportunities for these facilities to engage available trained manpower and employ them on priority activities. It will promote the use of indigenous RD&E and market the results of its products under an active publicity and sales program. It will facilitate the establishment of a framework which provides and expands opportunities for public and private sector cooperation. It will support the RTG efforts in improving the overall policy environment to make it more conducive to investment in S&T activities. STDB will also be allowed to seek other supplemental support.

The STDB needs greater flexibility than can be provided if it were a Thai government agency. It also requires extensive private sector participation in its management. On the other hand, the character of AID loan funds, the intended uses of the funds and the existing tax laws would rule out a purely private, non-government organization as borrower and manager. An institution now exists, the Thailand Institute of Science and Technology Research, created 20 years ago by a special Parliamentary Act, that has the requisite legal framework. This institution (TISTR) also has other responsibilities (i.e. the operation of 14 laboratories) that would create a conflict of interest in its management of the tasks intended for STDB.

The Project design team has succeeded in resolving this dilemma by obtaining agreement from all parties that STDB will be an independent sub-unit of TISTR, entitled to operate with all the authorities and flexibilities bestowed on TISTR by the Parliamentary Act in performing STDB's designated functions, yet free from interference in its decision making by the TISTR officers and Board. Given the scarcity of models available to guide the design team in designing this highly innovative, broad scoped, multisectoral activity, it has been concluded that this approach offers the greatest chance for success in initiating this activity. It is anticipated that the mid-term evaluation, scheduled for FY 1989, will provide a basis for determining the future course and structure of STDB.

The establishment and strengthening of STDB is thus a Project activity designed to provide a missing ingredient necessary to achieve the Project purpose. Once established, it will responsible for administering AID and RTG Project funds and coordinating all Project activities (for details, see Section VI - Implementation Plan).

Specific activities to be accomplished in relation to STDB itself include:

a. establishment of STDB by the TISTR Board and Minister of MOSTE under the legislative authority of TISTR;

b. recruitment of professional/support staff and other start-up activities;

c. improvement of the management skills of professional and administrative staff by providing on the job training opportunities;

d. development of administrative and financial procedures to ensure the efficiency and effectiveness of the new organization;

e. development of detailed contracting, procurement and sales procedures;

f. establishment of a management information system (MIS) for the management, monitoring and evaluation of Project activities;

g. installation of a comprehensive system for the management of RD&E activities under the Project. All aspects of RD&E ranging from problem identification, through criteria and operating procedures development, to application of technology developed/adapted, will be covered;

h. establishment of a comprehensive program aimed at bridging the gap between RD&E and its users in improving industrial processes and products; and

i. development of detailed public relations, publicity and promotional procedures to market the use, or application and commercialization of Thai RD&E products.

Inputs will include long and short term US (126 person months) and local (117 person months) technical assistance ($ 2,200,000) in the areas of RD&E management, accounting, contract administration, publicity and promotion. Certain equipment ($170,000), workshops/conferences ($500,000), and operating costs ($3,025,000) (see Section VII - Cost Estimates and Financial Plan) will also be financed hereunder. AID grant funds will be used to finance TA costs. The operating costs will be financed jointly by DTEC, RTG and Project grant funds, while loan funds will be used to purchase needed vehicles.

2. Review of S&T Policy and Practice

In the course of designing this Project, USAID commissioned various studies to examine the current policy environment as it relates to science and technology development and application in Thailand. The results of these studies indicate that the general policy environment for S&T development is good. Lack of institutional and financial mechanisms to bring the private and public sectors together to solve technology-related problems of Thailand, however, has been identified as one key constraint. The RTG has agreed to establish the STDB to address this constraint. Some of the other identified policy constraints will be addressed directly or indirectly under Project components. In addition, studies have identified subject areas and issues that require further study and analysis.

The purpose of this activity is to strengthen the capacity of Thai organizations to modify S&T policy where necessary and strengthen practices where their weaknesses impede policy implementation; and to serve the RTG with the required analysis on which policy makers may base their actions. It is based on the assumption that careful analysis of problems and the alternate choices of actions leads to sound and reasonable policy decisions. This activity is designed to strengthen the RTG S&T policy and practice in three ways. The first is to strengthen the capacity of Thai organizations to carry out necessary policy studies. The second is to analyze pressing current problems through specific studies. The third is to support professional exchanges which will be directly applicable to policy examination.

(a) Strengthening Analytical Capacity

The policy formation structure for S&T in Thailand has been developing in recent years, but needs further strengthening and rationalization. The Fifth Plan was the first to contain a section devoted to Thai S&T. A Ministry of Science, Technology and Energy (MOSTE) is now operating and coordinating mechanisms are being developed. At the same time, more remains to be done.

The Project funds will be used to provide short-term US/Thai technical assistance to strengthen the capacity of key public and private policy planning institutions. The process of identifying key issues, establishing priorities, monitoring effects of policies, and the like will be strengthened. STDB, working with the MOSTE, will identify areas and organizations which would receive priority consideration.

(b) Studies on Policy and Practices

In the course of designing this Project, various assessments were made of tne current policy environment as it relates to science and technology development and application in Thailand. These assessments have focused on the constraints which impede the use of science and technology and issues that require further study.

The policy study program will make a significant contribution in addressing specific policy constraints identified in the various studies commissioned and in the Economic Analysis Section. Studies that are conducted with the RTG will help strengthen staff capabilities and policy implementation directly, while contracting studies to non-governmental sources would help strengthen linkages at the policy level. Studies on economic policy (e.g. tax and trade regime incentives) could be contracted to economists at any of several universities. Studies on patent or other legal aspects affecting private sector interest in RD&E might be conducted under auspices of the Joint Public-Private Sector Coordinating Committee. Some of the evaluative studies could be most effectively done by MOSTE, while NESDB might conduct studies relating aspects of S&T planning to overall development. Development of a data base and policy assessment function would take coordinated efforts between MOSTE/NESDB/NSO, with MOSTE taking the lead. Independent organizations, such as TDRI and the Industrial Management Company,

would be particularly appropriate for studies where independence or outside judgement is especially desired.

(c) Dialogue on Policy and Practice

Since the development of S&T sector assessment and science policy among developing countries is a relatively recent activity, with Thailand being a slightly late starter compared with some other countries, much could be gained by Thai policy makers and policy analysts through professional exchange with selected countries e.g. Korea, Malaysia, India, Israel and Portugal, where promotion of S&T development by government has been taking place during the early stages of industrialization. In addition, the cross-cutting nature of much S&T policy content suggests that provision should be made under the Project for occasional conferences and workshops organized around specific policy areas, possibly geared to the research agenda and the consideration of the policy papers and their recommendations as the research program begins to produce results, so that alternative policies can also emerge. Similar mechanisms will be used with regard to current practice which cause problems in carrying out approved policy or exist by default in the absence of clear policy. The conduct of these conferences, under STDB or other auspices as appropriate, would also contribute to the process of developing stronger more regular communication and collegiate ties among the several agencies and institutions that comprise the S&T infrastructure, as well as with the private sector through participation of the Association of Thai Industries (ATI) and individual members of the financial and industrial sectors. In some of the analytical work and workshops, participation of US consultants may also be desirable.

The inputs to be financed hereunder include 36 person months of mostly local, but some US technical assistance ($300,000), a total of 25 policy studies ($500,000) and costs associated with study tours and meetings to be held to promote policy dialogue ($100,000). All of these costs will be financed out of Project grant funds.

3. Research, Development & Engineering (RD&E)

The terms, research, development and engineering (RD&E) are generally self-explanatory, but as used herein they represent technical activities designed to help:

. diagnose or resolve problems limiting development,

. develop processes and products for improved or new industry development,

. improve standards and quality control, and

. broaden the base for and use of advanced or emerging technologies for development.

In other words the RD&E activities include development, transfer, application or utilization of technology to address development

problems. The RD&E activities are fundamental for industrial development. They will help further develop Thai scientific and technological human resource capability, capitalize on the nation's investment in human resource development, bring the public and private sectors together to solve development problems, and create the foundation for expanded indigenous involvement in industrial growth. The RD&E activities will be carried out by scientists and technologists in universities, research institutes, government agencies and private sector laboratories, in accordance with the procedures detailed in Annex K.

Technical Areas of Concentration

The following three technical areas have been selected for priority RD&E concentration under the Project (for detailed discussion on the rationale for the selection of these priority technical areas and specific activities to be financed, please refer to Annex G - Technical Analysis):

- Bioscience and Biotechnology

Bioscience/biotechnology represents the use of a biological system to produce a product, the use of a biological system as a product; or the use of advanced biological techniques to indirectly provide a product, process or service. This area of concentration brings contemporary and emerging technologies to bear on some traditional as well as new problems in Thailand. The relevant technologies are based on the fundamental abilities of living organisms as well as the bioengineering or advanced technological principles embodied in bio-product processing or packaging. The methodogies have direct relevance to plant, animal, marine or aquacultural, and chemical or health-related industries. They include tissue culture, cloning, protoplast fusion or embryo transplant for plant, fish or animal product improvement; and genetic engineering for vaccine and diagnostic development, while building the foundation for improvement in all of the above. They also include bio-product processing (thermal, frozen, extrusion, extraction, or fermentation) or bio-product packaging techniques to enhance the development of higher valued commercial products.

Bioscience/biotechnological methodologies may make it possible to achieve timely quantum leaps in problem resolution, and strengthen the foundation of biologically-based industries or open new industrial opportunities. The area of bioscience/biotechnology was further selected because it can: improve the nation's rich natural and renewable resource base and potential; focus on industrial developments which have proven economic value or which have obvious economic potential for the future; utilize the disciplines wherein Thailand has good technical capability, and meet some of the nation's high priority goals.

A few RD&E activities to be focused on in this priority technical area include: giant prawn production through hormonal control; bioconversion of cassava to more profitably utilize raw materials; transfer and use of embryo transplant technology for milk yield improvement; cloning of improved carrageenan to enhance the product's competitive advantage; tissue

culture for maize improvement; cloning for catfish yield improvement; retortable pouch utilization for reduction in container costs; hormonal spawning for yield improvement; bioproduct packaging to reduce produce loss; utilization of advanced tropical fruit juice technology for product enhancement; biotechnological development of virus-free potatoes; and adaptation of recombinant DNA and monoclonal antibody technology for vaccine and diagnostic development and control.

Material Technology

Material technology represents the extraction, refinement, and high temperature processing and polymerization of inorganic and organic based natural resources. It includes existing and emerging methodologies to address some traditional as well as new problems in Thailand. The relevant material technology methodologies, therefore, focus on ceramics (classical and industrial), metallurgy (tools), mining (mineral refinement), and polymers (rubber, wood and plastics). They include preparation of high quality raw material and the economically feasible conversion of raw materials to higher value states. The existing processes and products, involving this broad area of material technology, are generally of low quality and lacking in consistency. Material technology was selected for priority focus because of Thailand's natural resource base, its potential for making qualitative improvements in industrial processing, and its available human resources. It is also a high national priority.

Illustrative problems to be focused on in this area are: poor and inconsistent quality of ceramic materials; improvement in metallurgical quality and corrosion control; development of kaolin refinement procedures; improvement in firing and glazing technologies; transfer of industrial ceramic technologies; assessment of machine and tool development potentials; survey of the technological needs of the metal industries; improved mining and mineral processing technology; improved rubber milling technology; assessment of wood technology needs; and the development of a more consistent plastics polymerization process and control.

Applied Electronic Technology

Applied electronic technology represents the application and use of computers and the practical application of electronic principles for industrial improvements. Unlike the other two areas, it is not based on natural resources, but it is important to help the natural resource based industries achieve competitive status, by improving their controls, producing to standards and quality, and increasing productivity. The country must be fully-capable of storing and using information for increased/quality production as well as gaining access to export markets. Thailand is well behind countries like Korea, Taiwan and Singapore in application and use of computers.

RD&E activities to be focused on in this area include the problems of inadequate computer application and insufficient technology application for software development. Software development would be confined

only to areas of concentration that are within the scope of this Project. Prior to financing specific activities in this area of concentration, the RTG/USAID and the TA contractor will ensure that the planned activities will complement and not supplant private sector activities.

Categories of RD&E Activities

An amount of $30 million, out of a Project total of $49 million, has been allocated for this Project element. The bulk of this resource will be used to build a solid indigenous RD&E foundation in support of priority development needs. Three different types of RD&E activities to be funded, in each of the technical areas above, are designated, competitive and company-directed. The selection of the various kinds of RD&E activities and the estimated total costs are based on known needs of S&T institutions, problems faced by industries, as identified by US and Thai experts, and development priorities of the RTG. While the estimated total for the designated RD&E program is relatively firm, it is difficult to predict demand for the other two types of RD&E activities. Lacking history of RD&E use by the private sector and competitive funding of RD&E in Thailand, demand for private sector and competitive RD&E funds will be evaluated and adjustments to allocations proposed here will be made. Similarly, while we have estimated the average costs discussed above, our experience may prove the average cost to be less or more. The total number of activities to be funded will be adjusted accordingly.

(a) Designated RD&E

The designated (problems and institutions) RD&E activities will provide resources for work on known, high priority problems, in accordance with RTG policy. The conduct of the work itself will simultaneously build the capacities of the designated institutions in areas deemed essential for present and future industry growth. These activities will enhance the development of state-of-the-art technologies, or absorb emerging technologies, in various areas and solve crucial problems. All work will be of generic interest for industry, and also be aimed at strengthening the S&T infrastructural base so as to help sustain industrial growth. The rationale for selecting each problem area may be found in Appendix 1, Annex G. Accordingly, other RD&E activities will be developed as the Project is being implemented. The shortlisted institutions for each problem area have been selected based on needs, qualifications of scientists and technologists and other situational factors. The institutions listed will be invited to prepare proposals for the designated RD&E activities. The criteria and operating procedures to be used are listed in Annex K.

The designated RD&E institutions in specialized fields will be linked with leading institutions (public or private) in relevant fields in the US. Each designated RD&E proposal will budget an appropriate amount for the technical support required from the linked institution. STDB's TA contractor will work with the Thai RD&E institution in identifying the linkage partners and making all necessary arrangements.

It is expected that a total of 48 designated RD&E proposals, at an average cost of $250,000, for a total of $12 million will be funded under the Project. AID will pay 75% of these costs out of loan funds while the RTG will contribute 25% through budgetary allocations. These cost estimates are inclusive of all technical assistance, equipment, operating and other costs. The estimate of $250,000 per designated RD&E project is based on an assumed multi-disciplinary approach involving substantial amounts of time of two to four key investigators, at least one post-doctoral fellow, one Ph.D. assistantship and four technicians. Modest to moderate amounts of equipment and supplies will also be required. This concentrated focus will be necessary to evolve timely results of high quality, so as to be of interest to industry. The $250,000 cost estimate is further based on experience with more narrowly focused Program in Science and Technology Cooperation (PSTC) grants abroad, and academic and industrial RD&E project costs in the US (academia and industry), adjusted for Thai cost differences. It has been estimated that about 48 projects over a four year period will go a long way in upgrading the institutional capabilities in the priority areas, with the greatest potential.

The following is a listing of USAID and RTG agreed upon designated RD&E agenda for the first year:

Table 2
Summary of First Year Designated RD&E Projects

Problems	Institutions
Bioscience and Biotechnology	
a. Plant, Animal and Medical Biotechnology	
. Tissue culture technology to improve yield and reduce disease problems in maize, potatoes, cowpeas and tropical fruits	Kasetsart University Chiang Mai University Khon Kaen University Prince of Songkhla University
. Embryo transplant to improve milk yield	Kasetsart University Chulalongkorn University Mahidol University
. Hormonal control of giant prawn production	Chulalongkorn University Mahidol University
. Vaccine and diagnostic development (Disease control & industry development) and recombinant DNA and monoclonal antibodies	Mahidol University Dept. Med. Science Chulalongkorn University
b. Bio-Product Processing/Packaging	
. Advanced technology for cassava bioconversion and product production to improve value	TISTR Kasetsart University Chulalongkorn University

. Advanced technology for juice enhancement and cocoa development	Kasetsart University Prince of Songkhla University Chiang Mai University Khon Kaen University
. Bio-product packaging to reduce loss	TISTR Kasetsart University Chiang Mai University
. Bio-product spoilage/rejection	Chiang Mai University Prince of Songkhla University TISTR

Material Technology

. Refinement techniques for producing high quality kaolin	Department of Mineral Resources (DMR) TISTR Chiang Mai University
. Improvement in quality and process control in classical ceramics	Chiang Mai University Chulalongkorn University
. Transfer and modification of industrial and fine china ceramic technology	TISTR Chiang Mai University Chulalongkorn University
. Survey of technological needs of metal industry (including feasibility for machine and tool industry)	TISTR
. Cashew nut shelling	Khon Kaen University Prince of Songkhla University
. Improved technology and control in southern mines	Prince of Songkhla University
. Rubber technology improvement	Prince of Songkhla University

Applied Electronic Technology

. Computer application enhancement	ISEC/NIDA (National Institute of Development Administration KMIT PSU, KKU, CMU, CU, MU, KU, MOSTE
. Software development	KMIT Chulalongkorn University

(b) Competitive RD&E

These competitive RD&E activities will have problem solving as a primary objective. The selection of specific problems and institutions will be made in consultation with the private sector over the life of the Project. The Project funds will be used to bridge the gap between the RD&E institutions and the continuing generic needs of industry. The projects will be totally driven by the demand-side of RD&E. In the process of carrying out competitively funded RD&E activities, each activity will also contribute towards capacity building in Thai RD&E institutions.

Basically, the solution of competitive RD&E problems should result in new/improved process(es) and/or product(s), improved state-of-the-art technology in Thai industry, and have relevance to development (i.e. potential for enlarging employment, increasing export, expanding equity/income distribution, or creating a more balanced industrial growth. In selecting the problems for study, special attention will be given to the solution's potential spread effect, downstream investment potential, effect on cost-savings, productivity or quality improvement, and whether they have been identified by small/medium scale rural industries in non-Bangkok areas. The criteria and procedures to be used in making the selections are contained in Annex K.

A sum of $9 million will be set aside for competitive RD&E activities. AID will pay 75% of these costs using loan funds, while the RTG will pay the balance out of its contributions to the Project. It is expected that an average of 15 RD&E competitive activities will be funded annually for a total of 60 over the first four years at an average cost of $150,000 each. The average cost is based on the highly successful use of this level of funding in PSTC/AID grants now underway in Thailand. These projects will be more narrowly focused, with fewer collaborators, and will have a lower expectation for institutional building, then exists in the more highly funded designated RD&E projects. The estimated number (60) of projects is believed to be the minimum that will yield a sufficient number of successful results to demonstrate to industry, the ability of indigenous RD&E efforts to solve local problems.

(c) Company-Directed RD&E Activities

While competitive RD&E activities will be demand-driven and will be conducted for or by industries, company directed RD&E activities will represent the most advanced stage of progression toward the self-sustaining commercialization of RD&E. A company, or a combination of companies, may undertake a self-directed and self-financed RD&E activity from a special fund to be established under the Project. The Fund is proposed on the assumption that the return on investment in company and industry directed RD&E is adequate to allow for the recovery of RD&E costs, and that establishment of a credit facility to finance a portion of the "front end" development costs and reduce the risk of failure is an effective means of encouraging Thai industry to undertake RD&E for its own technical problem solving. It is a necessary component of a comprehensive endeavor to reduce

Thailand's dependence on foreign technology.

The RTG has established a special fund to provide loan financing for private sector RD&E. The current Thai annual budget allocates Baht 15 million to the MOSTE for this purpose. AID funds in an equivalent amount ($550,000) will be made available each year to the STDB. The AID funds will be administered jointly with the MOSTE loan funds and will be made available to private companies on a "venture capital" basis. The AID funds would buy a 25% interest in the results of the RD&E work. If successful, the company would pay royalties to STDB. If the RD&E work results in failure, the company would have no further obligation to STDB, other than repayment of the MOSTE loan.

The company would agree to meet 50% of the research project costs with its own resources if the project is approved. 25% of the research cost would be financed with RTG loan funds at 10% annual percentage rate (APR), the RTG prescribed rate of interest. The remainder (25%) of the cost would be financed with AID funds. These AID funds will be provided by STDB to the company as a credit to be utilized for specified costs of the research proposal. Payment will be made directly by the bank agent of STDB to the supplier of the services upon authorization. This investment of funds by STDB will entitle STDB to a 25% equity interest in any intellectual property rights derived from the RD or E. STDB may pass on these rights, or a portion of them, to the participant university or government RD&E laboratory.

Further refinement or modifications in the terms of the incentive structure described above may result from subsequent discussions among USAID, STDB, and the agent bank. Initial experience with the program, in which company demand for such financing begins to manifest itself may also suggest desirable changes in the ratios of the different funding sources. It may also be possible to persuade the agent bank to take a participation in the loan. The program will be structured to allow for adequate flexibility to tailor the terms to suit the demand.

The approach is similar in concept and purpose (although not in its mechanics) to the Canadian "Program for Industry/Laboratory Projects" (PILP). It is designed to encourage companies to take advantage of technology in the form of scientific and engineering knowledge and resources existing within government laboratories and universities. The availability of this program, and the funds behind it, is intended to stimulate government laboratories and universities to market their skills and capabilities with the private sector. Additionally, under certain circumstances private companies may also undertake in-house research under this program without participation of government or university laboratories. In such instances AID funding will be restricted to finance only actual cash expenditures of the research performed.

AID's initial funding of $550,000 will be matched by an equivalent amount of RTG funds. The two funds together will then be matched with an equivalent contribution from the private company. Thus there is a 4/1 impact ratio for the AID funding contribution.

The intellectual property rights accruing to STDB from this program will contribute to STDB's future income sources. It will also focus STDB's attention on the policy issues associated with the protection of intellectual property rights in Thailand.

A sum of $9 million is expected to be spent for the company-directed proprietary RD&E program. Half of this amount ($4.5 million) is expected to be contributed by the private sector companies participating in this program. AID loan funds in the amount of $2.25 million will be matched by RTG funds in an equivalent amount. The average company-directed RD&E cost is estimated to be $500,000 for a total of 18 activities. For further details, please see Annex K, Criteria and Operating Procedures.

(d) RD&E Support Activities

Two types of activities will be funded in support of the RD&E component of this Project. This includes long term M.S. and Ph.D. training in priority technical areas which are currently in short supply. Project funds will also support workshops/symposia, conferences and other professional exchanges in support of RD&E activities.

Grant funds, in the amount of $1,000,000, have been set aside to finance 25 Ph.D. (48 month duration) and 30 M.S. degree (30 month duration) training in Thai universities. The objective here is to ensure an adequate supply of highly trained professionals within the three priority technical areas. An adequate number of qualified professionals with M.S. and Ph.D.'s, mostly educated in the US, are members of the faculties of the leading universities in Thailand. Graduate programs have been developed at some institutions, and are being developed at others. The support for Thai students to study abroad has diminished. As Thailand now seeks to gain self-reliance in S&T, it should and can move forward with the training of its own students. Graduate assistantships provided through this Project will make it possible for students to seek advanced degrees and professional careers through these institutions. Examples of areas where shortages exist include ceramic engineering, genetic engineering, and computer application. This activity will also indirectly benefit the institutions which offer these programs. The implementing agency, STDB, will identify areas of specialization on which to focus, and in conjunction with DTEC and develop the criteria and procedures to be followed in the selection of participants and programs.

In addition, $500,000 will be set aside in support of activities which foster private and public sector linkages in the transfer of technology. These activities will: a) facilitate the transfer of technologies to other professionals and end-users; b) contribute to the strengthening of local professional societies; and c) help develop technology enhancement linkages with scientists and engineers in Thailand and the US. The costs to be financed hereunder include travel, per diem, technical assistance, publications and other incidental costs associated with such activities. Symposia, conferences, workshops, exhibits, professional short-term training and seminars are excellent support mechanisms to achieve these objectives.

4. Industrial Development Support

This component of the Project is designed to provide support to industrial development in three key areas. First, standards, testing and quality control will be strengthened in order to make more reliable standards available to industry and to improve quality control in the production process of industry. Second, a Technical Information Access Center will be supported by the Project to permit industry and S&T institutions to remain current on technological choices available in the international markets, to know how to search for those technological choices and to assess their comparative benefits and costs. Third, a Diagnostic/Research Design Service will be established to offer well publicized low cost technical assistance services to industry to diagnose technical problems and identify requirements to solve these problems.

(a) Standards, Testing and Quality Control

Thai exports are beset with quality control problems. Shipments are sometimes rejected at the point of delivery because they do not comply with international standards. Thai consumers express a preference for imports over similar domestic products because they seem to lack confidence in the quality of the local product.

The term standards generally refers to documentary standards (criteria) against which the quality of finished products is measured. This activity is performed by Thailand Industrial Standards Institute (TISI). Well maintained and calibrated testing facilities are required to measure the quality of a product or process against the documentary standards. Metrology, calibration and testing are being operated by Department of Science Sevices (DSS), TISTR and some universities. Quality Control (QC) refers to a series of activities which are carried out to build quality into the product at each step in the production process. Quality control is considered by senior Thai S&T planners as Thailand's most critical need which deserves priority focus under the S&T Project.

The number of problems faced by domestic producers in producing quality products are many. There are limited or no criteria and/or measuring capacities to judge the performance of Thai products in given environments. Many of the measurement standards in use are not traceable to internationally accepted standards. The existing metrology and calibration services in Thailand are fragmented and require rationalization to improve their efficiency and reliability. There is insufficient interaction between public and private sector laboratories. There is a very limited laboratory accreditation system. The effort to encourage industry to promote standardization and assist industry in establishing quality control is weak. The RTG considers the problem of quality assurance, particularly as it relates to Thai exports, a critical concern and has included it in its recent statement which identified priority areas requiring action.

Two approaches will be used to improve the quality of Thai products: one approach focuses on establishing testing programs which will lead to rejecting products which do not meet given standards; a second approach aims at minimizing rejections by making improvements in the production process itself. Fortunately, the adoption of these two approaches does not require the establishment of new organizations, nor is there a need for massive upgrading of equipment. Thailand is also fortunate to have some maintenance and servicing facilities.

This Project activity is also designed to support the RTG's efforts to improve the quality of Thai products as part of its domestic "Buy Thai" campaign, as well as making its export drive a success. The activities proposed hereunder build upon Thailand's existing physical and human resources. Specifically, the Project funds will be used to:

(1) coordinate and reinforce the activities of existing standards organizations through the Standards, Testing and Quality Control Office of STDB. A coordinating committee composed of representatives of key standards organizations including, but not limited to, TISI, TISTR, DSS, Division of Measurement Control (DMCO) and selected private sector representatives will be established. The staff of STDB supported by a full time senior advisor, in the area of quality control and selected short term (64 person months) consultants in the areas of quality control, standards and testing, will help the committee plan, streamline and interlink the functions of standards organizations. This coordinating mechanism will also be used to help improve the delivery of services to private sector organizations;

(2) strengthen the capacity of key organizations by training eighteen professionals (up to one-year duration) in the US in the areas of quality control and in maintenance of standards and associated calibration work in selected areas;

(3) sponsor a series of 25 workshops and training courses for the users of measurement standards in Thai industries to be conducted by key standards organizations with the assistance of mostly local and selected foreign experts;

(4) establish a national voluntary laboratory accreditation system which will be open to both public and private organizations aimed at improving performance so as to increase the international acceptability of test results. MOSTE's efforts will be supported through STDB by provision of technical assistance and needed equipment in the establishment of a laboratory accreditation authority within the Ministry.

(5) sponsor a series of 25 quality control workshops both in Bangkok and in other regions on a regular basis to promote quality in the production process. The participants will represent employees of Thai industries plus representatives from the public sector. The areas to receive focus in this program will include the principles of quality management, quality control, engineering, statistics in quality control and participative

management (quality circles). The efforts of the private sector in instituting quality training programs in their plants will also be supported by provision of technical advice;

(6) sponsor a comprehensive publicity program promoting concepts of quality in the production process. This program will be developed and launched by contracting media services and needed technical inputs; and

(7) lastly, selected upgrading of metrological equipment in support of the three priority areas of concentration will be financed under the Project. While many of the equipment needs have been identified, these will have to be carefully scrutinized prior to the commencement of any procurement.

In summary, inputs to be financed under this Project include long and short term US technical assistance ($1,500,000), US training ($250,000), in-country training inclusive of workshops on the use of standards and on quality improvements ($500,000), promotional activities ($100,000) and equipment ($1,500,000). The total cost of this Project activity is $3,850,000. The technical assistance is calculated at $600,000 for long-term and $900,000 for short-term personnel. The 50 in-country workshop and training courses are calculated at $10,000 each, for $500,000. Examples of equipment needs include $50,000 for precision melting point temperature calibration; $40,000 for photometers and monochromators; $75,000 for testing equipment (photometric, voltage, light, color); $300,000 for analyzers (starch, protein, amino acid, spectrophotometer, fluorometer, high pressure liquid chromatograph, analytical centrifuges etc.); $200,000 for analytical chemistry equipment (mass spectrometer, octane analyzer, thermal gravimetric analyzer, elemental analyzer, nitrogen analyzer, pograph and conductivity meter); $300,000 for ceramic and metal testing (ultrasonic nondestructive; torsion, high temperature microscope, stereo microscope, electron microscope, induction furnace, magnetic separator, brightness tester etc); $300,000 for electric and electronic (frequency standardization and acoustics testing, high power loading); $235,000 for testing equipment (hardness, abrasion, crack, crimp etc.). All of these equipment needs will be purchased from the US. Except for US training which is grant funded, all of the costs will be financed using Project loan funds.

(b) Technical Information Access Center

There are unmet or inadequately served information needs in Thailand, that are particularly relevant to the achievement of the development objectives of this Project.

(1) Scientific and technical RD&E is being undertaken in Thailand without adequate information about the results of other related research that has been completed or is underway in other countries;

(2) "Buy or Make" decisions, with regard to undertaking problem solving RD&E in Thailand, are being made without current and reliable data on the availability of technology in Thailand and/or other nations.

(3) Investment decisions to purchase foreign technology are being made without adequate information about the technological choices available to the Thai investor and to their relative costs and benefits;

(4) It is likely that investments in important economic sectors are not being made because of the investors inability to obtain reliable information about the state-of-the-art and their perceived risk of undertaking an investment in a manufacturing process that may be obsolete or not appropriate to the Thai context.

A Technology Information Access Center (TIAC) will be established to meet these needs. It will serve two primary sets of clients.

- the RD&E community,

- the business and investment community.

The TIAC, to be established, can be viewed as a "suspension" bridge", with one pier in Thailand and the other in the US, linked by high speed communications. The "pier" in Thailand would provide an access point for the Thai business and RD&E communities to the vast and widespread technology data sources located in Thailand and abroad. The "pier" in the US would be a designated representative of the Thai TIAC who would secure access to the multifold networks of data bases and S&T information sources in the US The "link" between the two "piers" would utilize, as appropriate, special satellite channels, commercial telex, international courier service, and international mail. The objective would be to provide turn around service in 7 to 14 days from inquiry to full response.

The proposed "Technology Information Access Center" will build on and supplement existing facilities and services to create a modern information service to provide reliable, low cost, high speed service to the Thai investment decision maker, whether he be in the private sector, in the academic RD&E community or in government. The activities to be financed under the Project include:

. The existing TISTR National Documentation Center (NDC), will be modernized by utilizing digital and microfilm technology for storage and retrieval of information. It will be linked through an EDP and communication network with Thai university libraries, to serve the RD&E community. University science/technology libraries will be similarly modernized and integrated into the data network.

. A branch of the Technical Information Access Center will be established to serve the business and investment community. It will be located at and managed by the "Association of Thai Industries" (ATI) as an agent for STDB. It will utilize existing S&T data bases (TISTR's National Documentation Center; the compilers of various private and public trade and product manufacturing indices, business publications, government data sources, and data from producers associations etc.) and enhance these primary information sources with its own data base, to arrive at a comprehensive

compilation of Thai S&T and production information, with an ability to retrieve that information rapidly.

. The "pier" in the US would serve both TIAC-ATI and the TIAC-NDC. It will be located at the US/ASEAN Center for Technology Exchange in New York and linked electronically with TIAC in Bangkok. It will not create its own data base; rather it will build access to a network of information sources that will allow it to be responsive to requests from Thailand. Some of the sources will be automated, others will be human, and accessable via telephone.

Organizationally, the Manager of TIAC-ATI will report to the Project Director of STDB. The Manager of TIAC-ATI will be physically located at the ATI. He will have responsibility over the TIAC operation at ATI and the US Representative's operation. He will have authority to direct the work of TISTR's National Documentation Center (TIAC-NDC) as it relates to TIAC's function, particularly those aspects dealing with their links to university libraries and their processing of scientific information requests to the US representative. Schedule of fees to be charged for services will be authorized by STDB upon recommendation of the TIAC Manager. All fees collected will be retained by TIAC. It is intended that TIAC will be financially viable by the end of the Project.

The TIAC will be established and made operational by:

. executing an agency agreement with ATI to establish TIAC-ATI on their premises;

. modernizing the NDC and enabling it to act as the center of S&T data;

. execute a contract with the US/ASEAN Center for technology exchange in N.Y. to act as US representative for TIAC;

. contract with a data processing center in Thailand to service TIAC requirements, including development of necessary software;

. lease telephone lines for linkage of TIAC-ATI with the TISTR National Documentation Center (NDC) and Thailand's Universities; and

. purchase communications and data storage for TIAC-ATI, TIAC-NDC and for each university in the network.

Total cost of this activity is estimated at $2,650,000. Major cost components are for technical assistance ($350,000), equipment ($400,000), operating costs ($1,750,000), and short term training ($150,000). With the exception of short-term training which is grant funded and RTG contributions of $125,000 towards operating costs for this activity, all of the costs will be financed using Project loan funds. A more detailed description of costs and this activity may be found in Annex L.

(c) Diagnostic/Research Design Service

Diagnosing technical problems encountered by Thai producers, and designing methodology for RD&E to solve those problems, is a major deficiency in Thailand today. Its resolution is essential to achieve success of this Project. The recent "Buy-Thai" campaign to shift consumer demand away from imports and towards domestic products faces the difficulty that the public feels that Thai products do not meet international standards. As the competence of Thai RD&E facilities is upgraded through other activities of this Project (i.e. designated RD&E), it becomes important to make the results of that competence available to the productive sector.

Industrial consultancy services, drawing in part on the personnel of these upgraded facilities, could bring about quality improvement of Thai products. There is a tendency among Thai manufacturers to disparage the worth of indigenous consulting firms. They assume that competent solutions are available only from foreign sources. Resistance to employment of local consulting firms also stems from a) uncertainty about the "track record" of these firms, b) concern about their high daily fees and c) a preoccupation with secrecy of company affairs.

This activity is intended to rationalize and speed up the development of the technical service industry in Thailand. It is also intended to identify important areas in which Thai industry requires RD&E support, and to facilitate the preparation of well conceived RD&E designs for financing under the RD&E activities of this Project. It will also help Thai manufacturers identify production problems that do not require new technologies but can be solved by applying technical or managerial knowledge that is already available. It will build momentum for the enhancement of RD&E in Thailand by creating a relationship between the domestic consulting industry and Thai producers to achieve technological improvement. It is another important link between the suppliers of technology and those who use it.

A small service unit, offering well publicized low cost services to industry by providing local and foreign short-term technical advisors will be established to help producers diagnose technical problems, identify technical needs, structure feasibility studies and design RD&E projects to solve those problems. The service unit will have only a skeleton staff, but will draw on qualified Thai technical RD&E personnel at universities, government research laboratories (enhanced through designated RD&E activities), and private consulting firms. These indigenous capabilities will be supplemented as needed with foreign technical advisors. User charges will be structured to make the activity at least partially self supporting by the end of the Project's seventh year.

The service will be offered at a "Request Center" headquartered at the Association of Thai Industries where it is easily accessible to the Thai industry. It will be located in the same premises as the TIAC. It will have its own budget, charge fees for its services and be responsible to the STDB, which will provide supplementary funds for its operation.

This activity will be implemented through a contract with ATI to establish the service. A "Request Center" will be established to:

- assist manufacturers, technologists and scientists in formulating requests for diagnostic or research design services;
- maintain a register of consultants, technologists, scientists, and consulting firms whom it recognizes as having credentials and qualifications to offer service;
- publicise and market the services offered by it to industry, financial intermediaries and technologists;
- set standard charges and fees for consultancy services offered by associated consultants; and
- establish a code of conduct for consultancy services.

The "Request Center" shall not provide consulting services with its own staff. Sources of technical specialists shall include:

- Thai university faculty
- Thai engineering institutes
- Thai government laboratories, including TISTR
- associated financial institutions such as IFCT
- Thai private consulting companies
- UN technical assistance agencies such as ESCAP, UNIDO,
- US bilateral assistance activities including IESC, activities financed under this Project, and
- any of the western bilateral assistance programs that are willing to participate in this activity.

Total funding for this activity is estimated at $950,000. Major cost components are technical assistance ($100,000) and equipment ($50,000) and operating costs ($800,000). With the exception of $75,000 of operating expenses which will be financed by RTG contributions, Project loan funds will be used to finance all of these costs. A more detailed description of this activity and costs may be found in Annex M.

IV. RELATIONSHIPS WITH OTHER PROGRAMS, POLICIES AND ACTIVITIES

A. Relationship to Other USAID Projects

The S&T for Development Project will both benefit from and reinforce two other major USAID projects. The first, Agricultural Technology

Transfer (493-0337), is a $5 million Project to accelerate public and private sector capacity to identify, introduce, and manage modern traditional agricultural technology. The Project was initiated in late FY 1984. The Work Plan for FY 1985 consists of the following technology transfer sub-projects:

- low moisture packaging to prevent seed deterioration;
- drying technology to control aflatoxin contamination in agricultural products;
- fresh fruit and vegetable quality improvement;
- control of black mungbean Macrophoming Phaseoli contamination;
- improved yield and quality of fish products; and
- improvements in cultural practices to reduce fish losses due to disease.

Most of these subactivities are areas of potential supplementary investigation and support with advanced technologies under the S&T Project. Implementation of both projects will be carried out so that the two projects are complementary. They will draw on a different cadre and employ different technologies.

A second major USAID Project, Rural Industries (RI) (493-0343), is being designed for implementation in FY 1986. The primary focal point of Project support will be the promotion of agro-industry. The expansion of agro-processing industries will have powerful backward linkages to agricultural employment and forward linkages to transport and other sectors. It will link very closely to and be supported by the S&T Project activities in this area.

A key element of the RI Project will be the creation of a special staff unit in the financial implementing agency (probably IFCT) dedicated to assisting agro-processing enterprises. The unit is intended to ensure that comprehensive project planning is undertaken in each case, to take adequate account of aspects of agro-processing that have proved difficult for such ventures to overcome in past experience - viz. reliable raw material supply arrangements with large numbers of small farmers, adequate medium-term financing to cover the gestation period of the Project, appropriate and adequate arrangements for technology choice and efficient plant operation, etc.

During the design for the RI PID, it became evident that technical problems had frequently hampered development of agro-processing enterprises, and that it was not uncommon for such enterprises to either fail to overcome these problems, or to succeed only by trial and error learning. Given the high cost of working capital credit in Thailand, trial and error has the major disadvantage of stretching out the gestation period of a venture and creating serious problems of medium-term financing and profitability.

The S&T Project will be able to provide an important assist to the agro-processing facility. The diagnostic service will provide the unit with a systematic access to sources of specialized consulting capabilities, since the unit itself will not have an extensive in-house technical capability. The TIAC will provide the unit with access to technology sources. In developing

the RI PID, examples were identified of enterprises that failed to solve specific technical problems relying on the potential sources of expertise that happened to be known personally to the management of the firms interviewed. While reliance on personal contacts may often work, such a system for access to technology is basically amateurish for a modern business sector and must be replaced by systematic access procedures.

The link to the agro-processing units will also provide STDB with direct knowledge of agro-processing technical problems that should be considered for RD&E by them. Thus relations between the agro-processing unit and the STDB executive staff will be an important source of current information on private sector problems needing research, in one of the country's most important industrial sub-sectors, and conduit for establishing relationships between producers and S&T facilities which are now very weak.

A second focus of the RI Project will be on town-based small and medium scale enterprises (SMEs) producing consumer goods, agricultural machinery and implements, and other small-scale manufactures for provincial markets. Entrepreneurs planning to expand capacity or develop new product lines (in effect up-country import-substitution against Bangkok or foreign suppliers), represent an important group needing technical assistance. The RI Project will strengthen Thailand's industrial extension and outreach services to help provide better information and low-cost assistance to these entrepreneurs. Both the TIAC and diagnostic services will be useful to these functions to provide wider information back-up than would be available otherwise. RD&E needs could also be communicated to STDB should they arise, although the scale of such enterprises makes it likely that some problems common to numbers of SMEs will be identified by the different services devoted to provincial enterprise. The STDB staff would need to develop appropriate contacts for recurrent review of the experience of these services, so that general problems could be identified in a fashion similar to the identification of problems general to large numbers of agricultural producers, none of whom individually could develop a research proposal.

Finally, mention should be made of the more modest but highly significant S&T activities underway with central funding support. USAID is currently cooperating with Thailand through grants made by the Office of the Science Advisor, AID/Washington. This program makes small grants to key Thai scientists and institutions for scientific and technological research that is focused on solving specific problems. During FY 1984, five such grants were awarded. For FY 1985, an additional ten grants have been approved. Through FY 1985 approximately $4 million in science grants will have been awarded to individual investigators within Thailand. These programs will continue as the Science and Technology for Development Project is being activated. It should be noted that the O/SCI program in Thailand is the largest of all in countries currently participating.

All of the USAID projects reviewed above will be coordinated by the Mission, and the RTG.

B. Relationship to the CDSS

The USAID/Thailand CDSS proposes a limited, concentrated program for the period FY 1985-1988. The Mission's program will be built around four basic elements: a) a focused loan program, b) a fund for policy analysis and program development, c) a fund to support private voluntary organizations, and d) increased use of specialized centrally funded activities. The loan program consists of the S&T Development and Rural Industries/Employment projects.

The CDSS analysis identifies both lagging rural production of quality products for export, and growing un- and underemployment as among the most serious political and economic problems which Thailand will face during the next decade. This suggests the appropriateness of major programs in these areas. In its forthcoming 6th Five Year Plan, the RTG will place high priority on technical and scientific modernization and the promotion of rural industry as means to stimulate production and increase employment. Science and technology along with rural industries are areas where no major comprehensive foreign donor assistance (with the exception of the Eastern Seaboard Development Program and various World Bank analytical studies) has been provided to date, and are undertakings identified by the NESDB as priorities for AID loan funding. AID's own analysis supports the conclusion that these two priorities are vital to an evolving Thailand, and notes historically that no developed country has achieved industrialized status unaccompanied by rapid technological change.

C. Relationship to AID Policies

Design of the S&T for Development Project has been an outgrowth of AID policy to engage in policy dialogue with cooperating countries, to promote institution building, to engage the private sector more actively in the process of national growth and development, and to apply science and technology more directly in solving of key development problems.[1] The matrix below outlines the principal policy, institutional, private sector, and S&T components of overall Project design.

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1 AID Policy Papers: Approaches to the Policy Dialogue, December 1982, Institutional Development, March 1983, and Private Enterprise Development, May 1982.

Figure 2

POLICY DIALOGUE	INSTITUTIONAL DEVELOPMENT
-- Analytical Capacity Building -- Establishment of STDB	-- Establishment of STDB -- Designated RD&E and RD&E Support -- Diagnostic/Research Design Service -- Standards, Testing and Quality Control -- TIAC
PRIVATE SECTOR	**SCIENCE AND TECHNOLOGY**
-- Competitive and Company Directed RD&E -- Diagnostic/Design Research Service -- Strengthening of Institutional Framework -- TIAC	-- RD&E Component -- Standards, Testing and Quality Control -- TIAC

The proposed Conditions Precedent and Covenants to the S&T Project go well beyond the norm because they reflect concrete actions that can make a difference in the future pace and directions of science and technology in Thailand. They reflect selected policy issues which have been extensively discussed with many elements of the RTG. The Project will provide support for continued policy research and analysis as an integral component of implementation activities.

Reviewers of this Project Paper will note that not only is the Project design based on substantive joint public-private sector cooperation, but it also provides for continuing inputs from and involvement of the private sector.

Institutionally, the Project is attempting to establish a framework that is mutually supporting in its structure, dynamic in its orientation, and capable of sound resource mobilization and management. Bringing the country's S&T private and public sector institutions together in a concerted national effort is an overriding objective of the Project. Creation of the STDB and its supporting network are the principle means of achieving this objective.

While AID has yet to issue its first Policy Paper on Technology Development and Transfer, the Project design team believes that it has constructed a fundamentally sound and achievable set of objectives and activities. Some of the best US and Thai scientists and technologists have interacted at length in determining the Project's components and objectives.

The Project is consistent with AID's Science and Technology Policy Determination which stresses development of policies and institutions that permit cooperating countries to make and implement better technological choices. Most notably, the Project's conception and design have drawn extensively from a BIFAD report on middle income countries which highlights the importance of creating scientific, technical, and educational capacities rivaling those embodied in the US system of higher education and research.

D. Lessons Learned from Similar AID Projects

In terms of magnitude and as an integral element of a "middle income" strategy, AID has no model in science and technology which lends itself directly to a bilateral Project of this nature. The AID experience in Korea does not easily lend itself to a free economy, as exists in Thailand, because Korea has a more centrally controlled economy. However several lessons have been learned which will help guide the evolvement of this program:

. build strong linkages between government, universities and the private sector so that R&D and S&T education and training are relevant to the needs and demands of the ultimate users;

. select and focus on key development problems for sustained research efforts;

. create policy and management environments that facilitate the development (including education and training) and effective utilization of S&T capacity in government, schools and universities, and the private sector; and

. maintain continuity in S&T policies and programs that reach small and medium scale farmers and firms and do not discriminate against them.

Egypt, with a proposed $100 million Multisector Science and Technology Project (263-0140) is mounting a comparable effort. USAID/India is also considering and planning for the launching of a major S&T program. The S&T undertakings in Thailand, Egypt and India should provide valuable experience for such future initiatives in other AID country programs.

E. Relationship with Other Donor Activities

The Royal Thai Government has concluded a bilateral scientific and technological agreement only with the United States Government to date. However, the RTG is considering similar agreements with the United Kingdom, West Germany, the Netherlands, Japan, Canada and Korea. Several have expressed interest in supplementary or complementary activities to this S&T

for Development Project. Canada has indicated interest in support of physics and mathematics as basic undergirding for the industrialization process. The Asia Foundation has distributed thousands of scientific and technological books and related materials. UNIDO has established a small technology information exchange center at Udorn.

The World Bank has a team of specialists studying areas in S&T based industries where they might work with the RTG, along with other donors. Liaison has been established for continued discussion at the appropriate time.

V. SUMMARY OF FEASIBILITY ANALYSES

A. Technical Analysis

1. Selection of Technical Areas

During the past 15 months, leading Thai and US scientists, technologists, administrators, researchers, and businessmen have been engaged in the process of reviewing the technical areas that should receive the Project's initial focus. Through this process, bioscience/biotechnology, material technology, and applied electronic technology were selected for priority concentration.

Bioscience/biotechnology was selected because it can build on Thailand's traditional agriculture and enhance agricultural productivity; it can improve the technological base for Thailand's food processing industries (i.e., bio-product processing and bio-product packaging); it can provide a competitive foundation for developing the health-related industries; and ultimately further develop the natural resources (forestry) and contribute to improvements in environment (air/water) areas.

Material technology was selected as the second area because it relates to Thailand's natural resource base, and encompasses the needs of the industrial sector of this country. Classical ceramics are of poor and inconsistent quality, and industrial ceramic technology has not been fully absorbed within the country. Most of the relevant technologies, except through isolated joint-ventures, are below state-of-the-art. High performance ceramic technology has not been introduced here. Raw materials are present. Kaolin and industrial ceramic components are imported in large quantities. Thousands of people are employed in Thailand's underdeveloped ceramic industries, which are barely holding onto their existence. Minerals are crudely mined, without currently available levels of technology for mining or processing. Crude ores are sold at low prices and imported in refined states at high prices. The metal or tool industry is underdeveloped. Hundreds of small manufacturing establishments produce low level quality products. Over thirty times more tools are imported than produced here. Sixteen hundred plastic plants produce low quality products. Several hundred wood processors lack technology, and over a hundred rubber mills are limited to the same low level of processing that they had decades ago. This area of concentration will build on the extensive, established industries, which are employing increasing numbers of people.

Applied electronic technology was selected as the third area of concentration because it is an obviously vital area within the country's industrialization movement, considering world competition in general, and more immediate competition from Korea, Taiwan, Hong Kong and Singapore in particular. The focus will be on computer use and application in government to gain efficiency and in industry to improve both efficiency and process control. Basically it will help industries produce to standard.

2. Technical Approaches to Address Identified Constraints

The technical approaches which are proposed have been chosen because of the unique manner in which they can resolve identified constraints or minimize their effects. The over-riding constraint of a lack of an institutional and financial mechanism to bring about the relevant, coordinated use of S&T capabilities in Thailand, for example, will be addressed by the establishment of STDB. No existing orgnization has the authority, resources or the flexibility to forge linkages between the university, government and the industry. This organization will be run by a private and public sector board with the authority to establish priorities, criteria and operating procedures and fund programs. STDB will seek inputs from the private sector regarding technology related problems and then invite S&T institutions in the public sector to design remedies to address the identified problems. This institutional arrangement thus provides the flexibility and needed mechanism to help bridge the gap that now exists between the users and producers of technology.

The activity directed at the review of S&T policy and practice will strengthen the capacity of Thai organizations to work toward the modification of S&T policy where necessary and strengthen practices where their weaknesses impede policy implementation. In short, the activity will strengthen analytical capability, support separate studies to highlight needs in policies and practices, and provide opportunities for dialogue between policy planners and those affected by their policies.

The lack of state-of-the-art technology in some industries, which is now a constraint to development, will be overcome by strengthening the institutional capacities of the designated RD&E centers, by provision of technical assistance through the linked centers of excellence in the US. In order to ensure that Thai S&T institutions acquire excellence and their efforts are problem focused, a critical constraint, a comprehensive competitive RD&E program has been designed. Under this activity, private sector industry will identify technology related problems as a first step and then S&T institutions will be competitively selected, based on the merits of their proposed remedies. The company-directed RD&E, on the other hand, will promote the use of indigeneous RD&E, and represent the ultimate extension of RD&E activities to industrial application. These activities will also encourage the expansion of in-house industrial RD&E capabilities, where currently only about five or six now exist, which certainly represents a constraint.

Some of the irrelevance and lack of timeliness of past RD&E programs, obvious constraints, have been due to the inability of RD&E workers to gain access to what has been done in other places of the world. Likewise decisions on whether to "make" or "buy" have been made by investors without adequate knowledge of the choices. The Technology Information Access Center reduces this constraint by making it possible for RD&E workers as well as investors to have access to the latest published technology or knowledge of the technological sources. This can improve the quality of the RD&E, as well as the technological choice made by the investor. The designated RD&E centers will thus be able to further enhance their relevance and capability. The Diagnostic/Research Design Service will help the Thai industry identify its problems and feed this information back to the S&T institutions to design appropriate remedies to address these problems.

Thai products are beset generally with poor and inconsistent quality, which are constraints to the retention of existing export markets. Shipments are also sometimes rejected, or discounted, at the point of delivery because they do not comply with international standards. This fact, as well as the image that goes with it, impacts adversely on the development of new markets. Thai consumers themselves lack confidence in the quality of local products. The problem is a national one, requiring the creation of an overall metrological and quality control program. Currently there are duplicities of functions in various organizations. There is also a real or perceived lack of awareness in or sensitivity to the importance of quality control, on the part of both the managers and the workers. These constraints will be met by coordinating and reinforcing the activities of the existing standards organizations through the STDB. Technical consultants will help key organizations streamline and interlink the functions of their organizations. Programs will be developed to focus attention on the principles of quality and hence improve awareness and sensitivity to its importance.

3. Indigenous Institutional and Professional Capacities

Thailand currently has seven universities with significant potential in one or more of the technical areas of concentration. Chulalongkorn has significant strength in the physical sciences, Mahidol University has a world-class biological capability, KMIT has unique strength in the practical aspects of engineering, Kasetsart University is pre-eminent in agriculturally/biologically-based sciences, NIDA has reputed capability in management science and each of the regional universities (Chiang Mai, Prince of Songkhla and Khon Kaen) have special capabilities related to regional problems. TISTR has twenty years of industry related experience and is currently being restructured for improved effectiveness. The Department of Medical Sciences is expanding with the creation of a National Institutes of Health. The Department of Mineral Resources has an extensive network and the Department of Inland Fisheries has a university-based facility. Numerous others may ultimately participate but these institutions will be the main public participants, and they are generally of the "quality-base" needed to launch this Project.

Most of the professionals in these institutions, with advanced

degrees, have obtained at least one degree at a US university. The facilities in which these professionals work are adequate. The professional competence of the RD&E personnel is very good. One proof of these professional strengths is that Thailand leads in quality and number of active and approved science grants in AID/W PSTC Science Grants Program in worldwide competition.

In summary, considering the existing capacities of Thai S&T institutions, technical inputs that are proposed to be provided under the Project, coupled with other interventions planned to address the identified constraints, this Project is both technically sound and feasible. For detailed discussion on the technical aspects of the Project, please see Annex G, Technical Analysis.

B. Economic Analysis

Thailand has gradually been entering a period of growing dependence on technology. The need to speed up this process in agriculture has long been recognized. The need in industry has been inadequately explored, while potential benefits and costs of the application of modern technologies to the emerging structure of Thai industry is even less thoroughly studied. Thailand's entry into the status of a "Newly Industrializing Country" (NIC) could be seriously hindered if its technological basis is not greatly strengthened. In the short run, the basic reorientation of Thai trade policy from import-substitution to export-promotion also has significant technological implications not normally attended to under "Structural Adjustment" programs; in contrast to protected import-substitution industries, manufactured exports must meet international standards at internationally competitive costs. The powerful association observed (in countries like Taiwan and Korea) between growth of manufactured exports and the domestic mastery of modern technologies has demonstrated the strong demand-pull effects on a country's technological needs and capabilities. The virtual certainty that Thailand will be experiencing a similar growth path makes it urgent that the domestic capability to meet these needs be strengthened.

Experience in other NICs also shows a pattern of technological development in industry. Technology is first acquired, largely from abroad; then gradually mastered as enterprises learn how to improve its application and make minor adjustments; then adapted through incremental changes and small engineering improvements for local conditions. Finally the capacity to generate completely new products and processes develops as the earlier processes create broad domestic technological capabilities. Gains in productivity from the modest learning and adaptation processes can be as large as the gains from the initial installation of a newly acquired technology. The scope for such incremental benefits has been demonstrated in Thailand in the specific case of the engineering industry, where substantial inefficiency was identified in a World Bank study, for the technology in use. One study of experience in several LDCs of the benefits gained (reduction in domestic resource costs in relation to FX saved) from the 5-10 year technological mastery process in technology-intensive infant industries, suggests benefits that would justify levels of effective protection up to 100%. As stressed in this Project analysis, Thailand already has invested substantial amounts in

building up its S&T human capital along with technical facilities at numerous universities and other facilities, but these capacities are largely unutilized for direct application to Thai industrial problems. For relatively modest cost, this Project aims to create linkages, to develop incentives for both sides to interact, and to study the policy framework (legislation, scientific wage and incentive systems, the structure of inter-institutional cooperation, the financing instruments for technology-based industries, etc.) within which technological capacity and technology acquisition, generation and adaptation grow and interact. The potential multiplier effect should be quite high.

To meet the Project purpose and serve its goal, it will be necessary to help the RTG strengthen a number of institutional capacities and technical/economic processes that underlie the development of modern technological utilization. The actual research agenda identified for the first round of research activities that will form part of this broad effort, has been selected after a thorough process of interaction between Thai and US scientists and Thai S&T and general development policy makers. The subjects chosen will include new areas for product development based on domestic resources and products, and new approaches to major problems or product opportunities that have not yet had the benefit of the research potentials of the technologies to be applied. As in all such RD&E, the outcome of any one line of attack cannot be known in advance, although the probabilities of success can be enhanced through careful screening of the options and a thoroughly professional conduct of the research. The extremely high returns to the development costs of research in cases like the wheat HYVs are well known. Early successes from even a modest number of the research lines on the first agenda could yield benefit potentials far in excess of the entire cost of the Project. As in all other research and innovational work, these subjects will also depend, for their ultimate impact, on the associated processes of extension and marketing, etc., depending on the extent to which a particular advance required an extensive diffusion to large numbers of producers.

The economic benefits from technological advances in health are relatively straight forward in concept, although often difficult to measure in practice. Vaccines are normally highly cost-effective in terms of curative costs and productivity losses avoided from the morbidities and mortalities prevented. Potential benefits and costs would need to be weighed separately in each case depending on the technologies and health problems involved.

With the above qualifications in mind, some preliminary indications of economic benefits that could be expected from a number of the designated RD&E activities and from the diagnostic and technological access activities are presented in Annex H. In summary form, the analysis indicates a) potential gains of Baht 1.3 billion per year (nearly $50 M) in maize export earnings from control of aflatoxin (multiples in one year, over the estimated RD&E costs); b) the importance of possible new product uses for cassava in the face of large-scale over-production and the 800,000 farm families involved; c) potential savings in external payments for technology transfer (licensing fees, etc.) through the technology search operations of the TIAC; d) the high multiple of technological diagnosis that could derive from introducing to

Thailand the systematic use of technical consulting to reduce inefficiency using the technology in current use; e) very large potential export earnings from specific technological problem-solving in marine shrimp production, with a doubling of this major export item (currently $140 M annually) not an infeasible target; f) substitution of domestically processed kaolin for imports (Baht 13 M in 1983), and creation of technological basis for technical quality ceramics to substitute for ceramic components now imported for a number of Thai industrial products including the currently very large scale production and export of integrated circuits; g) significant gains could derive from an upgrading of the institutional/ technological basis of the Thai mining and metallurgy industries. These represent a selection from the initial agenda of project activities.

C. Social Soundness Analysis

Thai society and government are primed for a major effort to develop science and technology in Thailand. Perhaps most important, the government is now prepared to lead such development.

Thailand has traditionally been and continues to be a society where patronage, family and ethnic ties, are important. Recently, however, such elements have weakened in their influence making way for the gradual but significant emergence of a technocratic and entrepreneurial elite. Such changes should help the gradual evolution of the role of S&T which the Project envisions facilitating. Thailand has a socio-cultural environment and history that favors such a development.

In Thailand there is no question that the infrastructure to spread the information, technology, and products of a S&T Project such as this one is generally in place, though there is room for improvement and adjustment. In the past decades, Thailand has developed extensive systems of roads, television, telephones, health centers, extension services, electricity, educational opportunities, transportation, distribution, information exchange, and commerce, even in remote rural areas.

The specific spread effect potentialities of this Project will vary substantially among the different components. The R&D activities that concern agricultural production (e.g. cassava substitution, new cassava-based products, improved fruit and vegetable packaging, etc.) will have wide effects in different parts of the country depending on the crops involved.

Some of the R&D work will focus on technologies that would need to be adopted by relatively concentrated producing units, e.g. the southern coastal areas where shrimp production is concentrated. Spread effects should take place rapidly, while secondary effects of the very substantial income generation inherent in this case would be very wide in terms of regional income and expenditure, government revenue, etc.

The technology service components are being designed to ensure appropriate connections with provincial outlets and networks. The TIAC and the Diagnostic/Research Design Service will extend their services in three

ways: 1) the Association of Thai Industries (ATI) has a nationwide membership (1,600 members) and will build its own channels into various industrial centers of Thailand, 2) the TIAC will be linked with the electronic data processing communications network linking Thailand's universities, allowing rural manufacturers to communicate directly with them, and 3) ATI will build links with similar efforts supported by other aid donor agencies now operating in rural Thailand, such as the UNIDO activity in Udorn.

The location and spread of RD&E work respecting industry generally cannot of itself counterbalance the economic and social forces that have resulted in concentration of 80% of Thai industry into the greater Bangkok area. The intent will be to ensure that rurally located industries are not underserved, as noted above, and to incorporate concern for the character of technology choices, especially the search for labor versus capital-intensive options into the workings of the technology services and the criteria for selection of R&D subjects and their research design.

The Project aims to create a multitude of non-farm employment opportunities through S&T developments beginning in such areas as bio-product processing (particularly food processing and packing), improved metallurgical industries, refinement of natural resources, and improved ceramic and rubber production. Higher levels of technology, increased productivity and higher quality or higher valued raw materials or processed products are needed to support more in-country investment, hence more employment.

Developments in biotechnology in such areas as reduction in aflatoxin contamination and control of disease in fish production would benefit the poor as producers and consumers. The development of new or improved fruits or vegetables which would be disease or pest resistant, would mean reduced application of pesticides - hence lower residue contamination. Vaccines for Japanese encephalitis, dengue hemorrhagic fever, and other diseases would also carry great health benefits to the rural poor.

Taken broadly, the flow of industrial technology in Thailand will continue to reflect the urban bias of industry (a phenomonon not limited to Thailand). Apart from the important question of labor versus capital intensity, the technology flow in industry is not in itself an important determinant of the distribution of the economic gains accruing to its users, compared with the conditions of skilled and semi-skilled labor supply, RTG minimum wage regulations and their enforcement, etc.

In sum, S&T is by nature an endeavor that must be conducted in the first instance by highly trained people. Its effects can be virtually universal on a society, depending on the specific technology involved, the efficiency of diffusion, and on the economic and social framework and the equity with which that framework allows assets and income to be generated and shared.

Project activities that would have a direct benefit on the majority of Thais who live in rural areas, and particularly on the rural poor, include benefits in non-farm employment, agricultural improvements, health, standard of living, and hopefully eventually in the environment.

For detailed discussion or questions of social/cultural feasibility, spread effects, and Project beneficiaries, please see Annex I.

D. Environmental Analysis

The Project meets the criteria for a Categorical Exclusion under 22 CFR 216.2 (c) (2) (ii) and (iii). A categorical exclusion is, therefore, recommended and requested in Annex F. Prior to funding of RD&E activities, each proposal will be examined for its environmental impact in accordance with the criteria and operating procedures detailed in Annex K.

E. Administrative Analysis

The critical contributions which this Project is expected to make to the resolution of the S&T development problem are a) facilitating changes to be instituted in Thailand's resource allocating process for S&T, and b) encouraging linkages and opportunities for interaction between industry and the producers of RD&E. Changing the resource allocation system will result in funding being directed to a different set of priorities (production problem solving) than in the past. New linkages generated by these activities between technical personnel in RD&E, and investors/producers, will encourage the utilization of available human resources to meet the technical needs of the economy and the commercialization of the RD&E results. It is intended that the private producers, the university academics, the public sector RD&E personnel, the government administrators and policy makers will be induced to interact through the proposed implementing mechanism to create the broader institutional framework discussed above.

The Project requires a single funding and coordination unit to give direction to the network of public and private institutions comprising the S&T community in Thailand in order to enhance the efficient allocation and utilization of RD&E capabilities.

The implementing organization will: 1) finance such RD&E as is identified as being demanded by Thai producers and is consistent with Thailand's development priorities; 2) upgrade the capabilities of existing Thai institutions to perform RD&E, provide opportunities for these facilities to engage available trained manpower and employ them on priority activities; 3) promote the use of indigenous RD&E and market the results of its products under an active publicity and sales program; 4) facilitate the establishment of a framework which provides and expands opportunities for public and private sector cooperation; and 5) support the RTG efforts in improving the overall policy environment to make it more conducive to investment in S&T activities.

Finally, the implementing agency should be a small and responsive organization which serves as a focal point for managing diverse Project activities and controlling financial resources. The implementing agency should not be overburdened with operational responsibilities, pulling it away from its catalytic role.

Within the scope of the S&T for Development Project, this organization should be able to discharge a set of specific functions as listed in Appendix 1 to Annex J.

The following questions were considered in evaluating the suitability of the available choices for an administrative structure of the implementation mechanism:

1. Should the organization be a public sector body (either as a part of a ministry or a state enterprise); or should it be a non-government entity, such as a private foundation or association?

2. Is it possible for an existing institution to take on the necessary functions or does a new institution have to be created? If a new institution needs to be created, is it possible to do so within the proposed implementation time frame of the Project?

3. Is the implementing institution to be a temporary organization whose functions will end with the completion of the Project, or is there a known or perceived need for a permanent organization, to continue to perform the intended functions after the Project is completed?

Various existing RTG ministries and government entities were considered as possible loci for the implementing agency. It was concluded that none existed that would be suitable to take on the required functions in their present form.

There is no existing non-government foundation, scientific or business association that has the scope and stature to take on the responsibility for the proposed functions. Moreover, such an entity, were it to be created, would not be acceptable to AID as the borrower of the AID loan without an RTG repayment guarantee. The RTG would find it extremely difficult to extend such a guarantee, or to provide RTG contributions to such an entity.

The alternative of breaking the program into individual pieces and administering each piece through a different organization such as through institutes, universities, and private sector organizations, was considered impractical and unacceptable to both the RTG and USAID. There must be a strong interrelationship among the various program activities for there to be a reasonable prospect of success. Therefore, the RTG and USAID have concluded that a single control point is essential. However, as can be seen in the Project description, different existing institutions that are part of the business and S&T community will be designated agents of the new implementing organization to take operational responsibility for discrete segments of the Project under the overall direction of the implementing organization.

The implementing organization needs greater flexibility than can be provided if it were a Thai government agency. It also requires extensive private sector participation in its management. On the other hand the character of AID loan funds, the intended uses of the funds and existing tax laws would rule out a purely private, non-government organization as borrower

and manager. However, state enterprises have a significantly greater degree of operational flexibility than government ministries, and do allow private sector participation in their management.

A state enterprise now exists, the Thailand Institute of Science and Technology Research, that has the requisite legal framework. However this institution (TISTR) also has other responsibilities (i.e. the operation of 14 laboratories) that would create a conflict of interest in its management of the tasks intended for the implementing agency. It is also in a period of transition to overcome certain managerial problems that might impede its effectiveness in assuming new responsibilities.

The alternative of creating a new organization and thereby more government, is not attractive either. However, new institutional and financial mechanisms will be required to forge effective public and private sector collaboration.

The Project design team has obtained agreement from all parties (RTG, TISTR) that the implementing mechanism will be a new independent sub-unit of TISTR, entitled to operate with all the authorities and flexibilities bestowed on TISTR by the Parliamentary Act in performing the designated functions, yet will be free from interference in its decisionmaking by the TISTR officers and Board.

It has therefore been decided that a Science and Technology Development Board (STDB), with the desired characteristics and the authority to perform the requisite functions will be created under the authority of the TISTR Act of 1979. TISTR's Legislative Act would provide the necessary flexibility for STDB's operations. STDB would be granted certain exceptions from RTG regulations to give it the necessary flexibilities to carry out its functions in a timely manner. At the same time it would be linked with TISTR and through it with MOSTE thereby enabling it to receive RTG funds and AID grants, as well as AID loan funds to the RTG. It would receive its direction from its own Board of Directors representing a broad spectrum of public and private entities (for details, see Annex J, Appendix 1).

STDB will be designed to manage all Project functions with a small staff to support each activity. This fixes responsibility for line functions clearly and practically. STDB will have the ability to disburse funds and act promptly by its delegated authority as outlined in Annex J, Appendix 1.

In an effort to attract highly qualified professionals to STDB's staff, competitive salaries will be offered to candidates selected for employment. It is envisaged that the professional staff would not exceed 20 individuals with expertise in the S&T related areas necessary to effectively implement this Project. Additionally, STDB will be supported by a Technical Advisory Committee and both long and short term technical services as described in Appendix 1 and in the Implementation Plan section of this paper.

As STDB will not be conducting operational Project activities such as RD&E, the management capabilities of the principal organizations involved will be very important. Examples of institutions with RD&E management capability include Kasetsart, Khon Kaen, Chulalongkorn, Chiang Mai, Prince of Songkhla and Mahidol Universities as well as TISTR, TDRI, KMIT and NIDA, among others. This capability has been confirmed through other USAID financed activities such as BOSTID research grants, the Khon Kaen University Research Development Project and the Agricultural Technology Transfer Project and visits to all of the institutions by Project design experts during June 1984 to January 1985. Impressive levels of competence have been observed in multidisciplinary fields of RD&E both through individual and collaborative efforts. For further details, see Annex G - Technical Analysis.

In summary, the adminstrative structure selected for the implementation mechanism answers the three critical issues (Page 40 above) as follows:

1. The implementing organization (STDB) will be operating under the legal framework of a state enterprise (TISTR) that will have been given additional flexibility to allow selective exemption from those RTG regulations that would inhibit prompt performance of its assigned functions. However, TISTR as presently organized is not operationally suited to act as the implementing agency.

2. An existing institution (TISTR) will provide the legal corpus for the STDB. However, the STDB will be a newly created sub-unit of TISTR, with full independence from the board and officers of TISTR with respect to the performance of its assigned functions. The only action required to create STDB is passage of a resolution to do so by the Board of TISTR at one of its regular monthly meetings. Funding can then be provided and recruitment of staff can begin.

3. It is clear that the functions assigned to STDB will be continued, but the administrative and organizational structure may subsequently take a different form (e.g., a private foundation). The RTG is understandably reluctant to establish a permanent entity at this time, which may later be difficult to dismantle. Given the scarcity of models available to guide the design team in structuring this highly innovative, broad scoped, multisectoral activity, it has been concluded that the STDB approach offers the greatest chance for success in initiating this activity. It is anticipated that the evaluation, scheduled for 1989 will provide a basis for determining the future course and structure of STDB.

The establishment of STDB as proposed, together with the technical and managerial inputs to be provided under the Project should permit the successful administration of this Project.

VI. IMPLEMENTATION PLAN

A. The Implementing Agency

The Science and Technology Development Board (STDB), will be established to act as the implementing agency for the Project. In order for it to receive financial support from and through the RTG, STDB will be incorporated as an independent entity under TISTR, immediately after the Project Paper approval, as a pre-implementation activity, prior to the signing of the Loan/Grant Agreement. The separate STDB Board of Directors, comprised of Thai public and private sector representatives, will be appointed under the authority of the TISTR Act of 1979, upon invitation from the Minister of MOSTE. (For detailed discussion on the composition and functions of STDB see Annex J.)

The functions of STDB, as described in Appendix 1 to Annex J, are:

. perform as a decision-making body;

. establish and fund services and programs to address priority S&T needs;

. set its own priorities, criteria and operating procedures;

. survey RD&E needs and solicit expressions of interest from the private sector to participate in RD&E activities;

. invite, commission, fund, monitor and direct RD&E activities;

. promote and fund private and public sector Thai and foreign joint venture RD&E activities;

. establish a fund to finance company directed RD&E activities;

. act as a funding conduit for the public and private sector organizations to perform RD&E;

. market RD&E results, obtain title to intellectual rights when appropriate, sell/license these rights or take equity, collect revenues and share royalties with RD&E institutions and researchers;

. set user charges for services rendered;

. set its own personnel policies inclusive of recruitment and dismissal, remuneration and benefits;

. prescribe its own contracting, procurement and sales rules and regulations; and

. exercise any powers necessary or incident to the exercise of the powers above enumerated.

STDB's functions will manifest themselves in a variety of contractual relationships. Certain contracting requirements can be specifically identified at the time the Project Agreement is signed. Others will evolve in the course of the seven year life of the Project. The following are descriptions of the most common contracting and/or other arrangements that STDB will have to undertake.

1. STDB professional and support staff recruitment.

2. Payments to STDB Board members, executive committee members and advisory committee members.

3. Contracting for local and US consultants: a) to strengthen STDB's operations; b) to serve on technical review panels in evaluating RD&E project proposals; c) to enhance the capabilities of institutions that have been selected to perform the designated, competitive and company directed RD&E activities; and d) to provide technical support to other implementing entities carrying out Project activities on behalf of STDB. These contactual arrangements will also involve the establishment of linkages between US and Thai public/private S&T institutions under the overall technical assistance contract.

4. Awarding RD&E funds to various public and private S&T institutions.

5. Financing workshops and conferences in support of Project activities.

6. Commissioning policy and other studies to be performed by institutions and/or individuals.

7. Entering into contracts wich various private sector organizations to act as agents for STDB in implementing company-directed RD&E, TIAC, Diagnostic/Research Design, and publicity/promotion services.

8. Procurement of equipment in support of Project activities.

B. Project Management

The STDB will be the central point for managing all Project activities and serve as a decision making body establishing and funding programs and services. The Ministry of Finance (MOF), while exercising overall control, will delegate authority to STDB in expending loan funds for Project activities. The Department of Technical and Economic Cooperation (DTEC) will exercise overall control in regard to grant funds. Incidental to these primary functions, STDB will coordinate the activities of various private and public sector S&T related organizations. In addition, it will arrange certain promotional and marketing activities central to its mission. Thus the implementing functions of STDB will focus on managing, financing, coordinating, monitoring and promoting, but not on actually operating Project activities.

In discharging its functions, STDB will be supported by a long term technical assistance contractor, with extensive experience in science and technology and RD&E management. The technical assistance contractor's role is comprehensive in the sense that it provides a variety of services in addition to pure advisory or consultative assistance. A Team Leader, with overall responsibility for technical support, will be assigned to STDB for a period of four years. Besides serving on STDB's Technical Advisory Committee for RD&E activities, he will confer with the Project Director and Executive Committee as appropriate. Additional responsiblities would include providing assistance in the recruitment and selection of local consultants as well as in the preparation of RD&E plans after proposals have been screened and reviewed.

Both US and local consultants will provide technical and managerial support to the implementing agency in strengthening its operations. The Technical Advisory Committee and a series of technical review panels will assist the STDB staff in conducting appraisal work. The services of a full time Project Monitor, with considerable AID project management experience in Thailand, will be provided under the Project, to help STDB meet various AID requirements and effectively monitor financed activities.

C. Procurement Plan

Since STDB will contract with other organizations and individuals to perform services prescribed by it, there will be extensive requirements for procurement of goods and services. It will be necessary for STDB to finance activities with a standard set of procedures, irrespective of the funding source utilized for a particular activity.

All parties involved in this Project's implementation will have to agree that DTEC will be responsible for procurement of equipment and services under this Project, financed with AID loan funds, AID grant funds and RTG cash contributions. DTEC regulations will apply to all Project procurement. However, DTEC will:

a. rely on STDB staff for all substantive program judgements and perform the necessary contracting services for STDB;

b. develop special procurement procedures for STDB that are suited to accomplish STDB functions. In this connection STDB will not be bound by certain limits normally applied to RTG agencies. For example, specific pay scales for STDB staff will be established that will be higher than standard RTG pay scales;

c. assign two full time contracting officers to STDB. In the light of the extensive contracting workload anticipated, and the importance of timely execution, these contracting officers will be located on the premises of STDB;

d. provide all reasonable latitude to STDB implementing agents and RD&E institutions who have received awards from STDB, to subcontract for procurement of locally available goods and services.

1. Technical and Professional Services

In addition to the provision of Thai professional and support staff for STDB's operations, it is estimated that 240 person months of long-term and 465 person months of short-term technical and managerial assistance will be required in areas which have been identified in the Project Paper. Given the nature of RD&E, exact technical requirements will be identified only during the preparation of specific RD&E proposals.

Sources of technical and professional services include both offshore (i.e. US) and Thailand. Offshore needs will be met through an overall technical assistance contract. No overall contractor is contemplated to secure the services of local technical experts. Local needs can be catergorized as those specific to STDB resource allocation functions, those specific to the employment of agents (i.e. Publicity, Company-Directed RD&E, TIAC and Diagnostic/Research Design Service), and those specific to designated/competitive RD&E and other Project activities.

Offshore Services

DTEC, in coordination with STDB, will be responsible for executing the overall technical assistance contract, which includes all US offshore requirements, regardless of grant or loan funding. Those known needs, both long and short term, will be detailed in this overall contract. In addition, there will be technical assistance needs specific to RD&E activities which will be identified during the preparation of proposals. STDB will issue individual requests for the technical assistance contractor to meet these needs after annual RD&E plans have been approved by the RTG and USAID.

The costs for known technical assistance needs will be built into the overall contract. Additionally, the formula or rate of reimbursement for unknown RD&E needs will be established in this contract. The expenses for RD&E specific consultancies will be incorporated into each RD&E activity and paid by USAID upon authorization from STDB/DTEC. The Science and Technology and Area Contracting Offices within USAID will assist DTEC in this contracting process.

Local Services

DTEC will contract for those services which are specific to the functions of STDB. These include STDB's professional and support staff, institutions conducting policy studies, baseline data collection and fincancial audits, and all known local consultant requirements as identified in the Project Paper. Although STDB will be responsible for the selection and employment of these services, DTEC will assist in the actual contracting and payment procedures. DTEC will also be responsible for processing payments for the convening of STDB Board, Executive and Advisory Committee meetings.

For those requirements which are specific to the employment of agents to conduct Company-Directed RD&E, TIAC, Diagnostic/Research Design Service and Publicity and Promotion activities, DTEC will assist in the

initial contracting arrangements on behalf of STDB. Any sub-contracting for services by these agents will be conducted in accordance with DTEC approved procedures. Payment for services in relation to these activities will be made by USAID.

Technical assistance requirements specific to RD&E activities will be identified by implementing agencies in their RD&E proposals. DTEC will assist STDB in developing standard contracting procedures and formats to be used for this activity. After annual RD&E plans have been approved by DTEC and USAID, the concerned RD&E implementing agencies will contract for technical consultants according to these approved procedures. While the consultants will be professionally responsible to the RD&E agencies requesting their services, STDB will be responsible for processing payments to the consultants through USAID.

Within STDB, the responsibility for overall coordination of contracting arrangements rests with the Chief of the Administrative Office.

The technical and professional services required in support of the Project are diverse and complex covering such fields as administration, finance, research management, policy and planning, marketing, public relations, standards, testing, quality control, computer networking, and a large number of subject specialities in the three priority RD&E areas of bioscience/biotechnology, material technology and applied electronics technology. While some of these services are required at the policy level and are advisory in nature, most will be focused on setting up and strengthening a multitude of programs and operations. There is also a need for establishing strong linkages between Thai and US centers and institutions, in order to enhance indigeneous RD&E capacities.

It is evident that with the broad spectrum of technical areas involved and the mix of services required, no single source of US technical assistance exists. Therefore, there is a need for an extremely flexible contracting mechanism. Possible choices include 1) a series of small contracts, 2) a Thai/US joint venture contract, 3) an overall contract with a consortium of US universities, or 4) a contract with a reputed institution such as the National Academy of Sciences. Considering the burden and complexity of managing a series of small contracts, this first option is effectively ruled out. Regarding the second option, it is difficult to conceive that a joint venture of even three or more firms would possibly have either the in house capacity in all of the required technical areas or the experience of managing such a diverse program to be entrusted with the responsibility of providing technical support under the Project. Therefore the option of using a joint venture contract arrangement is also ruled out. A consortium of universities, however, could be expected to have most of the expertise in providing technical support to the Project. The higher the number of institutions in the consortium, the better the chances are that the required technical resources will be available to the Project. However, these institutions do not have ready access to the best in industry, or the best in government. And regardless of the number of institutions participating in the consortium, this alternative cannot possibly combine all of the required

skills and thus it too limits the choices available to Thai S&T organizations in terms of developing long term institutional relationships as part of designated RD&E and other Project activities. Complicating this difficulty is the fact that although the general areas for technical assistance in RD&E activities have been identified, specific technical requirements will become obvious, as mentioned earlier, only during Project implementation. Although this alternative is highly desirable over the first two and goes a long way in meeting most Project needs, it still falls short of meeting all of the anticipated requirements.

This analysis leaves the Project with only one real possibility, i.e., the National Academy of Sciences. This institution commands Thai and international recognition. It commands the respect of US and Thai universities, and the high regard of research-rich private sector industries. It can deal easily and directly with all segments of government, yet it is not government, industry or a university. The NAS has been asked for technical support in setting up similar institutions and assisting in the scientific and technological development of such countries as Malaysia and the Peoples Republic of China, among others, in this part of the world. The RTG has expressed an interest in receiving technical support from this institution under the Project, because it knows that the best of industry, academia and government can be tapped through NAS. The RTG officials have expressed their appreciation of the technical assistance they have received from NAS in the design of this Project and in other S&T activities since the signing of the Thailand/US S&T Agreement in April, 1984. The requisite flexibility in identifying, coordinating and providing the necessary technical support for the Project can best be met by an arrangement with NAS.

There are several factors making NAS, the best suited institution to satisfy all of the offshore technical assistance requirements of the Project. It can assign its own staff to the Project on a long term basis to help manage and guide the implementation process with the help of substantial home office support and is able to hire other qualified short term technical and professional personnel. The considerable prestige that work with the institution carries, adequately ensures the availability of a large pool of technical and professional resources to choose from in order to meet Project needs. NAS is also capable of fostering linkages between Thai and US institutions/ centers/societies by arranging for short term training and providing technical assistance from desired institutions. Specific RD&E technical needs can be arranged under a level of effort arrangement when such needs become known. A detailed justification for the services of NAS on the basis of predominant capability has been included in Annex P.

2. Commodities

(a) General

Known commodity needs at this time include equipment for the Standards, Testing and Quality Control, TIAC, Diagnostic/Research Design Service, and STDB support components of the Project. Specifications for commodities will be defined prior to proceeding with actual procurement.

Accordingly, it is expected that the equipment list will be expanded and updated as Project needs are further developed.

(b) Responsible Agency

Responsibility for commodity procurement will be with DTEC/STDB. DTEC, in coordination with STDB, will set up procedures for conducting local and offshore commodity acquisitions. DTEC/STDB will be responsible for coordinating and arranging all offshore procurement. Local procurement will be conducted, in accordance with the established procedures, by RD&E teams and relevant implementing agencies. Procedures for both local and offshore procurement will be developed with the assistance and approval of the Regional Commodity Management Office (RCMO) at USAID. DTEC will be responsible for arranging clearance and delivery of goods. STDB will be responsible for reviewing the establishment of inventory control and end use verification.

(c) Equipment

The preparation of final lists of commodities and detailed specifications rests with each activity leader both within as well as outside of STDB. Known equipment needs at this time are listed in Annex O.

(d) Source and Origin

The authorized source and origin of equipment and commodities is Code 941 and Thailand. It is expected that most of the offshore equipment needs will be met in the US, however, a portion of the scientific equipment, specific to RD&E in particular, may have to be purchased from Code 935 country suppliers. The nature of these items is to be determined by STDB and implementing agencies as the Project progresses and the requirements become clearly defined.

In the interest of speeding Project implementation, USAID will issue waivers for the purchase of non-941 source and origin items, the nature of which is to be determined by the responsible agency (STDB), as needs arise in the case of presently unknown RD&E specific requirements. These items may be imported to meet Project needs or consist of locally purchased shelf items which exceed the authorized shelf item procurement costs. It is understood that USAID will approve and finance only those items which are listed as eligible in AID Handbook 15 and will specifically exclude any item which has its source or origin in a communist country or which contains any components from a communist country. It is anticipated that scientific equipment in this category may add up to $500,000.

In order to facilitate essential implementation actions, AID/W is being requested to issue a source/origin waiver for Project support vehicles.

(e) Delivery

Offshore 941-source purchases will be ordered on a CIF Bangkok basis. Responsibility for port clearance, payment of duties (if any) and inland transportation in Thailand rests with DTEC/STDB. Local source purchases will be ordered on an FOB Project site basis, in care of STDB or the implementing agency concerned. Code 935 source purchases, if any, will be ordered on a CIF Bangkok basis, with receipt, clearance and onward transport to be arranged by DTEC/STDB on behalf of the implementing agencies.

D. Training

Both long and short-term training activities will be grant funded under this Project. Academic fellowships will be awarded to 25 Ph.D. and 30 M.S. degree candidates for training in priority technical areas in Thai universities. The duration of these fellowships will be for 48 and 30 months, respectively. Short term study tours, to selected countries where promotion of S&T development by government has been taking place during the early stages of development, will be provided to ten policy planners and analysts for a duration of approximately one month each. Eighteen professionals will be trained in the US (6 to 12 months duration) in the areas of quality control and in maintenance of standards and calibration work. Apprenticeship training will be given to ten persons (four month duration) in the US in the area of utilization of existing S&T information systems.

The identification of the participants and the specific training programs will be the responsibility of STDB in coordination with the agencies/institutions involved. DTEC will be responsible for actual placement, arranging allowances, advances and travel. Where appropriate, DTEC will coordinate arrangements with the technical assistance contractor.

In addition to the aforementioned training, short term consultants will be responsible for transferring technical skills to their counterparts in the various areas in which Project activities occur. The specific skill areas and related activities are outlined in the Implementation Schedule (Chart VI-1). The transfer of technical skills will be accomplished in a variety of ways depending upon the nature of the Project activity. In some instances consultants will provide structured learning experiences through workshops and seminars. In other instances, consultants will assist in establishing procedures or solving particular problems by providing on-the-job training as in the case of STDB development support.

Necessary arrangements for any workshops/seminars/conferences will be the responsibility of STDB and the particular implementing agency involved.

E. Monitoring Plan

1. RTG

The primary responsibility for managing Project activities rests with the Project Director of STDB. Overall Project monitoring functions will

be performed by the STDB Executive Committee. This Committee will meet on a quarterly basis to assess Project progress towards its stated purpose and goal. Progress reports, compiled by the Project Monitor, will be reviewed at these meetings and subsequently submitted to USAID. These reports will summarize all ongoing Project activities, indicating their status, degree of completion, achievement of objectives, problems and proposed methods for resolving problem areas.

The professional staff and technical consultants of STDB will conduct site visits and analyze reports on the activities of the involved implementing agencies, to ensure compliance with established procedures. The RD&E office will be responsible for consulting with and evaluating the progress of the various institutions involved in RD&E activities. The Standards, Testing and Quality Control Office will assess the activities of the existing standards organizations and monitor the various workshops conducted under the Project. The Private Liaison Office will coordinate with TIAC and the Diagnostic/Research Design Service in analyzing the effectiveness of their industrial development support activities. The Planning Program Evaluation and Policy Review Office will be responsible for assessing the progress towards the strengthening of RTG S&T policies and practices.

The technical assistance contractor, in addition to coordinating management activities with the above offices, will also be responsible for the submission of reports which summarize contractors' progress towards accomplishing stated scopes of work, including tasks accomplished, anticipated actions, problems encountered and proposed resolutions.

2. USAID

USAID approval will be required for: 1) the establishment of the STDB Board and Executive Committee and the selection of the Project Director (initial conditions precedent to the Project Agreement); 2) operating procedures inclusive of financial, procurement, contracting, RD&E and others as appropriate; 3) a long term training plan; 4) annual RD&E, implementation and financial plans; and 5) the selection of implementing agents for the Company-Directed RD&E, TIAC and Diagnostic/Research Design Service elements of the Project.

The monitoring responsibility of USAID will focus on STDB's compliance with agreed upon policies and procedures as confirmed through Project plans, and financial and progress reports. In addition to reports, periodic consultations with STDB and RTG officials, site visits, Project baseline data and evaluations will be used as means to monitor Project progress. In managing Project inputs, USAID's primary role will be in ascertaining how the overall implementation process, such as cash flows, contractors' performance, S&T policy changes, public/private sector participation and RD&E instutional involvement, is functioning. A monitoring checklist detailing monitoring responsibilities within USAID will be developed by the USAID Project Officer. Given the size and complexity of this Project, and its role in the overall USAID program in Thailand, it is estimated that 100 percent of the USAID Project Officer's (USDH), the Science Advisor's and

two Foreign Service National's time will be devoted to monitoring Project activities.

Other USAID staff offices, such as RCMO, ACO, Finance and Program, will of course be required to provide their traditional support. In addition, the Offices of Health, Agriculture, Private Enterprise, Engineering, and Human Resources and Training will support and coordinate relevant Project activities.

The following Project indicators will be monitored:

a. Money expenditures

b. Equipment specification and procurement

c. Identification, selection, placement, return and utilization of trainees

d. RD&E - Designated
- Invitation to propose - instituion, key investigators, subjects/problems
- Research plans submitted - institutions, key investigators, subjects/problems, amount, time
- Approval & invitation
- Payments
- Completion
- Publication

e. RD&E - Competitive & Company-Directed
- Announcement & solicitation of grant availability
- Response
  # of proposals by source, subject area, amount, length of time proposed, researcher(s)
- Approval & initiation
- Payments
- Completion
- Publication

f. Standards, Testing and Quality Control
- Number and frequency of services performed by type of activity
- Requests/recipients
- Cost
- Outcome

g. Diagnostic/Research Design Service
- Level of activity - number & frequency of tasks
- Subjects or fields, e.g. plant bio tech, ceramics, etc.
- Length & cost of each task
- Who provided service?

- Who was recipient?
- Outcome
- Payments

h. Technical Information Access Center
- Number & frequency of uses
- Subjects
- Requestor
- Source
- Cost
- Payments
- Outcome

i. Policy Studies
- Number & description of studies done
- By whom?
- For whom?
- Cost
- Outcome

F. Evaluation Plan

This Project represents a unique departure from previous Mission activities as well as from traditional operating proceedures within Thailand. As an effort to link the Thai bureaucratic, intellectual, and industrial communities, it represents movement toward a goal that will take time to achieve and careful monitoring and evaluation to measure progress towards achieving that goal.

The Evaluation Plan consists of: a) the establishment of a baseline data collection system in FY 1985; b) an interim (process) evaluation to be conducted in FY 1989; and c) a final (impact) evaluation in FY 1992.

A total of $25,000 will be set aside from grant funds for baseline data collection, $75,000 for the FY 1989 evaluation, and $115,000 for the 1992 evaluation. Both evaluations will employ outside consultants, but the second will include surveys to assess private sector utilization of RD&E results.

1. Baseline Data - 1985

A baseline data collection system will be established in FY/1985, by a local research institute. Among its principal components will be data addressing the following elements of the Project:

(a) How many RD&E projects underway in June 1985 of type contemplated in Project? (# & $)

(1) Project areas

Bioscience/Biotechnology
Material Technology
Applied Electronic Technology

(b) How many researchers active in RD&E of type contemplated in Project in June 1985?

Individual universities
RTG agencies
Private Sector

(c) How many scientific articles published during 1984 in fields of interest to Project?

(d) How many companies engaged in relevant RD&E in June 1985?

Doing their own?
Paying institutes to do it?

(e) Status of patent & copyright law.

(f) Status of RD&E tax deduction proposal, and other such "incentive" proposals.

(g) Status of employment in priority industries in 1984.

(h) Level of output of priority products in 1984.

2. Interim Evaluation - FY 1989

The "keystone" of the Project is the degree to which the private sector will use the results of the Project, thus improving Thai employment, productivity, and exports. It is possible to determine certain surrogate indicators of progress toward these goals and toward use of the results of the Project by the private sector, but it is clearly inappropriate to attempt to quantify the results of the Project elements in the first-stage evaluation.

The initial evaluation will focus on the effectiveness of mobilizing planned inputs to achieve desired outputs. The following areas will be examined by the evaluation team:

(a) Program Administration

(1) STDB administration (staffing, facilities, performance)
(2) STDB Board participation
(3) STDB linkages with participating public and private institutions
(4) USAID Project management
(5) USAID & RTG budgets and financial management
(6) Technical assistance contract management

(b) S&T Policy Review

(1) Progress in addressing key policy constraints identified in Project design

- researcher compensation
- patent, copyright laws
- others

(2) Policy studies performed with follow-up action

(3) Professional exchanges

(c) RD&E

(1) Designated RD&E

. Analysis of process indicators identified and reported on regularly in monitoring system.

. Analysis of quality of proposals, plans and work performed to date.

. Analysis of RD&E content to determine if it fits program objectives.

. Analysis of on-campus organization, administration & participation in designated RD&E to determine if critical objectives will be achieved.

. Overall assessment of designated RD&E component performance and need for modifications, corrections, etc.

(2) Competitive RD&E

. Analysis of process indicators from monitoring system.

. Analysis of quality of proposals, plans, and work performed to date.

. Analysis of grant recipients to determine distribution of work and funds among institutions, fields, age groups, institution affiliation, critical cell affiliation, etc.

. Analysis of private sector participation in projects.

. Analysis of impact of program funds on allocations of other sources of RD&E funds in Thailand, e.g. NRC, universities' own funds, donors, TISTR, etc.

. Overall assessment of component performance and need for modifications, corrections, etc.

(3) Company Directed RD&E

- Analysis of process indicators from monitoring system.
- Analysis of quality of proposals, plans and work performed to date.
- Analysis of company (individual) grant/loan recipients to determine distribution by type, size, sector, problem, US joint venture affiliation, location, etc.
- Analysis of relationship of firm with RD&E institution to do work.
- Analysis of lending schemes.
- Overall assessment of component performance and need for modification, corrections, etc.

(d) Industrial Development Support

(1) Standards, Testing & Quality Control

- Analysis of process indicators from monitoring system.
- Assessment of performance by analysis of data on trends toward increased reliance by industry on the standard system.
- Analysis of extent of participation in voluntary research technology accreditation.
- Analysis of number of quality control activities undertaken with industry and their impact.

(2) Technical Information Access Center

- Assessment of Center's institutionalization - location, staff, budget, technology (computer, satellite, etc.).
- Assessment of performance by analyzing data on process indicators from monitoring system.
- Comparison of use by public sector RD&E personnel (literature search) vs companies (technology transfer).
- Comparison of use for external (foreign) sources vs local (Thai) sources.

. Analysis of prospects for self-sustainability - revenues.

(4) Diagnostic/Research Design Service

. Analysis of process indicators from monitoring system.

. Analysis of trend over time of nature of requests; e.g. product development vs. production problem.

. Analysis of maturation of service - growth of demand, response of service providers, ability to charge for service, etc.

. Analysis of prospects for self-sustainability.

(5) Overall assessment of industrial Development Support components and need for modification, correction, etc.

2. Final Evaluation - 1992

The first evaluation will measure the extent to which the Project has enhanced the effectiveness of public and private sector application of science and technology in Thailand's development (Project purpose). It will also assess the degree to which activities undertaken contributed to the attainment of Thai self-reliance in science and technology (Project goal).

As a subset of the above, the following project/program elements will be examined in detail:

- Economic Impact
- Employment Effects
- Rural/Urban Impact
- Industrial S&T Application
- Policy Support
- Institutional Development
- Human Resource Development
- Physical Results of Project Activities

For both the interim and final evaluations, a team of Thai and American consultants will be organized. Skill requirements will be in the areas of S&T, industrial management, economic analysis, public policy and administration, and human resource development. The evaluation team will be supported by RTG, private sector and USAID representatives. Planning for the design of both evaluations is to begin 6-12 months prior to assembly of the evaluation teams.

G. Implementation Schedule

Successful implementation of Project activities largely depends upon STDB's ability to: contract for essential local technical services; recruit

qualified Project support staff; install financial, administrative, contracting and procurement procedures; and receive support from MOSTE during its early stages. Pre-implementation actions and a first year work plan are detailed in sections 1 and 2 below. The overall implementation schedule, by fiscal year, is proposed in Chart VI-1. The financial plan for the Project is based on this implementation schedule. Considering the diverse nature of Project activities, it is foreseen that if delays occur in any of the pre-implementation actions the actual magnitude and sequence of events may vary from what is proposed in the first year work plan and overall schedule.

1. Pre-Implementation and Start-Up Activities

In order to successfully implement Project activities according to plan, it is imperative that certain pre-implementation actions take place. Those activities planned prior to the actual signing of the Loan/Grant Agreement will be funded using EPD-1 funds reserved for S&T. Activities planned after the signing but prior to satisfying the initial C.P.s, will utilize EPD funds or Project funds as may be authorized by the issuance of the first Project Implementation Letter (P.I.L.). During this pre-implementation phase, local PSC technical assistance will be provided to coordinate with MOSTE, MOF and DTEC in developing operating procedures and ensuring that the actions outlined below take place as planned.

Table 3
Pre-Project and Start-up Actvities

Activity	Responsible Agent	Completion Date
1. Final Project Approval	AID/RTG	04/30/85
2. STDB Established	TISTR Board	05/15/85
3. Congressional Notification Processed	AID/W	05/21/85
4. Loan/Grant Agreement Signed	MOF/DTEC/USAID	05/31/85
5. Private/Public Agencies Invited to Nominate Representatives to STDB Board	MOSTE	05/31/85
6. First PIL Issued	USAID	06/15/85
7. STDB Board of Directors Appointed	Private/Public Agencies	06/30/85
8. STDB Executive Committee Appointed	STDB Board	07/15/85

9.	Project Monitor, Project Director and Key Professional Staff Recruited	STDB	08/31/85
10.	Initial C.P.s Satisfied	STDB	08/31/85

2. First Year Work Plan

By December 31, 1985, STDB will become operational with its Board and Executive Committee appointed and functioning, Project Director and key staff recruited, initial C.P.'s met, technical assistance contractor selected and operating procedures adopted. It is expected that the actual implementation of Project activities will get underway during the second quarter of FY 1986.

In the area of S&T Policy Review, 6 person months of US technical assistance will be provided, a workshop held and at least one policy study initiated during the first year.

RD&E programs will be publicized, technical review panels held and proposals screened and approved. It is estimated that no fewer than 12 designated, 15 competitive and 1 company directed RD&E activities will be initiated. Candidates for M.S. and Ph.D. fellowships will be selected, a training plan developed and approximately 6 participants placed.

Under Industrial Development Support, long term technical assistance for Standards, Testing and Quality Control and 6 person months of short term assistance for TIAC and the Diagnostic/Research Design Service will be provided during the first year. Equipment requirements and specifications will be finalized and procurement procedures initiated. Publicity and promotional campaigns will be undertaken in all three areas. One workshop on quality control and another on standards will be conducted.

Soon after the initial C.P.'s have been met, a baseline data collection system will be established by STDB through a contract with a local research institute. Data collected will be utilized in future evaluations.

CHART VI IMPLEMENTATION SCHEDULE
FISCAL YEAR

Activity	Responsible Agent	1985				1986				1987				1988				1989				1990				1991				1992			
		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. INSTITUTIONAL FRAMEWORK																																	
A. Technical Assistance	DTEC, STDB, USAID																																
1) Long Term																																	
a. Project Monitor					x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	x												
b. Team Leader							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	x												
c. US Home Office							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	x												
2) Short Term																																	
a. Financial (12 pm)					x	x	x								x																		
b. Administrative (6 pm)					x	x																											
c. Publicity/Marketing (24 pm)					x	x					x	x			x	x			x	x													
d. Management Impr. (9 pm)							x				x						x																
e. Economic (24 pm)							x		x		x		x		x		x		x	x													
f. Accounting (24 pm)					x	x	x	x	x			x			x					x													
g. Contracting (6 pm)						x				x																							
h. Procurement (6 pm)					x	x																											
i. Office Management (6 pm)					x	x																											
j. Personnel (6 pm)						x	x																										
k. Others (24 pm)								x	x			x	x			x	x			x	x												
B. STDB Support																																	
1) Personnel	STDB																																
a. Director					x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	x
b. Professional Staff							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	x
c. Support Staff							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	x
2) Facility Improvement	MOSTE, STDB																																
a. IFB's						x																											
b. Contracting						x																											
c. Complete							x																										
3) Office Equipment																																	
a. IFB's						x																											
b. Contracting						x																											
c. Delivery							x																										
4) Vehicles																																	
a. IFB's						x																											
b. Contracting						x																											
c. Delivery							x																										
C. Committee Meetings	STDB																																
1) Board of Directors				x			x				x				x				x				x				x				x		
2) Executive Committee				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	x	x	x	x	x
3) Tech. Adv. Committee							x	x			x	x			x	x			x	x			x	x			x	x			x	x	
D. Professional Exchanges	STDB						x		x		x		x		x		x		x		x		x		x		x		x		x		x

CHART VI IMPLEMENTATION SCHEDULE
FISCAL YEAR

Activity	Responsible Agent	1985				1986				1987				1988				1989				1990				1991				1992			
		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2. S&T POLICY REVIEW																																	
A. Technical Assistance	STDB, DTEC																																
1) Short Term (36 pm)								x	x	x		x	x	x		x		x		x													
B. Policy Study Agenda	STDB																																
1) Areas and Issues Identified	MOSTE, NESDB						x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
2) Studies Conducted	S&T Policy Orgs.							x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
C. Policy Dialogue	STDB																																
1) Professional Exchanges									x			x	x																				
2) Workshops/Conferences								x		x		x		x		x		x		x		x		x		x		x		x			
3. RD&E																																	
A. Activities																																	
1) Designated	STDB																																
a. Proposals Submitted	S&T Orgs.					x				x				x				x															
b. Proposals Screened	RD&E/TAC						x				x				x				x														
c. Plan Approved	Exec. Comm.						x				x				x				x														
d. Proposals Awarded	STDB							x				x				x				x													
e. Activities Conducted	S&T Orgs.							x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
2) Competitive																																	
a) Program Publicized	RD&E/PPP				x				x				x				x																
b) Expressions of Interest Submitted	Industry Etc.						x				x				x				x														
c) Expressions of Interest Screened	RD&E/TAC						x				x				x				x														
d) Priority Problems Approved	Exec. Comm.						x				x				x				x														
e) Problems Publicized	RD&E/PPP						x				x				x				x														
f) Proposals Screened	RD&E/TAC							x				x				x				x													
g) Plan Approved	Exec Comm.							x				x				x				x													
h) Proposals Awarded	STDB								x				x				x				x												
i) Activities Conducted	Industry, S&T Orgs.									x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x

CHART VI IMPLEMENTATION SCHEDULE
FISCAL YEAR

Activity	Responsible Agent	1985				1986				1987				1988				1989				1990				1991				1992			
		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
3) Company-Directed																																	
a. Fund Established	STDB						x																										
b. Program Publicized	PSL/PPP							x-	--	--	--	--	--	--	--	--	--	--	--	--	-x												
c. Proposals Submitted	Industry								x-	--	--	--	--	--	--	--	--	--	--	--	-x												
d. Proposals Screened, Approved, Funded	Financial Institute								x-	--	--	--	--	--	--	--	--	--	--	--	-x												
e. Activities Conducted	Industry								x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-x
B. Technical Assistance																																	
1) US	STDB, DTEC																																
a. Review Panel (36 pm)	TAC						x	x			x	x			x	x			x	x													
b. Technical Support (26 pm)	RD&E								x	x			x	x			x	x			x												
2) Local																																	
a. Review Panel (72 pm)	TAC						x	x			x	x			x	x			x	x													
b. Technical Support (72 pm)	RD&E								x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-x
C. RD&E Support																																	
1) Fellowship Training	STDB/DTEC																																
a. Ph.D. (25)								x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-x				
b. M.S. (30								x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-x				
2) Technology Transfer	STDB																																
a. Professional Linkages							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-x
b. Workshops/Conferences							x				x		x		x		x		x		x		x		x		x		x		x		x
4. INSTITUTIONAL DEVELOPMENT SUPPORT																																	
A. Standards, Testing and Quality Control																																	
1) Technical Assistance	STDB/DTEC																																
a. Long Term							x-	--	--	--	--	--	--	--	--	--	--	--	--	--	-x												
b. Short Term																																	
- Standards (32 pm)								x		x		x	x		x		x		x		x												
- Quality Control (32 pm)								x		x	x		x	x		x		x		x													
2) Standards Equipment																																	
a. Requirements	STDB/STQC							x																									
b. IFB's									x																								
c. Contracting										x																							
d. Delivery											x																						

CHART VI IMPLEMENTATION SCHEDULE
FISCAL YEAR

Activity	Responsible Agent	1985				1986				1987				1988				1989				1990				1991				1992			
		Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter				Quarter			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
3) US Training	STDB/DTEC																																
a. Standards																																	
- 12 persons										x	--------		x																				
- 6 persons															x		x																
4) Publicity and Promotion (QC)	STQC/PPP							x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
5) Workshops	STQC																																
a. Standards									x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x	
b. Quality Control									x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x		
B. Technical Information Access Center																																	
1) Technical Assistance (6 pm)	STDB/DTEC						x	x																									
2) Equipment	STDB/PSL																																
a. Requirements Identified								x																									
b. IFB's									x																								
c. Contracting										x																							
d. Delivery											x																						
3) US Training	STDB/DTEC																																
a. Apprenticeship (40 pm)												x				x				x													
4) Publicity & Promotion	PSL/PPP							x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
C. Diagnostic/Research Design Service																																	
1) Technical Assistance	STDB/DTEC						x	x																									
2) Equipment	STDB/PSL																																
a. Requirements Identified								x																									
b. IFB's									x																								
c. Contracting										x																							
d. Delivery											x																						
3) Publicity Promotion	PSL/PPP							x	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	x
5. EVALUATION																																	
A. Base Line Data	STDB					x																											
B. Mid-Term	STDB/USAID																	x															
C. Final	STDB/USAID																													x			
D. Financial Audits											x								x								x				x		

H. Project Specific Conditions Precedent and Covenants

1. Initial Disbursement

Prior to the initial disbursement under the Project, or to the issuance by AID of documentation pursuant to which disbursement will be made, the Borrower/Grantee will, except as the parties may otherwise agree in writing, furnish to AID in form and substance satisfactory to AID:

(a) evidence of the establishment of a Science and Technology Development Board (STDB) by the Borrower/Grantee under the legislative authority of Thailand Institute of Scientific and Technological Research (TISTR); and

(b) a statement of the name of the person(s) in STDB designated as authorized representative(s) on behalf of the Borrower/Grantee and of any additional representatives, together with a specimen signature of each person specified in such statement.

2. Disbursement for Project Activities Other Than STDB Operations

Prior to the release of funds for Project activities other than the operations of STDB itself, the Borrower/Grantee will furnish to AID, in form and substance satisfactory to AID, evidence that an appropriate set of regulations governing the administration of Project funds will be formulated by the Borrower/Grantee in consultation with the STDB representatives to facilitate Project implementation.

3. Disbursement for RD&E Costs

Prior to the release of funds for RD&E costs each year, the Borrower/Grantee will furnish to AID annual designated and competitive RD&E plans, separately, detailing the specific problems to be focused on by the S&T institutions (inclusive of the name of principal investigators) to be awarded RD&E funds, total costs of each activity, cost breakdown and disbursement projections over the life of each activity; and annual estimated expenditures for company directed RD&E activities.

4. Disbursement for Long-Term Training Costs

Prior to disbursements for Project funded long term (one year or more) training activities, the Borrower/Grantee will furnish to AID a training plan which describes the areas, level and types of training to be funded, the selection criteria and procedures to be used in carrying out this activity.

5. Additional Disbursement

Prior to disbursements for subsequent years (FY 1987), the Borrower/Grantee will furnish to AID an annual implementation and financial plan for all Project activities other than RD&E and long term training activities.

6. Covenants

The Borrower/Grantee agrees:

(a) that decisions taken by STDB will not be reversed by any authority unless such reversal is agreed to by the parties to the Agreement;

(b) to make concerted efforts to integrate S&T in social and economic development plans, and to increase and sustain its appropriations for S&T RD&E activities;

(c) to work towards providing incentives for the users of locally developed technological innovations, adaptations and applications and maximum protection possible of the intellectual property rights to technologies developed under this Project;

(d) to indicate, within the first three years of the Project, the terms under which the pecuniary benefits derived from commercialization of RD&E results will be shared by the RD&E grant recipients, STDB and possibly the private sector industries/companies participating in Project funded activities; and

(e) to consider the recommendations of the mid-term evaluation team in formulating its plans for integrating the functions of STDB into a permanent structure.

VII. COST ESTIMATES FINANCIAL PLAN AND FUNDING MECHANISMS

1. Summary Financial Plan:

The AID contribution over the seven(7) year Life of the Project is $35 million of which $27 million will be soft Loan and $8 million will be Grant funded. RTG "in-kind" and budgetary support is estimated at $9.5 million of which no more than $1.4 million will be provided through the DTEC Counterpart Fund. Contributions from private sector companies in Thailand will total $4.5 million for a total host country contribution of $14 million. The cost for all Project inputs total $49 million.

2. Funding Responsibilities

The AID Grant will fund all costs related to Policy Review, technical assistance for the Establishment of the Institutional Framework, professional exchanges costs, RD&E support costs, training costs, evaluation costs, and a portion of the personnel expenses for the staff of the implementing agency.

The Loan will cover costs for equipment, RD&E Projects, workshops under Standard, Testing and Quality Control, and all technical assistance related to RD&E and Industrial Development Support.

The RTG will fund support personnel costs under the DTEC Counterpart Fund and a 25% contribution to the cost of the RD&E activities and all

operating costs of the implementing agency with the exception of salaries for professionals through a budget allocation. Private sector companies will contribute to the Project at a rate of 50% of Company-Directed RD&E cost.

3. Disbursement Procedures

The Ministry of Finance will be the borrower for the loan portion of the project and administrative responsibility will be delegated to the implementing agency, STDB. DTEC will be the grantee and administrator for the grant.

An annual financial plan will be submitted for the loan and the grant by September 15th for the upcoming year which will specify planned activities. The plan will also indicate method of disbursement to be utilized.

Loan Funds:

A direct letter of commitment (DIR L/COMM) will be used to disburse loan funded US technical assistance after certification that services were received by the STDB. The DIR L/COMM procedure or direct payment will also be used for major equipment purchases. Funds for studies, local technical assistance and Standards, Testing and Quality Control workshops will be advanced by USAID to the STDB for immediate disbursing needs.

In the case of RD&E, a three month disbursement requirement will be provided to the STDB, which, in turn, will advance funds on a quarterly basis to the S&T institutions based on the estimate of cash needs in the proposals. Reports on actual expenditures will be prepared by the S&T institution every six months and forwarded to STDB in order to liquidate advances received during the period. During the last six months of the activity, ten percent of the funding will be retained by STDB and paid only after receipt of the final product.

Disbursements for RD&E will be on a pari-passu basis with USAID and the RTG funding 75% and 25% of requirements respectively for designated and competitive activities and 50% and 50% respectively for company-directed activities. Detailed instructions to RD&E institutions will be prepared by STDB and approved by USAID on administration of the activities i.e. accounting requirements, advance of funds, regulations, eligible cost items, purchasing, etc.

Grant Funds:

The US technical assistance contract will be paid by USAID through a direct L/COMM. Funds for all other elements of expense with the exception of US Training and Evaluation will be advanced by DTEC to STDB. Studies under Policy Review will be administered in the same manner as loan-funded activities but will not be on a pari-passu basis. US Training and Evaluation costs will be disbursed directly by USAID after appropriate approvals.

4. Recurrent Budget Analysis

At a time when the RTG is initiating a virtual total freeze on growth of public sector expenditures, the recurrent cost implications of any new activity must be taken into account, and no doubt will be on the RTG side as this Project is negotiated in detail. On the other hand, the immediate budget impact on the RTG is minor as can be seen from the financial plan in ANNEX N. Total costs for the RTG over the seven year life of the Project will be $9.5 million, of which recurrent costs will be $1.5 million. Continuing current costs after that would, of course rise, depending on further US participation at that time and the extent to which the activities envisaged grow and are jointly financed with the private sector. The gradual rise in private sector share of financing of the information and diagnostic services is relevant to this perspective, and will help keep RTG costs down.

Taking a larger perspective, however, it is clear that nothing very precise can be said about the net effects on recurrent RTG costs if the Project's wider objectives are substantially achieved. A major rise in RD&E activities work under government and institutional auspices will require a concomitant increase in recurrent costs, except, as that cost increase is demand-driven in industry and shared with the private sector. However, when account is taken of the high benefit-cost ratios of RD&E activities, it is not unreasonable to expect that economic pay-off to give rise to increases in the RTG's tax base that could result in revenue enhancement considerably greater than the cost to the public sector of the underlying RD&E. Due to these revenue generations, it should be in the interest of the RTG to find ways of financing an institution, if necessary, which is somewhat different from the rest of the Thai bureaucracy due to the relatively higher professional salaries paid and modified administrative procedures. At this stage little can be said beyond such general considerations. One of the responsibilities of S&T assessment will be to monitor public and private sector S&T expenditures. As public sector expenditures grow, and net recurrent cost implications become more significant, the assessment and policy function should also review the net cost burden and develop appropriate recommendations for cost-sharing or benefit-sharing if that appears necessary.

5. Financial Review and Audit

Funds have been provided in the Evaluation element of this Project for financial reviews and audits of the Project. We anticipate an initial financial review of systems and procedures of the STDB after its establishment with periodic review of its performance thereafter. Audits of Project expenditures will be conducted at least every two years.

Table 4
Summary Cost Estimates and Financial Plan
(US $000)

	USAID		Host Country			
	Loan	Grant	RTG	DTEC	Other	Total
1. Establishment of Institutional Framework:						
TA		2,200				2,200
Operating Costs	100	1,145	420	1,400		3,065
Committee Meetings		200				200
Professional Exchanges		500				500
	100	4,045	420	1,400		5,965
2. S&T Policy Review:						
TA		300				300
Studies		500				500
Policy Dialogue (Study Tours/Mtgs)		100				100
		900				900
3. Research, Development & Engineering:						
Designated	9,000		3,000			12,000
Competitive	6,750		2,250			9,000
Company-Directed	2,250		2,250		4,500	9,000
TA	1,150					1,150
RD & E Support		1,500				1,500
	19,150	1,500	7,500		4,500	32,650
4. Industrial Development Support:						
STDS, Testing & QC	3,600	250				3,850
Tech. Info. Access Ctr.	2,375	275				2,650
Diag. Research Design Service	950					950
	6,925	525				7,450
5. Evaluation & Financial Review		300				300
Sub-Total	26,175	7,270	7,920	1,400	4,500	47,265
6. Contingency - 10% (Excludes Projects-Element #3)	825	730	180			1,735
TOTAL PROJECT	$ 27,000	8,000	8,100	1,400	4,500	49,000

Table 5
Cost Estimates by Source of Funding and FX/LC Costs

Project Elements	AID Grant FX	AID Grant LC	AID Loan FX	AID Loan LC	Host Country DTEC	Host Country MOSTE	Host Country Priv. Sector	Total
1. Establishment of Institutional Framework (STDB Operations)								
A. Professional Staff		1,075						1,075
B. Support Staff					1,000			1,000
C. Travel					300			300
D. Facilities (Upgrading)					100			100
E. Office Equipment	35	35						70
F. Vehicles				100				100
G. Utilities						60		60
H. Supplies						20		20
I. Repair & Maintenance of Vehicles						45		45
J. In-kind Office Space						295		295
K. Board/Exec. and Advisory Comm. Mtg.		200						200
L. Professional Exchanges (Mtgs.)	250	250						500
M. Technical Assistance	1,900	300						2,200
Sub Total	2,185	1,860		100	1,400	420		5,965
2. S&T Policy Review								
A. Technical Assistance	150	150						300
B. Studies		500						500
C. Policy Dialogue (Study Tours/Mtgs.)	50	50						100
	200	700						900
3. Research, Development and Engineering								
A. Projects								
i) Designated			1,000	8,000		3,000		12,000
ii) Competitive			750	6,000		2,250		9,000
iii) Company-Directed			250	2,000		2,250	4,500	9,000
B. Technical Support (Consultants)			864	286				1,150
C. RD&E Suoport								
i) Univ. Fellowships (In-Country)		1,000						1,000
ii) Tech. Transfer (Visits/Mtg)	250	250						500
	250	1,250	2,864	16,286		7,500	4,500	32,650
4. Industrial Development Support								
A. Standards, Testing & Quality Control								
i) Technical Assistance			1,500					1,500
ii) Equipment			1,500					1,500
iii) Workshops (In-Country)			100	400				500
iv) US Training	250							250
v) Publicity and Promotion				100				100
B. Technical Information Access Center								
i) Technical Assistance			350					350
ii) US/ASEAN Center for Tech. Exchange			1,000					1,000
iii) Equipment			400					400
iv) US Training	150							150
v) Data Processing Costs				625				625
vi) Other Operating Costs (Personnel)		125						125
C. Diagnostic/Research Design Service								
i) Technical Assistance			100					100
ii) Equipment			50					50
iii) Engineering Consultant Services				800				800
Sub Total	400	125	5,000	1,925				7,450
5. Evaluation	100	200						300
Sub Total Project	3,135	4,135	7,864	18,311	1,400	7,920	4,500	47,265
Contingency	315	415	686	139		180		1,735
GRAND TOTAL	3,450	4,550	8,550	18,450	1,400	8,100	4,500	49,000

Total Project FX Costs $12,000,000
LC Costs $37,000,000

$49,000,000

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

ANNEX A

Life of Project
From FY 85 to FY 89
Total Project Funding $49,000,000
Date Prepared: March 25, 1985

Project Title & Number: Science and Technology for Development (493-0340)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal	Measures of Goal Achievement	Means of Verification	Assumption for Achieving Goal
The goal of this Project is Thai self-reliance in S&T.	. increased local content to new production units established; . increased exports of manufactured goods; . increased agricultural products in processed form; . significantly increased employment; . expanded diversification of the economy, as reflected by type and number of industries formed; . reduction in product rejection rate for exports.	National Statistics Project Evaluation	Political stability
Project Purpose	End of Project Status	Means of Verification	Assumption for Achieving Purpose
The purpose of this Project is to enhance the effectiveness and extent of public and private sector application of S&T to Thailand's development.	1. RD&E institutions in priority technical areas capacities improved. 2. Increased number and improved quality of RD&E researchers, faculty and students in key public and private institutions and industries, including universities, in three major subject areas (bioscience and biotechnology; metallurgy and material technology; and applied computer and electronics technologies). 3. RD&E activities are problem focused and demand driven. 4. Meaningful, working relationships formed between the private and public sectors, both domestic and foreign, and between local universities, government agencies and private sector industries. 5. Institutional and financial mechanisms in place for the private and public sectors to collaborate in RD&E activities. 6. Private sector industries/companies use and application of RD&E significantly increased. 7. Enhanced investments in RD&E based industries will be measurable and documentable. 8. Private sector industries' and RD&E institutions' capacity to correctly diagnose technical problems and identify the appropriate technology to address given problems demonstrably increased. 9. Standards, testing and quality control activities operating efficiently, e.g., with reduced turn-around time and enhanced utility. 10. Improved policy framework for the enhancement of RD&E activities and enterprises. 11. Demonstrable resolution of specific problems addressed by RD&E.	National Statistics Special Studies and interviews with policy/decision makers and other concerned individuals	Required policy and other changes are made. Economic outlook and investment prospects remain stable.
Project Outputs	Magnitude of Outputs	Means of Verification	Assumption of Achieving Output
1. Strengthening the Existing Institutional Framework 2. Review of S&T Policy and Practice	1. Private sector use of indigenous S&T institutions in the application, adaptation and development of needed technologies significantly increased. 2. Science and Technology Development Board established. 3. Research studies on ten policy constraints undertaken. 4. At least ten meetings on key policy issues involving academic, private sector and public policy planners held. 5. Analytical capacity of selected policy institutions satisfied.	Project progress reports. Regular Project monitoring. Special studies and regular evaluations. Official and unofficial Project records and other available records.	RTG ensures the autonomy of new organization and encourages active private sector participation Private Sector willing to participate actively and cooperatively. Thai and US institution and other organizations willing to cooperate, make long-term commitments. Suitable problems and RD&E projects can be identified

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project
From FY 85 to FY 89
Total Project Funding $49,000,00[illegible]
Date Prepared: March 25, 1984

Project Title & Number: Science and Technology for Development (493-0340)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Program or Sector Goal	Magnitude of Outputs	Means of Verification	Assumption for Achieving G[illegible]
3. Research. Development and Engineering Activities	6. About 48 designated 60 competitive, and 18 private sector research projects undertaken in bioscience/biotechnology, metallurgy/material science, and applied computer/electronic technology.		
4. Industrial Development support	7. Standards, testing and quality control improved, testing turn around time shortened. 8. The Technical Information Access Center is operating efficienly. 9. A diagnostic/Research Design Service is functioning.		

Project Inputs and Magnitude

Means of Verification: AID & RTG records

Assumption for Providing I[illegible]

	$ Million Total 7 Years	$ Million Estimated Distribution by Year 85	86	87	88	89	90	91	92
1. Establishment of Institutional Framework									
a) Technical Assistance	2.20	0.05	0.55	0.50	0.55	0.55	0.00	0.00	0.00
b) Operating Costs	3.07	0.00	0.65	0.40	0.40	0.40	0.42	0.40	0.40
c) Committee Meetings	0.20	0.01	0.03	0.03	0.03	0.03	0.03	0.02	0.02
d) Professional Exchange	0.50	0.00	0.09	0.09	0.09	0.09	0.09	0.03	0.02
Subtotal	5.97	0.06	1.32	1.12	1.07	1.07	0.54	0.45	0.44
2. S&T Policy Review									
a) Technical Assistance	0.30	0.00	0.08	0.08	0.07	0.07	0.00	0.00	0.00
b) Studies	0.50	0.00	0.02	0.08	0.16	0.08	0.08	0.04	0.04
c) Policy Dialogue	0.10	0.00	0.01	0.04	0.01	0.01	0.01	0.01	0.01
Subtotal	0.90	0.00	0.11	0.20	0.24	0.16	0.09	0.05	0.05
3. Research Development & Engineering									
a) Designated	12.00	0.00	0.50	2.00	2.50	2.50	2.50	1.00	1.00
b) Competitive	9.00	0.00	0.50	1.00	1.50	2.00	2.00	1.00	1.00
c) Company-Directed	9.00	0.00	0.50	1.00	1.50	2.00	2.00	1.00	1.00
d) Technical Assistance	1.15	0.00	0.27	0.28	0.27	0.27	0.02	0.02	0.02
e) RO&E Support	1.50	0.00	0.12	0.28	0.28	0.28	0.28	0.18	0.08
Subtotal	32.65	0.00	1.89	4.56	6.05	7.05	6.80	3.20	3.10
4. Institutional Development Support									
a) Standards, Testing and Quality Control	3.85	0.00	0.42	2.18	0.53	0.47	0.09	0.09	0.07
b) Technical Information Access Center	2.65	0.00	0.62	0.95	0.29	0.29	0.24	0.17	0.09
c) Diagnostic/Research Design Service	0.95	0.00	0.11	0.09	0.21	0.19	0.18	0.14	0.03
Subtotal	7.45	0.00	1.15	3.22	1.03	0.95	0.51	0.40	0.19
5. Evaluation and Financial Review	0.30	0.00	0.01	0.12	0.01	0.01	0.01	0.01	0.13
6. Contingency - 10% (Excludes Studies #3)	1.73	0.00	0.25	0.45	0.25	0.25	0.18	0.18	0.17
Grand Total	49.00	0.06	4.73	9.57	8.65	9.49	8.13	4.29	4.08

(09) ACTION AID4 INFO AMB DCM2 ECON CHRON PROJ: 493-0340 (S+T)

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PP RUHTBK
DE RUEHC #2657/01 2660914
ZNR UUUUU ZZH
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TO AMEMBASSY BANGKOK PRIORITY 1599
BT
UNCLAS STATE 292657

C&R RECEIVED
24 SEP 1984

LOC: 08 691
22 SEP 84 0813
CN: 02231
CHRG: AID
DIST: AID

ACTION TO:
DUE DATE: 9-26-84
ACTION TAKEN: NAN
INITIAL: WB
DATE: 09/24

AIDAC

E.O. 12356: N/A
TAGS:
SUBJECT: THAILAND S&T PID APAC REVIEW

1. APAC MET SEPTEMBER 5 TO REVIEW S&T STRATEGY PAPER AND PID. STRATEGY PAPER WAS APPROVED FOLLOWING PRESENTATION BY BRISKEY. PID WAS ALSO APPROVED WITH RECOMMENDATION THAT DESIGN SCHEDULE BE DEVELOPED FOR PREPARATION OF FIVE YEAR PROJECT WHICH ENSURES ADEQUATE CONSIDERATION OF THE OUTSTANDING ISSUES RAISED IN THE PID AND DURING AID/W REVIEW. ADDITIONALLY THE APAC REQUESTS THAT EVERY EFFORT BE MADE DURING THE DESIGN PROCESS TO INCORPORATE SMALL BUSINESS ORGANIZATIONS COVERED BY THE GRAY AMENDMENT INTO THE PROJECT. THE FOLLOWING CONCERNS WERE DISCUSSED AND ARE BEING COMMUNICATED AS GUIDANCE FOR PROJECT DESIGN.

2. PRIVATE SECTOR. THE STRATEGY PAPER AND PID IDENTIFY A RANGE OF CONSTRAINTS RELATED TO INVOLVEMENT OF THE PRIVATE SECTOR IN THE PROJECT, AND THE PID LISTS PRIVATE SECTOR PARTICIPATION AS ONE OF THE PRINCIPAL PP DESIGN ISSUES. THE APAC REVIEWED THE CRUCIAL ROLE OF THE PRIVATE SECTOR IN SCIENCE AND TECHNOLOGY ACTIVITIES.

AMONG THE PROBLEMS DISCUSSED WERE A CURRENTLY INADEQUATE POLICY FRAMEWORK TO PROVIDE INCENTIVES FOR PRIVATE SECTOR INVESTMENT; FINANCIAL MECHANISMS TO STIMULATE PRIVATE/PUBLIC SECTOR JOINT EFFORTS, INCLUDING US/THAI JOINT VENTURES POSSIBLY IN COORDINATION WITH THE UPCOMING RURAL INDUSTRIES PROJECT 493-0345); AND IDENTIFICATION OF "COMMERCIALIZABLE" S&T ACTIVITIES, ESPECIALLY IN THE NEAR TERM. THE CONSENSUS OF THE APAC WAS THAT MAJOR ATTENTION SHOULD BE GIVEN TO THIS TOPIC IN PP DESIGN FOR THE FIRST PHASE, PARTICULARLY GIVEN THE "DEMAND-DRIVEN" "PROBLEM ORIENTATION" NATURE OF THE PROJECT.

3. THAI GOVERNMENT INVOLVEMENT. THE APAC FULLY AGREED WITH THE PIVOTAL ROLE THE RTG WILL PLAY IN THE PROJECT - AND RECOGNIZED THE COMPLEXITY OF THE VARIOUS CONTRIBUTIONS CALLED FOR ON ITS PART. INITIATIVES TO IMPROVE THE POLICY FRAMEWORK MUST BE TAKEN BY GOVERNMENT, AS MUST EFFORTS TO CALVANIZE AND COORDINATE GOVERNMENT,

DISTRIBUTION

ACT		INFO
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	O/FIN	✓
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	O/RCM	
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	DTEC	
	C&R	✓

ACADEMIC AND INDUSTRY RESOURCES. READINESS OF RTG TO DEVELOP AND FOSTER THESE CHANGES AND COMMIT NECESSARY RESOURCES TO THE PROPOSED EFFORT SHOULD BE INCORPORATED IN PP DESIGN IN A COLLABORATIVE STYLE, INCLUDING PROVISION FOR RECURRENT COSTS AND "ADDITIONALITY" IN ITS BUDGETARY CONTRIBUTION.

4. INSTITUTIONALIZATION. THE INSTITUTIONAL OR ORGANIZATIONAL ARRANGEMENTS PROPOSED CALL FOR AN EXCEPTIONAL DEGREE OF COORDINATION AMONG A RANGE OF VARIOUS THAI INSTITUTIONS WITH A RECORD OF VERY LIMITED SUCCESSFUL COORDINATION IN THE PAST. PARTICULARLY IN THE FIRST FIVE YEARS, ACHIEVING PROJECT OBJECTIVES IN A TIMELY FASHION WILL DEPEND TO A SIGNIFICANT EXTENT ON THE DEGREE TO WHICH VARIOUS ENTITIES - SOME OF WHICH ARE NEWLY CREATED - CAN WORK EFFECTIVELY TOGETHER. IN THE INSTITUTIONAL ANALYSIS SECTION OF THE PROJECT PAPER, CONSIDERABLE DETAIL SHOULD BE INCLUDED REGARDING THE VARIOUS ROLES AND INTERRELATIONSHIPS OF PARTICIPATING ORGANIZATIONS AND THE DEGREE OF INTERDEPENDENCE AMONG THESE ORGANIZATIONS NECESSARY FOR PROJECT SUCCESS. THE INVOLVEMENT OF A CONSIDERABLE NUMBER OF DIFFERENT ORGANIZATIONS WILL LIKELY PLACE A HEAVY BURDEN ON MISSION PROJECT MANAGEMENT. THE PROJECT PAPER SHOULD INCLUDE A COMPREHENSIVE PLAN ON HOW THESE MANAGEMENT IMPLEMENTATION RESPONSIBILITIES WILL BE UNDERTAKEN.

5. RESEARCH. A NUMBER OF PRIORITY RESEARCH AREAS AND TOPICS ARE IDENTIFIED IN THE PID. THE OBJECTIVES OF RESEARCH INVESTMENTS IN THESE AREAS AND RATIONALE FOR SELECTION OF SPECIFIC TOPICS, HOWEVER, WERE NOT ALWAYS EVIDENT FROM THE DOCUMENTATION WE REVIEWED. QUESTIONS AS TO THE RELEVANCE AND PRIORITY OF SPECIFIC RESEARCH AREAS TO KEY NEEDS, REQUIRE GREATER ANALYSIS IN SOME CASES . THE APAC FELT IT WOULD TAKE A LONGER TIME FRAME THAN ORIGINALLY PLANNED TO PROVIDE THOROUGH FLESHING OUT OF THE RATIONALE FOR VARIOUS RESEARCH OBJECTIVES, AND, IN THE PROCESS, PROVIDING A STRONGER OVERALL ANALYTICAL BASE FOR DECISIONS BEING MADE. IT ALSO AGREED WITH THE PID EMPHASIS ON THE NEED TO DEVELOP SEPARATE PROCEDURES FOR THE DESIGNATED VS. COMPETITIVE RESEARCH ACTIVITIES AND THE NEED TO EXPLORE BARRIERS AND INCENTIVES TO ENHANCED UNIVERSITY RESEARCH AND TO PROMOTE INVOLVEMENT OF UNIVERSITY RESEARCHERS IN S&T RESEARCH (EG, BY REDUCING TEACHING REQUIREMENTS AND ELIMINATING LIMITATIONS PLACED ON PRIVATE SECTOR CONSULTANCIES BY ACADEMICIANS). IN ADDITION, DESIGN SHOULD ADDRESS THE CONCEPT AND FEASIBILITY OF AN S&T DEVELOPMENT CORPS AND SHOULD CONSIDER CAREFULLY THE STRUCTURE AND FUNCTION OF TISTR IN STIMULATING APPLIED RESEARCH AND PROVIDING TECHNICAL SUPPORT TO PRIVATE INDUSTRY.

ANNEX B

6. INSTITUTIONAL DEVELOPMENT AND PROBLEM-SOLVING. THE APAC DISCUSSED PROSPECTS FOR ACHIEVEMENT OF THE PID OBJECTIVE OF INSTITUTIONALIZATION OF A "SYSTEM" OF S&T RESEARCH AND DEVELOPMENT IN THE NEAR TERM AS OPPOSED TO CONCENTRATING ON ACHIEVEMENT OF THE NARROWER PROBLEM-SOLVING OBJECTIVE. COMMITTEE CONSENSUS DID NOT FAVOR ONE EMPHASIS OVER THE OTHER. IN FACT, THE APAC RECOGNIZES THAT THERE WILL BE NUMEROUS TRADEOFFS MADE DURING DESIGN AND IMPLEMENTATION AS TO WHETHER RESOURCES SHOULD AIM TO STRENGTHEN RESEARCH INSTITUTIONS IN A SYSTEMATIC APPROACH TO RESEARCH AND DEVELOPMENT, OR TO SOLVE SPECIFIC RESEARCH PROBLEMS HAVING NEAR TERM POTENTIAL FOR APPLICATION AND COMMERCIALIZATION. THE PURPOSE OF THE FIVE YEAR PROJECT - AS PART OF A PROPOSED LONGER TERM PROGRAM - SHOULD BE EXPLICIT AS TO THE BALANCE STRUCK BETWEEN THE TWO SIDES OF THIS ISSUE.

7. UNIVERSITY PARTICIPATION. THE ROLE OF THE CHULALONGKORN PROGRAM IN MEETING CURRENT AND PROJECTED NEEDS IN SCIENTIFIC AND TECHNICAL FIELDS SHOULD BE FULLY ADDRESSED. A CAREFUL INSTITUTIONAL ANALYSIS OF THE STRENGTHS AND WEAKNESSES OF CHULALONGKORN IN TERMS OF

ITS FACULTY, CURRICULUM, PHYSICAL PLANT, AND CAREER PATHS OF ITS GRADUATES IS REQUIRED TO DEFINE CRITICAL DEFICIENCIES AND THE SCOPE OF PROJECT INPUTS TO ADDRESS THESE DEFICIENCIES. POLICY/INSTITUTIONAL IMPEDIMENTS TO PROGRESS SHOULD ALSO BE IDENTIFIED AND ADDRESSED IN THE PP AND A DETAILED BUDGET FOR SPECIFIC PROJECT COMPONENTS SHOULD BE PREPARED. THE PREPARATION OF AN R&D MANPOWER DEVELOPMENT PLAN WAS ALSO RECOMMENDED TO PROVIDE GUIDANCE ON THE MAGNITUDE AND COMPOSITION OF EFFORTS TO STRENGTHEN UNIVERSITY CAPABILITIES FOR S&T RESEARCH.

8. SELECTION OF ACTIVITIES. THE NEED FOR ADDITIONAL ANALYTICAL WORK TO DEVELOP FURTHER THE UNDERPINNINGS OF THE PROJECT WAS MENTIONED IN PARA 5 ABOVE. DEVELOPMENT OF APPROPRIATE CRITERIA AND PROCEDURES FOR RESEARCH PROBLEM SELECTION IS IDENTIFIED AS A PRINCIPAL ISSUE IN THE PID. WHAT IS PARTICULARLY IMPORTANT IS INVOLVEMENT OF THE US SCIENTIFIC/TECHNOLOGICAL COMMUNITY AT APPROPRIATE STAGES IN SELECTION OF RESEARCH AREAS TO HELP ENSURE THAT RESOURCE ALLOCATIONS WILL BE APPROPRIATE. SUCH ALLOCATIONS MUST BE CONSISTENT NOT ONLY WITH THAI INTERESTS AND CAPACITIES BUT ALSO THE STATE AND DIRECTION OF KNOWLEDGE AND RESEARCH OUTSIDE THAILAND. THE APAC DISCUSSION UNDERLINED THE NEED FOR COLLABORATIVE IDENTIFICATION OF AN INITIAL SET OF SPECIFIC HIGH PRIORITY FEASIBLE ACTIVITIES WHICH COULD CONSTITUTE PART OF A FIRST YEAR WORK PLAN AND SERVE AS THE BASIS FOR BUDGET PREPARATION.

9. DESIGN. THERE WAS CONSIDERABLE APAC DISCUSSION CONCERNING THE PROCESS APPROACH TO DESIGN. IT IS RECOGNIZED THAT WHILE SOME ASPECTS OF THE PROJECT IMPLY NEED FOR LESS DETAIL IN INITIAL DESIGN, OTHER COMPONENTS REQUIRE SPECIFICITY INCLUDING A DETAILED BUDGET. SUGGESTED KEY ELEMENTS FOR ELABORATION IN DESIGN INCLUDE

PREPARATION OF A DETAILED FIRST YEAR WORKPLAN IN CONJUNCTION WITH HOST-COUNTRY COUNTERPARTS, A DETAILED MANAGEMENT INFORMATION SYSTEM WITH A STRONG MONITORING AND EVALUATION COMPONENT, AS WELL AS THE PROCESS FOR DEVELOPMENT AND SELECTION OF VARIOUS SUBPROJECTS. A PROPOSED SCHEDULE FOR SEQUENCING PROJECT DESIGN WAS DISCUSSED, INCLUDING THE INITIATION OF FEASIBILITY WORK PRIOR TO PROJECT PAPER WRITE-UP. SIMILARLY, THE PROVISION OF AN A.I.D.-KNOWLEDGABLE CONSULTANT WAS SUGGESTED TO ASSIST IN WRITING SCOPES OF WORK AND THE PROJECT PAPER. AT THE REQUEST OF THE MISSION, BOB PRATT WILL COME ON TDY TOWARD THE END OF SEPTEMBER TO WORK WITH THE MISSION ON A DETAILED DESIGN STRATEGY AS PART OF COMMENCEMENT OF PROJECT PAPER PREPARATION.

10. COMPUTERS. THE APAC RECOGNIZES AND ENDORSES THE APPROPRIATENESS OF COMPUTER TRAINING BEING PROVIDED FOR A WIDE RANGE OF ACTIVITIES IN THAILAND. HOWEVER, SUPPORT FOR PREPARATION OF COMPUTER SOFTWARE SHOULD BE CONFINED ONLY TO THE AREAS OF JOINT US/THAI PRIORITY DEVELOPMENT INTERESTS. IN ADDITION, CARE SHOULD BE TAKEN THAT ASSISTANCE DOES NOT SUPPLANT PRIVATE SECTOR INITIATIVE. IN THIS REGARD, THE PP SHOULD DESCRIBE THE SKILL LEVEL AND CAPACITY OF COMPUTER PERSONNEL IN THAILAND, THE CURRENT TRAINING FACILITIES, THE UTILIZATION OF COMPUTER FACILITIES BY THE PRIVATE AND PUBLIC SECTORS, AND THE EXISTING INCENTIVES AND OPPORTUNITIES (EG. AVAILABLE FINANCING) FOR PRIVATE SECTOR INITIATIVES IN THIS AREA.

11. PROJECT GOALS AND OBJECTIVES. THE APAC RECOMMENDS THAT LINKAGES BETWEEN SELECTION AND APPLICATION OF APPROPRIATE TECHNOLOGY AND DEVELOPMENT NEEDS BE DESCRIBED IN RELATION TO ACHIEVEMENT OF PROJECT GOALS AND OBJECTIVES, SUCH AS EMPLOYMENT CREATION. SHULTZ
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ANNEX B-2

ISSUES AND COMMENTS
SUMMARY OF PROJECT PAPER'S RESPONSE
TO APAC PID REVIEW CABLE

In the cable (84 State 282657, Annex B) authorizing USAID to proceed with the preparation of a Project Paper, several issues were raised. Each of these issues is quoted and discussed briefly below and/or in more detail in the annexes of the Paper.

Issues/Concerns

1. APAC MET SEPTEMBER 5 TO REVIEW S&T STRATEGY PAPER AND PID. STRATEGY PAPER WAS APPROVED FOLLOWING PRESENTATION BY BRISKEY. PID WAS ALSO APPROVED WITH RECOMMENDATION THAT DESIGN SCHEDULE BE DEVELOPED FOR PREPARATION OF FIVE YEAR PROJECT WHICH ENSURES ADEQUATE CONSIDERATION OF THE OUTSTANDING ISSUES RAISED IN THE PID AND DURING AID/W REVIEW. ADDITIONALLY THE APAC REQUESTS THAT EVERY EFFORT BE MADE DURING THE DESIGN PROCESS TO INCORPORATE SMALL BUSINESS ORGANIZATIONS COVERED BY THE GRAY AMENDMENT INTO THE PROJECT. THE FOLLOWING CONCERNS WERE DISCUSSED AND ARE BEING COMMUNICATED AS GUIDANCE FOR PROJECT DESIGN.

Comment/Resolution

A. Anticipating that it would take approximately nine months in start-up activities and knowing that it would require two to three years to complete proposed RD&E activities, to be funded in the fourth year (FY 1989), it was decided to plan the Project life for a more realistic duration of seven years.

B . Small business firms covered by Gray Amendment were utilized in developing the Project Paper.

C. Issues raised in the PID have been addressed throughout the body of the PP.

Issues/Concerns

2. PRIVATE SECTOR. THE STRATEGY PAPER AND PID IDENTIFY A RANGE OF CONSTRAINTS RELATED TO INVOLVEMENT OF THE PRIVATE SECTOR IN THE PROJECT, AND THE PID LISTS PRIVATE SECTOR PARTICIPATION AS ONE OF THE PRINCIPAL PP DESIGN ISSUES. THE APAC REVIEWED THE CRUCIAL ROLE OF THE PRIVATE SECTOR IN SCIENCE AND TECHNOLOGY ACTIVITIES.

AMONG THE PROBLEMS DISCUSSED WERE A CURRENTLY INADEQUATE POLICY FRAMEWORK TO PROVIDE INCENTIVES FOR PRIVATE SECTOR INVESTMENT; FINANCIAL MECHANISMS TO STIMULATE PRIVATE/PUBLIC SECTOR JOINT EFFORTS, INCLUDING US/THAI JOINT VENTURES POSSIBLY IN COORDINATION WITH THE UPCOMING RURAL INDUSTRIES PROJECT 493-0345); AND IDENTIFICATION OF "COMMERCIALIZABLE" S&T ACTIVITIES, ESPECIALLY IN THE NEAR TERM. THE CONSENSUS OF THE APAC WAS THAT MAJOR ATTENTION SHOULD BE GIVEN TO THIS TOPIC IN PP DESIGN FOR THE FIRST PHASE, PARTICULARLY GIVEN THE "DEMAND-DRIVEN" "PROBLEM ORIENTATION" NATURE OF THE PROJECT.

Comment/Resolution

A. The inadequacies of the policy framework for private sector investment (and also for RTG involvement - see 3A) are recognized in the PP. Rectifying these inadequacies requires a sustained effort. The STDB organizational structure provides for a "Policy Review" unit with a mandate, and also funding, to focus on the specific policy constraints and alternate means of addressing those constraints. The composition of the STDB Board of Directors includes senior and well respected private sector representatives, including the Thai Bankers Association and the Chamber of Commerce. The RTG has, in the course of Project design, taken several policy decisions which give increasing recognition of the need to provide incentives for private sector investment, including the establishment of a loan fund, with RTG resources, to finance private sector RD&E.

B. The RD&E program is specifically responsive to joint private/public sector collaboration requirements and will work on problems and opportunities of generic interest to industries. The Company-directed RD&E will depend upon company initiatives and needs of a proprietary nature. US/Thai joint ventures would also be eligible for financing under this scheme.

C. The composition of the STDB, and its proposed method of operation (whereby the STDB would own a share of the intellectual research funded by them) will provide the mechanism for identification of commercializable S&T activities. STDB will seek to market its "Assets" as they are developed.

There may still be a need for a "venture capital" fund to finance high risk/high yield ventures to put these new technologies into production. Depending upon the outcome of the company-directed RD&E effort proposed herein, however, it is possible to expand the scope of this activity.

Issues/Concerns

3. THAI GOVERNMENT INVOLVEMENT. THE APAC FULLY AGREED WITH THE PIVOTAL ROLE THE RTG WILL PLAY IN THE PROJECT - AND RECOGNIZED THE COMPLEXITY OF THE VARIOUS CONTRIBUTIONS CALLED FOR ON ITS PART. INITIATIVES TO IMPROVE THE POLICY FRAMEWORK MUST BE TAKEN BY GOVERNMENT, AS MUST EFFORTS TO GALVANIZE AND COORDINATE GOVERNMENT, ACADEMIC AND INDUSTRY RESOURCES. READINESS OF RTG TO DEVELOP AND FOSTER THESE CHANGES AND COMMIT NECESSARY RESOURCES TO THE PROPOSED EFFORT SHOULD BE INCORPORATED IN PP DESIGN IN A COLLABORATIVE STYLE, INCLUDING PROVISION FOR RECURRENT COSTS AND "ADDITIONALITY" IN ITS BUDGETARY CONTRIBUTION.

Comment/Resolution

A. The readiness of RTG is evidenced from its agreement on the establishment of STDB to foster private and public sector cooperation and to cause RD&E efforts to be demand-driven. In addition the RTG plans call for the establishment of an Interministerial S&T Council to promote policy coordination within the RTG.

B. Considering the austerity measures which RTG has taken to correct the effects of Baht devaluation, RTG has agreed to make substantial cash contributions.

Issues/Concerns

4. INSTITUTIONALIZATION. THE INSTITUTONAL OR ORGANIZATIONAL ARRANGEMENTS PROPOSED CALL FOR AN EXCEPTIONAL DEGREE OF COORDINATION AMONG A RANGE OF VARIOUS THAI INSTITUTIONS WITH A RECORD OF VERY LIMITED SUCCESSFUL COORDINATING IN THE PAST. PARTICULARLY IN THE FIRST FIVE YEARS, ACHIEVING PROJECT OBJECTIVES IN A TIMELY FASHION WILL DEPEND TO A SIGNIFICANT EXTENT ON THE DEGREE TO WHICH VARIOUS ENTITIES - SOME OF WHICH ARE NEWLY CREATED - CAN WORK EFFECTIVELY TOGETHER. IN THE INSTITUTIONAL ANALYSIS SECTION OF THE PROJECT PAPER, CONSIDERABLE DETAIL SHOULD BE INCLUDED REGARDING THE VARIOUS ROLES AND INTERRELATIONSHIPS OF PARTICIPATING ORGANIZATIONS AND THE DEGREE OF INTERDEPENDENCE AMONG THESE ORGANIZATIONS NECESSARY FOR PROJECT SUCCESS. THE INVOLVEMENT OF A CONSIDERABLE NUMBER OF DIFFERENT ORGANIZATIONS WILL LIKELY PLACE A HEAVY BURDEN ON MISSION PROJECT MANAGEMENT. THE PROJECT PAPER SHOULD INCLUDE A COMPREHENSIVE PLAN ON HOW THESE MANAGEMENT IMPLEMENTATION RESPONSIBILITIES WILL BE UNDERTAKEN.

Comment/Resolution

A. The organizational structure of STDB, together with other measures being contemplated by RTG (establishment of the S&T Council) are responsive to these concerns. The STDB mechanism is designed to "manage" the activity by facilitating interaction among the various elements that have an interest in the development of S&T in Thailand; specifically, the RD&E community, the private sector and the relevant government and parastatal agencies. In the last analysis, it is these indigenous elements which must engage in the social that will lead to technological modernization of the Thai productive sector (See Annex J).

B. Project implementation is designed to assure effective use of resources while encouraging the constructive interaction among the elements described above. The STDB structure minimizes the requirement for mission participation in direct management. The management responsibilities of USAID are described in Section VI.

Issues/Concerns

5. RESEARCH. A NUMBER OF PRIORITY RESEARCH AREAS AND TOPICS ARE IDENTIFIED IN THE PID. THE OBJECTIVES OF RESEARCH INVESTMENTS IN THESE AREAS AND RATIONALE FOR SELECTION OF SPECIFIC TOPICS, HOWEVER, WERE NOT ALWAYS EVIDENT FROM THE DOCUMENTATION WE REVIEWED. QUESTIONS AS TO THE RELEVANCE AND PRIORITY OF SPECIFIC RESEARCH AREAS TO KEY NEEDS, REQUIRE GREATER ANALYSIS IN SOME CASES. THE APAC FELT IT WOULD TAKE A LONGER TIME FRAME THAN ORIGINALLY PLANNED TO PROVIDE THOROUGH FLESHING OUT OF THE RATIONALE FOR VARIOUS RESEARCH OBJECTIVES, AND, IN THE PROCESS, PROVIDING A STRONGER OVERALL ANALYTICAL BASE FOR DECISIONS BEING MADE. IT ALSO AGREED WITH THE PID EMPHASIS ON THE NEED TO DEVELOP SEPARATE PROCEDURES FOR THE DESIGNATED VS. COMPETITIVE RESEARCH

ACTIVITIES AND THE NEED TO EXPLORE BARRIERS AND INCENTIVES TO ENHANCED UNIVERSITY RESEARCH AND TO PROMOTE INVOLVEMENT OF UNIVERSITY RESEARCHERS IN S&T RESEARCH (EG. BY REDUCING TEACHING REQUIREMENTS AND ELIMINATING LIMITATIONS PLACED ON PRIVATE SECTOR CONSULTANCIES BY ACADEMICIANS). IN ADDITION, DESIGN SHOULD ADDRESS THE CONCEPT AND FEASIBILITY OF AN S&T DEVELOPMENT CORPS AND SHOULD CONSIDER CAREFULLY THE STRUCTURE AND FUNCTION OF TISTR IN STIMULATING APPLIED RESEARCH AND PROVIDING TECHNICAL SUPPORT TO PRIVATE INDUSTRY.

Comment/Resolution

A. Rationale for priority areas and research topics is described in Annex G. Specific RD&E activities will be governed by criteria and procedures described in Annex K.

B. APAC suggestion regarding time frame has been accomodated.

C. Separate procedures have been established. See Annex K.

D. Barriers to university involvement have been identified (see Policy Review - Section III E 2). Legal status of STDB has been structured to overcome the major constraint for research funded under this Project. But continued efforts will be made to realize general solution at policy level for Thai universities.

E. S&T development corps concept has been reviewed and dropped from the Project.

F. RTG has undertaken a major effort to upgrade TISTR, enhance its effectiveness and change orientation to serve private sector more effectively. Leadership of TISTR has been changed. A new 5 year development plan for TISTR has been drawn up, approved and is being effectively implemented. USAID review suggests these efforts are on the right track. To the extent it is possible for this Project to support the MOSTE/TISTR effort, the Project design has done so.

On the other hand, TISTR's role is not dominant in private sector support activities [See TIAC and Diagnostic Activities described in Section III 4 (b) and (c). See also Annex L and M].

Issues/Concerns

6. INSTITUTIONAL DEVELOPMENT AND PROBLEM-SOLVING. THE APAC DISCUSSED PROSPECTS FOR ACHIEVEMENT OF THE PID OBJECTIVE OF INSTITUTIONALIZATION OF A "SYSTEM" OF S&T RESEARCH AND DEVELOPMENT IN THE NEAR TERM AS OPPOSED TO CONCENTRATING ON ACHIEVEMENT OF THE NARROWER PROBLEM-SOLVING OBJECTIVE. COMMITTEE CONSENSUS DID NOT FAVOR ONE EMPHASIS OVER THE OTHER. IN FACT, THE APAC RECOGNIZES THAT THERE WILL BE NUMEROUS TRADEOFFS MADE DURING DESIGN AND IMPLEMENTATION AS TO WHETHER RESOURCES SHOULD AIM TO STRENGTHEN RESEARCH INSTITUTIONS IN A SYSTEMATIC APPROACH TO RESEARCH AND DEVELOPMENT, OR TO SOLVE SPECIFIC RESEARCH PROBLEMS HAVING NEAR TERM POTENTIAL AND APPLICATION AND

COMMERCIALIZATION. THE PURPOSE OF THE FIVE YEAR POROJECT - AS PART OF A PROPOSED LONGER TERM PROGRAM - SHOULD BE EXPLICIT AS TO THE BALANCE STRUCK BETWEEN THE TWO SIDES OF THIS ISSUE.

Comment/Resolution

The establishment of an institutional framework to foster private and public sector cooperation for S&T development and efforts to promote suitable policy framework have been designed in favor of institution building objectives of the Project. In terms of RD&E activities, the balance between institution building (designated research) and problem solving (all other activities) is largely weighted towards the problem solving side.

The economic analysis (Annex H) draws comparisons with the experiences of other countries, i.e. Korea, and suggests that the highest productivity gains occur at the adaptation end of the S&T scale, where technology developed in the more advanced societies, and imported into the developing country is utilized more and more effectively. While investment in the basic research end of the scale should not be ignored, it is not likely to yield high returns until a later stage in the development process.

Issues/Concerns

7. UNIVERSITY PARTICIPATION. THE ROLE OF THE CHULALONGKORN PROGRAM IN MEETING CURRENT AND PROJECTED NEEDS IN SCIENTIFIC AND TECHNICAL FIELD SHOULD BE FULLY ADDRESSED. A CAREFUL INSTITUTIONAL ANALYSIS OF THE STRENGTHS AND WEAKNESSES OF CHULALONGKORN IN TERMS OF ITS FACULTY, CURRICULUM, PHYSICAL PLANT, AND CAREER PATHS OF ITS GRADUATES IS REQUIRED TO DEFINE CRITICAL DEFICIENCIES AND THE SCOPE OF PROJECT INPUTS TO ADDRESS THESE DEFICIENCIES. POLICY/INSTITUTIONAL IMPEDIMENTS TO PROGRESS SHOULD ALSO BE IDENTIFIED AND ADDRESSED IN THE PP AND A DETAILED BUDGET FOR SPECIFIC PROJECT COMPONENTS SHOULD BE PREPARED. THE PREPARATION OF AN R&D MANPOWER DEVELOPMENT PLAN WAS ALSO RECOMMENDED TO PROVIDE GUIDANCE ON THE MAGNITUDE AND COMPOSITION OF EFFORTS TO STRENGTHEN UNIVERSITY CAPABILITIES FOR S&T RESEARCH.

Comment/Resolution

A careful analysis of a model undergraduate program at Chulalongkorn University led to the decision that this activity be dropped from the proposed Project.

Issues/Concerns

8. SELECTION OF ACTIVITIES. THE NEED FOR ADDITONAL ANALYTICAL WORK TO DEVELOP FURTHER THE UNDERPINING'S OF THE PROJECT WAS MENTIONED IN PARA 5 ABOVE. DEVELOPMENT OF APPROPRIATE CRITERIA AND PROCEDURES FOR RESEARCH PROBLEM SELECTION IS IDENTIFIED AS A PRINCIPAL ISSUE IN THE PID. WHAT IS PARTICULARLY IMPORTANT IS INVOLVEMENT OF THE US SCIENTIFIC/TECHNOLOGICAL COMMUNITY AT APPROPRIATE STAGES IN SELECTION OF RESEARCH AREAS TO HELP ENSURE THAT RESOURCE ALLOCATIONS WILL BE APPROPRIATE. SUCH ALLOCATIONS MUST BE CONSISTENT NOT ONLY WITH THAI INTERESTS AND CAPACITIES BUT ALSO THE STATE AND

DIRECTION OF KNOWLEDGE AND RESEARCH OUTSIDE THAILAND. THE APAC DISCUSSION UNDERLINED THE NEED FOR COLLABORATIVE IDENTIFICATION OF AN INITIAL SET OF SPECIFIC HIGH PRIORITY FEASIBLE ACTIVITIES WHICH COULD CONSTITUTE PART OF A FIRST YEAR WORK PLAN AND SERVE AS THE BASIS FOR BUDGET PREPARATION.

Comment/Resolution

A. Criteria and procedures for research problem selection are described in Annex K.

B. Involvement of the US S&T community was extensive during the Project design phase. Continued involvement will be arranged through technical assistance contract (See Annex K and Section III.C.3).

C. Identification of initial set of research areas has been completed for designated research. (See Section III C 3(a). Identification of competitive and company-directed research will be achieved by adherance to procedures described in Annex K.

Issues/Concerns

9. DESIGN. THERE WAS CONSIDERABLE APAC DISCUSSION CONCERNING THE PROCESS APPROACH TO DESIGN. IT IS RECOGNIZED THAT WHILE SOME ASPECTS OF THE PROJECT IMPLY NEED FOR LESS DETAIL IN INITIAL DESIGN, OTHER COMPONENTS REQUIRE SPECIFICITY INCLUDING A DETAILED BUDGET. SUGGESTED BY KEY ELEMENTS FOR ELABORATION IN DESIGN INCLUDE PREPARATION OF A DETAILED FIRST YEAR WORKPLAN IN CONJUNCTION WITH HOST-COUNTRY COUNTERPARTS, A DETAILED MANAGEMENT INFORMATION SYSTEM WITH A STRONG MONITORING AND EVALUATION COMPONENT, AS WELL AS THE PROCESS FOR DEVELOPMENT AND SELECTION OF VARIOUS SUBPROJECTS. A PROPOSED SCHEDULE FOR SEQUENCING PROJECT DESIGN WAS DISCUSSED, INCLUDING THE INITIATION OF FEASIBILITY WORK PRIOR TO PROJECT PAPER WRITE-UP. SIMILARLY, THE PROVISION OF AN AID-KNOWLEDGABLE CONSULTANT WAS SUGGESTED TO ASSIST IN WRITING SCOPES OF WORK AND THE PROJECT PAPER. AT THE REQUEST OF THE MISSION, BOB PRATT WILL COME ON TDY TOWARD THE END OF SEPTEMBER TO WORK WITH THE MISSION ON A DETAILED DESIGN STRATEGY AS PART OF COMMENCEMENT OF PROJECT PAPER PREPARATION.

Comment/Resolution

A. First year work plan is described as part of Section VI - Implementation Plan.

B. Monitoring and Evaluation Plan is described in Section VI.

C. The process for selection of sub-projects is described in Annex K

D. Recommendations regarding Project design work have been accomodated.

Issues/Concerns

10. COMPUTERS. THE APAC RECOGNIZES AND ENDORSES THE APPROPRIATENESS OF COMPUTER TRAINING BEING PROVIDED FOR A WIDE RANGE OF ACTIVITIES IN THAILAND.

HOWEVER, SUPPORT FOR PREPARATION OF COMPUTER SOFTWARE SHOULD BE CONFINED ONLY TO THE AREAS OF JOINT US/THAI PRIORITY DEVELOPMENT INTERESTS. IN ADDITION, CARE SHOULD BE TAKEN THAT ASSISTANCE DOES NOT SUPPLANT PRIVATE SECTOR INITIATIVE. IN THIS REGARD, THE PP SHOULD DESCRIBE THE SKILL LEVEL AND CAPACITY OF COMPUTER PERSONNEL IN THAILAND, THE CURRENT TRAINING FACILITIES, THE UTILIZATION OF COMPUTER FACILITIES BY THE PRIVATE AND PUBLIC SECTORS, AND THE EXISTING INCENTIVES AND OPPORTUNITIES (EG. AVAILABLE FINANCING) FOR PRIVATE SECTOR INITIATIVES IN THIS AREA.

Comment/Resolution

A. Preparation of computer software will be confined to areas of priority interest. See Section III C 3. Guidance on this matter will be provided to STDB.

B. Project assistance will not supplant private sector initiatives. Private sector participation on STDB Board of Directors will accomplish this.

C. Two comprehensive reports on computer facilities and their uses were completed under the Project. A mini-needs assessment in the area of training is planned. This assessment will be performed by using technical assistance contract resources.

Issues/Concerns

11. PROJECT GOALS AND OBJECTIVES. THE APAC RECOMMENDS THAT LINKAGES BETWEEN SELCETION AND APPLICATION OF APPROPRIATE TECHNOLOGY AND DEVELOPMENT NEEDS BE DESCRIBED IN RELATION TO ACHIEVEMENT OF PROJECT GOALS AND OBJECTIVES, SUCH AS EMPLOYEMNT CREATION.

Comment/Resolution

A. The concerns regarding linkages have been incorporated in the criteria and operating procedures described in Annex K. Applications for study grants shall be required to show those linkages.

STATUTORY CHECKLIST

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?	Yes.

A. GENERAL CRITERIA FOR PROJECT

1. FY 1985 Continuing Resolution Sec. 525; FAA Sec. 634A; Sec. 653(b).

(a) Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the Project;	Congressional Notification will be forwarded to Committees.
(b) Is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that amount)?	Yes.

2. FAA Sec. 611 (a)(1). Prior to obligation in excess of $100,000, will there be:	Feasibility analyses have been prepared and included in the Project Paper.
(a) engineering, financial or other plans necessary to carry out the assistance and	
(b) a reasonably firm estimate of the cost to the US of the assistance?	
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance.	N/A

4.	FAA Sec. 611(b); FY 1985 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has Project met the standards and criteria as set forth in the Principles and Standards for planning Water and Related Land Resources, dated October 25, 1973?	N/A
5.	FAA Sec. 611 (e). If Project is capital assistance (e.g., construction), and all US assistance for it will exceed $1 million, has Mission Director certified and Regional Assistance Administrator taken into consideration the country's capability effectively to maintain and utilize the Project?	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.	No.
7.	FAA Sec. 601 (a). Information and conclusions whether Project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and 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) N/A; (b) This Project is designed to address unmet technology needs of the private sector. The RD&E Project component for the most part and the establishment of the Technology Information Access Center, and the Diagnostic Research Design Service activities directly contribute towards fostering private initiative and competition; (c) N/A; (d) Yes, indirectly; (e) All Project activities have been designed to accomplish this objective; and (f) N/A.

8. FAA Sec. 601(b). Information and conclusions on how Project will encourage US private trade and investment abroad and encourage private US participation in foreign assistance programs (including use of private trade channels and the services of US private enterprise).	This Project will indirectly encourage US private trade and investment in Thailand. The Project provides for substantial US technical assistance from both private and public sources under a technical assistance contract.
9. FAA Sec. 612(b); Sec. 636(h) FY 1985 Continuing Resolution Sec. 507. 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 United States are utilized in lieu of dollars.	The Royal Thai Government (RTG) contribution to the Project will exceed 25% of total requirements.
10. FAA Sec. 612(d). Does the United States own excess foreign currency and, if so, what arrangements have been made for its release?	There are no US owned local currencies available for this Project.
11. FAA Sec. 601(e). Will the Project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes. Technical assistance contract with NAS, however, would be procured non-competitively subject to the approval of a non-competitive waiver by AID.
12. FY 1985 Continuing Resolution Sec. 522. 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 asssistance likely to cause substantial injury to US producers of the same, similar or competing commodity?	N/A

13. FAA 118(c) and (d). Does the Project take into account the impact on the environment and natural resources? If the Project or program will significantly affect the global commons or the US environment, has an environmental impact statement been prepared? If the Project or program will significantly affect the environment of a foreign country, has an environmental assessment been prepared? Does the Project or program take into consideration the problem of the destruction of tropical forests.	The Project will have no significant effect on the environment, natural resources or tropical forests. See Annex E - Environment Analysis.
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 receipts and expenditure of Project funds (dollars or local currency generated therefrom)?	N/A
15. FY 1985 Continuing Resolution Sec. 536. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution?	No.

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria.

a. FAA Sec. 102(b); 111; 113; 281(a). Extent to which activity will:

(1) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out 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 the appropriate US institutions;	The Project will focus on the development, adaptation and application of appropriate technologies in improving the processes and products for domestic and export markets. This will benefit the country's poor in terms of improved health standards as a result of better quality local products for local consumption. It will also help generate employment opportunities in agro-business and other industries for the rural poor.
(2) 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;	No direct effect planned.
(3) support the self-help efforts of developing countries;	The Project focuses on strengthening the indigenous capability to solve problems limiting, and create opportunities for, development. In this way the Thais will be helping themselves through their people, improved institutions and alternative policies.

(4) promote the participation of women in the national economies of developing countries and the improvement of women's status; and	No differential effect on women is seen. Women are major participants in S&T organizations. Many of the new technology-based employment opportunities will be for women.
(5) utilize and encourage regional cooperation by developing countries.	No direct effect planned.
b. FAA Sec. 103, 103A, 104, 105, 106. Does the Project fit the criteria for the type of funds (functional account) being used?	Yes.
c. 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 businesses, and small incomes of the poor)?	Yes.
d. FAA Sec. 110(a). Will the recipient country provide at least 25% 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 being waived for a "relatively least developed" country)?	Yes.
e. FAA Sec. 110(b). Will grant capital assistance be disbursed for Project over more than 3 years? If so, has justification satisfactory to Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"?	N/A

f. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth?	Yes
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 consistent with the RTG's own development plans, is jointly developed, and is built on the country's human and natural resource base.
2. Development Assistance Project Criteria (Loans Only)	
a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.	Repayment prospects are excellent.
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the US with US enterprise, is there an agreement by the recipient country to prevent export to the US of more than 20% of the enterprise's annual production during the life of the loan?	N/A

ANNEX E

No. 0100/1242

Ministry of Science, Technology
and Energy,
Rama VI Road, Bangkok 10400.
Telex No.20838 MINSTEN TH

20 March B.E. 2528 (1985)

Mr. Robert Halligan
Director
USAID/Thailand
37 Soi Somprasong 3
Petchburi Road
Bangkok 10400

Subject: Science and Technology for Development Project (493-0340)

Dear Mr. Halligan:

This is to inform you that the Ministry of Science, Technology and Energy (MOSTE) along with Ministry of Finance (MOF), and the Department of Technical and Economic Cooperation (DTEC) have jointly reviewed the subject Project Paper which we designed in consultation with USAID. We are in complete agreement with the objectives, activities, implementation arrangements, and the financial plan proposed in the Project.

It is understood that an autonomous Science and Technology Development Board (STDB) will be established, under the legislative authority of Thailand Institute for Scientific and Technological Research (TISTR) as detailed in the Project Paper, to serve as the implementing agencey, The official(S) of STDB will be assigned as the designated representative(s) of the RTG for the administration of Project funds.

We, therefore, formally request that a loan of $27,000,000 and a grant of $8,000,000 be provided by USAID for this seven year Project. The RTG agrees in principle to contribute an equivalent of $9,500,000, and the Thai private sector is expected to contribute an equivalent of $4,500,000, for a total amount of $14,000,000, in local currency, as host country contributions towards the total estimated Project costs.

Your kind cooperation is much appreciated.

Sincerely yours,

(Danrong Lathapipat)
Minister of Science,
Technology and Energy

INITIAL ENVIRONMENTAL EXAMINATION

Project Location:	Thailand
Project Title:	Science and Technology for Development
Funding:	$27 million Loan $8 million Grant
Life of Project:	7 years
IEE Drafted by:	Dr. Basharat Ali, O/S&T, USAID/T
Reviewed by:	John W. Neave, O/ENG, USAID/T
Environmental Action Recommendation:	Categorical Exclusion
Concurrence:	Mission Director: _____ Robert Halligan
Bureau Environmental Officer's Decision:	APPROVED: _____
	DISAPPROVED: _____
	Date: _____

I. EXAMINATION OF NATURE, SCOPE AND MAGNITUDE OF ENVIRONMENTAL IMPACTS

A. Project Description

The Science and Technology for Development Project is designed to enhance the effectiveness and extent of public and private sector application of S&T to Thailand's development. This will be accomplished by focusing on the development, adaptation and application of technologies to solve specific priority problems facing Thailand. The four main areas of activity under the project are: 1) establishment of an institutional framework for research and development; 2) science and technology policy review; 3) research development and engineering; and 4) industrial development support. The three major subject areas to be pursued under the project are: 1) bioscience and biotechnology; 2) material technology; and 3) applied electronic technology.

Virtually all project funds will be used to finance technical assistant, training, workshop/seminars and operating costs. Limited commodity procurement is also planned.

B. Identification of Impacts

We foresee no adverse environmental effects resulting from implementation of this project. Any potential environmental impact of follow-on implementation (not known at this time) would be identified and resolved during the research and development stage.

II. CONCLUSIONS AND RECOMMENDATIONS

Based on the project description and identification of impact given above, it is judged that the project meets the criteria for a Categorical Exclusion under 22 CFR 216.2 (c) (2) (ii) and (iii), quoted below:

> (ii) Controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored.
>
> (iii) Analyses, studies, academic or research workshops and meetings.

There will be no construction, etc., under the project. A Categorical Exclusion is therefore requested.

TECHNICAL ANALYSIS

I. SELECTION OF TECHNICAL AREAS OF CONCENTRATION

During the past 15 months, leading Thai and US scientists, technologists, administrators, researchers, and businessmen have been engaged in the process of reviewing the technical areas that should receive the Project's initial focus. Numerous meetings, conferences and workshops were held with personnel from government agencies, universities and Thai industries. Over 20 studies were commissioned or Project directed (see Appendix 2). Approximately thirty American expert scientists also participated directly at various stages of the Project Paper preparation (see Appendix 3). Through this process, bioscience/biotechnology, material technology, and applied electronic technology were selected for priority concentration. The situation, problems and current needs relevant to this S&T Project have been addressed in the Project Rationale and further alluded to in the Economic Analysis (Annex H). The key needs are employment and export market access.

Bioscience/biotechnology was selected because it can build on Thailand's traditional agriculture and enhance agricultural productivity; it can improve the technological base for Thailand's food and processing industries (i.e., bio-product processing and bio-product packaging), and the health-related industries, and provide an expanded foundation for ultimately developing the natural resource (forestry) and environment (air/water) areas.

Essentially, bioscience and biotechnology means bringing contemporary or emerging technology to bear on the fundamental abilities of living organisms. The technologies to be applied include tissue culture, cloning, somoclonal variation, protoplast fusion, genetic engineering (recombinant DNA or monoclonal antibodies), or embryo transplant technologies, as well as bio-product processing (thermal, frozen, extrusion, extraction, or fermentation) or bio-product packaging techniques to enhance the development of value-added commercial products. This area of concentration will be multi-sectoral in focus and will utilize a category of human resources and a category of new technologies, heretofore not tapped or linked to industrial development.

Over 70% of Thailand's work force currently works in the agricultural sector. The export of agricultural commodities (now totalling over 60% of national export value) has been and is important to Thailand's economy. The ability to produce food is one of Thailand's greatest assets. The limits of expansion in useable land have been reached. Future growth in the production of agricultural products for export must be met by increases in productivity. The traditional approaches for increasing productivity are currently saturated with absorbable support (1985 CDSS). Hence it is appropriate to use the more advanced technologies to expedite the process of improvement. Thailand has the human resource base capable of absorbing these technologies. Accomplishments may be realizable in a fraction of the time that would be

required with traditional approaches. Enhancement of agricultural productivity can only add small amounts of employment, however, to handle the increased production, so it will be of little direct help in regard to the employment problem. Nevertheless, it will help greatly in an indirect way by accelerating the development of high quality processable products - which hold potentials for expansion of agro-industries, which could mean significant employment.

Within the rubic of bioscience/biotechnology, is a prime focus on food and other bio-product processing and packaging, and the contemporary and emerging technologies that are required to go with it. Hence this aspect can directly support an expansion in employment, while retaining focus on Thailand's productive assets. Many other aspects of bioconversions, extractions, digestions, extrusions and fermentations also may lead to increased employment. Also health-related industries can be developed, through the use of advanced biological technologies. While these will be small in volume, the pay-back can be significant, in terms of what it can do to enhance the productivity of the work-force.

Material technology was selected because it relates to Thailand's natural resource base, and encompasses the needs of the industrial sector of this country. Industry employs thousands of workers and, like food-processing, has the potential for significantly alleviating the employment problem. An improved technological base would not significantly add jobs by itself, but it may retain existing jobs, and create the opportunity for significant expansion as the market dictates. More specifically, classical ceramics are of poor and inconsistent quality, and industrial ceramic technology has not been fully absorbed into the country. Most of the relevant technologies, except through isolated joint-ventures, are below state-of-the-art. High performance ceramic technology has not been introduced here. Kaolin and industrial ceramic components are imported in large quantities. Minerals are crudely mined, without currently available levels of technology for mining or processing. Crude ores are sold at low prices and imported in refined states at high prices. The metal or tool industry is underdeveloped. Hundreds of small manufacturing establishments produce low quality products. Over thirty times more tools are imported than produced here. Sixteen hundred plastic plants produce low quality products. Several hundred wood processors lack technology, and over a hundred rubber mills are limited to the same low level of processing technology that they had decades ago. Technology will be transferred, absorbed and modified within the RD&E infrastructure of the country. This area of concentration will build on the extensive, established 14dustries, which are employing increasing numbers of people.

In short, material technology includes various techniques for raw material enhancement and process improvement in the inorganic material areas of clay, minerals, or metals and organic material areas of rubber, wood and plastic components. Substantial short-term gains can be realized in this technical area of concentration, building on the old, established traditional industries, deterred by a low level of technology, poor quality control and an uncoordinated technical support group. While the technology area is not as well supported from a human resource standpoint, as is

bioscience/biotechnology, the technical people are available who can be brought up to speed. More of the material technology can also be, at least for the short term, transferred, absorbed, and modified to meet the current needs of Thai "material" industries, if the indigenous personnel are adequately involved.

Applied electronic technology was selected as the third area of concentration because it is an obviously vital area within the country's industrialization movement, particularly considering world competition in general, and more immediate competition from Korea, Taiwan, Hong Kong and Singapore in particular. What is meant here is that industries, government agencies, and universities must be able to use computers and apply them to sectoral needs. For example, industries, government agencies, universities, individual RD&E workers and businessmen must have access to the latest available technological information. This involves net-working internally and externally, storing, retrieving and accessing. Data for individual businesses or agency quality control problems, rejects, discounts, and variations must all be stored, transcribed and retrieved. In order to support this kind of activity, its application and use must permeate the entire S&T and business-related communities. Hence, this is a separate area of concentration. The task is enormous, and it is recognized that progress will be slow - but is essential if industrialization and its accompanying employment, is the sought after goal.

II. TECHNICAL APPROACHES TO ADDRESS IDENTIFIED CONSTRAINTS

A. Principal Constraints

Key constraints to S&T development in Thailand include the following: RD&E activities are carried on, for the most part, without clients and are looked upon as ends in themselves; private sector use of RD&E is very limited; Thai S&T organizations lack credibility with industry, and accordingly there is little interaction and no general mechanism to bring these two groups together; Thai industries face significant problems in production processes that result in inefficiencies and waste, increased cost and uncertain quality, and seem unable to diagnose their problems or design remedies for them; there is a technical information gap and RD&E personnel as well as investors are uncertain on whether certain technology is currently available, whether it needs to be developed/adapted locally or whether it must be imported from abroad; and S&T institutions are underutilized, and there is generally inadequate compensation for and protection of intellectual knowledge.

b. Technical Interventions Proposed to Resolve Constraints

The technical approaches which are proposed have been chosen because of the unique manner in which they can resolve identified constraints or minimize their effects. One of the key objectives of this Project is to institutionalize a process in which users and producers of scientific and technological knowledge directly interact with one another to solve relevant demand-driven problems. This will solve an over-riding constraint. The basic components are in place, but a gap exists. STDB will be formed to fill this

critical gap. This organization will be run by a private and public sector Board, with the authority to establish priorities, criteria and operating procedures and fund programs. The Board will appoint an Executive committee, with full delegated authority. The organization will facilitate the institutionalization of a process and have the flexibility and required mechanism to help bridge the gap that now exists between the users and producers of technology.
No existing organizations at the present time have the authority, resources or the flexibility to forego such linkages. For further details see the Administrative Analysis (Annex J).

The review of policy and practise activities will make a significant contribution in addressing specific policy constraints identified, help identify further key issues, establish priorities and monitor the effects of policies. In short the activity will strengthen analytical capacity and encourage dialogue between planners and those affected by the policies.

The RD&E activities, particularly the designated RD&E projects, will be problem focused on the one hand, but have a principal objective of institution building on the other. The lack of state-of-the-art technology in some industries, which is now a constraint, will be overcome by provision of technical assistance through the linked centers of excellence in the US. Several key designated activities have been identified (see Appendix 1), and a process will be in place for selecting the others. RD&E programs have not previously been supported in this country at levels sufficient to achieve relevance to industry needs or sufficient to succeed in obtaining industry's confidence in indigenous competence. The designated RD&E projects will build in the necessary activities to raise the state-of-the-art of the technology at hand, serve as a national reservoir of that technology, and link the S&T suppliers with the private sector. These projects will be supported at levels to attain quality, as well as relative speed in development - a necessary hallmark, if the projects are to interest industry.

Competitive RD&E activities will involve a two step process, first the problem identification, and then the selection of the proposal. The criteria evolved link the public and private sectors together directly and strongly. The problems will be identified by industry, but must result in new/improved process(es) and/or product(s), improve the state-of-the-art technology currently used, reflect real needs, and have industry participation. Additional selection criteria involve monetary support, spread effect, downstream investment potential, annual sales and productivity. This activity will directly address and remove the prior constraint of irrelevant RD&E. It will also link to the designated RD&E centers, avoiding duplicity, while assuring outreach to the real world of industry. Quality control problems in or with individual commodities will also be addressed in competitive RD&E projects.

Company-directed RD&E will promote building technical capacity within the individual company on the one hand, and utilize the public sector RD&E indigenous capability on the other, and actually represent the ultimate extension of RD&E activities to industrial application. The designated and

competitive programs will also be demand-driven, but, understandably, because they will be totally financed with public funds, the RD&E efforts will be of a more generic interest to industry, or at least be published, recorded in TIAC, and/or be made available to others as needed. The company-directed RD&E on the other hand, will represent a primary investment on the part of the company, with equity being taken only minimally by STDB, and hence the objective here is to commercialize the results within the company per se. Few companies now have technical capacity, and hence it is anticipated that the use of the company directed RD&E program must grow with time. If such is the case some of the funds earmarked for company-directed activities will be shifted temporarily into the competitive RD&E category. If, on the other hand, the use of this special fund exceeds expectations, competitive RD&E funds will be shifted into the company-directed category.

For information on the designated RD&E problem areas which were identified during Project Paper preparation, please see Appendix 1 and for details on the framework which has been designed for further identification of RD&E problems and the evaluation of proposals, please see the Criteria and Operating Procedures for RD&E Activities (Annex K).

The RD&E support activities provide for the selected programs, with capable people, to train their own RD&E personnel, related to Thai industry needs -- not the needs of or the programs in highly specific laboratories in foreign countries, many of which are not as relevant as they could be to Thailand's problems of today and the 1990's. We have evaluated the manpower requirements and a shortage exists in ceramic engineers, genetic engineers, tissue culture/protoplast fusion specialists, computer specialists, rubber specialists and fermentation engineers. The RD&E support activities include funds for graduate fellowships and scholarships for students to pursue the Master of Science and Doctor of Philosophy Degrees at Thai universities, in these areas, and others as the needs become clarified during Project implementation. The receipt of fellowships or assistantships will mandate an orientation toward industry, and an industrial linkage. They will be trained to think and be oriented toward research, development and engineering, and the real needs of industries.

Symposia, conferences, workshops, exhibits and seminars will provide support mechanisms for interchange between the public and private sectors. These activities also become the best, and perhaps the cheapest, way to encourage the private and public sector to adapt new techniques and new approaches. Funds provided through STDB can motivate the entire S&T community, and investors, and also bring focus to the professional societies which can develop many of the cross-linking activities. Through these interactive mechanisms, all S&T activities will become more relevant, and demand-driven. The mechanisms will create an environment for the public and private sectors to talk to each other, and to learn from each other.

The needs for quality control are abundant. This activity will finance the over-all program, on more of a national basis, provide equipment and technology to set quality control parameters, establish critical control points and carry out industry-wide analyses and monitoring functions. The

needs are enormous. Over $400 million were lost last year because of low quality and rejects in a few agricultural based products alone. Biologicals are inconsistent and suffer from a poor image. Ceramic products are considered highly variable and low in quality. The metal or machine industries are practically void of quality control and cannot access the world market. Standards and enforcements are not available. The plastic industries produce only low priced, low quality products. Wood and rubber are low in quality. The need for standards and quality control permeate every facet of the drive toward industrialization. A national movement must be set in motion to increase the quality of Thailand's products in general. This program facet will be geared to focus the Thai emotion on quality -- and its control. National programs will evolve, coordinated by STDB, to move or motivate industries and people toward the goal of production to standard. The only profitable way to use quality control is to establish procedures to prevent defects, not try to merely catch them through inspection. Inspection will only be one of the tools and probably a modest one at that. The focus on training, workshops, incentives, publicity, equipment and in-depth training is vital.

The Technology Information Access Center will serve both the suppliers and users of S&T. No nation carries out all of its own RD&E nor does it develop all of its own technology. Likewise no nation can afford the time or money to develop the technological solution, if the information is known or is available. All nations, including Thailand, must build on the work of others. The constraint of irrelevant RD&E and slow development of technology can be substantially overcome by having access to information that is published. Thailand must also be able to access information to help diagnose problems and it must access information to help expedite solutions. Scientific and technical RD&E activities are currently being carried out in Thailand without adequate information on publicly available information. Decisions to buy or develop are being made without current or reliable data. Investment decisions are being made without adequate information about the technological choices available. Taking advantage of opportunities can be important to RD&E personnel, investors and nations. Networking by computer to access American information can be a low-cost development activity today, contrasted with the costs which could occur by only one wrong decision alone. Microfilming at central and regional locations and enhancement of national and specialized documentation centers become part of technology access. From a technical standpoint such an activity is vital and in view of the relatively low costs today - for acquiring information versus developing it, or worse yet, not having it all, the Technology Information Access Center concept is both technically and economically sound. For details see Annex L.

Diagnosing technical problems encountered by Thai producers, and designing a methodology for RD&E to solve those problems, are major deficiencies in Thailand today. Knowledge of the problems can guide the public RD&E efforts, in terms of problem area selection. Knowledge of the problems can link in with the Technology Information Access Center. The Diagnostic/Research Design Service can be an important tool to link the public and private sectors and to orient the public sector programs. Obviously if the service is to be useful it must have individuals who are technologically

sound and equipped with the state-of-the-art skills and information. And they must be problem-solving focused. The designated RD&E component of this Project will be building the state-of-the-art levels of technology for specialized industries. These individuals can become part of the indigenous work-force for the Diagnostic/Research Design Service and these individuals can help the industries prepare proposals to solve their problems. From the standpoint of ensuring the best return on investment in the RD&E activities and the technology access activities, this activity is very sound. It is recognized that it may take time before it is used extensively, however significant economic incentives during the early years may help this process - but again it is economical because of the information that can feed back into the system, and because of the increased return on investment which the RTG can realize from the enormous investment ($300 million) it has already made in its Project-related professionals at seven universities alone. For details see Annex M.

Considering the existing capacities of Thai institutions, the technical inputs that are proposed to be provided under the Project, coupled with other interventions planned to address the identified constraints, this Project is both technically sound and feasible.

APPENDIX 1
ANNEX G

RECOMMENDED RD&E ACTIVITIES

1. Low Yield and Diseases in Maize, Potatoes Rubber, and Cowpeas That Lend Themselves To Solution Through Tissue Culture/Protoplast Fusion Technology

Location: Kasetsart (Kamphaengsaen)
Chiang Mai University
Prince of Songkhla University
Khon Kaen University

Maize has low yield and aflatoxin contamination. A cell culture program will be implemented to develop high protein, aflatoxin resistant, high yielding maize, disease resitant sweet corn, high yielding baby corn, and new popcorn varieties. Maize export values are on average 15% lower than market because of aflatoxin and exporters are finding it more difficult to find any buyers at all. This results in an aproximate loss of roughly $50 million annually in export earnings. The biotechnological approach can complement the drying technology studies underway. Sweet corn, and baby corn and pop corn have been selected as products with significant market potentials - and could create export processed industries in excess of 10,000 million Baht annually. This designated RD&E effort will strengthen the indigenous capability for turning these potentials into viable industries.

Potatoes have a high incidence of disease. Nearly all of the potatoes that are grown are imported as tubers from the Netherlands. A tissue culture program for *in vitro* tuberization will be developed at Chiang Mai University. The best germplasm will be identified and cloned. Shoots will be induced to form small tubers *in vitro*. The economic implications are significant, millions of Baht are lost each year. The designated capability will make it possible to also subsequently redirect the technologies towards other vegetables as well as fruits, as such problems take on top priority.

Rubber trees have major problems with fungus, caused by Phytophthora. Tissue culture techniques will be used to test for resistance. Also rubber tree yields are low, and time required for selection makes improvement a very slow process. Work will be carried to identify biotechnological indicators of rubber biosynthesis, i.e., accurate, simple and rapid selection of better clones. A possible relationship exists between HMG-CoA reductase activity and rubber yield. If this is confirmed, the enzyme level can be used as an indicator of yield potential. Thailand produces 15% of the world's rubber. Exports amounted to 12,000 million Baht last year. Yield increases of 200% should ultimately be achievable. Fungal disease losses of 14% should be correctable. This area has significant economic impact.

The development of cowpeas as an alternative crop for cassava has received extensive investigation at Khon Kaen University over the last eight years. This past year Japanese marketers ordered 300 MT. Only 30 MT could be

produced. Biotechnological improvement of yields and resistance to pests becomes essential in order to capitalize on this window of market opportunity. To retain and enhance the potential, it is apparent that the methionine deficiency in the cowpea should also be improved as quickly as possible. Evidence exists that the in vivo regulation of the lysine-threonine-methionine biosynthetic pathway may be used as the basis for selecting the proper mutants, which can become part of the biotechnology RD&E program. Over 800,000 farm families produce cassava. The market for such has been seriously diminished, replacement crops, with economic potential, are badly needed. The economic implications of this proposed designated RD&E are significant. Cowpeas are important sources of plant protein in Africa. They can be grown under marginal moisture and poor soil conditions and should be an agronomically and nutritionally useful alternative for cassava. Methionine improvements, via biotechnology, will enhance that usefulness for human nutrition purposes.

2. Low Milk Yield Which Can Be Enhanced By Embryo Transfer in Cattle

Location: Kasetsart University (Bangkhen Campus) and
Chulalongkorn University
Mahidol University

Dairy cows have low yields. The average milk production per cow in Thailand approximates 2000 kg per lactation period, yet yields of 4 to 5 fold over this are evident in individual cows. Although there have been several attempts to transfer frozen and fresh embryos they have not been successful because the scientists and technologists have been insufficiently trained, and have had a lack of understanding of the methodology.

An initial supply of embryos will be purchased in the US and shipped to Kasetsart University. Professional expertise will be provided to train and demonstrate the embryo transplant to ensure successful completion. Jointly, this process will then initially be carried out in Mr. Udom Vangtal's dairy near Kasetsart University's Research Institute. The technology will be absorbed and modified, as needed, to fit the tropical environment in Thailand.

Superovulation techniques will be acquired and modifed to improve the harvesting of ova. The timing, dose and kind of hormone administration will be perfected for Thailand conditions. Experiments will be carried out to develop more rational superovulation regimens. Non-surgical transfer techniques will be perfected for recipient cows. Efforts will be made to explore the immune transfer from the surrogate mother to her offspring and environmental factors influencing the offspring through embryo transfer.

The variation in fertility among sperm will be assessed in fertilization studies outside the body. These externally fertilized ova will be cultured in ways compatable with maintenance of the embryo. Techniques will also be pursued to clone embryos through several generations of identical clones.

3. Thai Aquaculture Can Be Enhanced By Fish Cloning

Location: Mahidol University
Payao Fisheries Station
National Inland Fisheries Institute.

The giant catfish is the world's largest fresh water fish. Because of its value, it has been nearly brought to extinction. It is a fast growing fish, but significant variability prevails. If it can be cloned and cultured it can probably be evolved into an industry. This biotechnological approach can greatly expedite the efforts. A large fish may weigh 400 kg and sell for US$8/kg. Parameters such as density and feeding are little understood.

4. Marine Plant Yields Can Be Improved Through Biotechnology

Location: Kasetsart University
Mahidol University

Marine plant yields need to be improved in order to be commercially viable. It is possible to biotechnologically produce new types of seaweed which grow faster, and are much easier to cultivate. Seaweed cultivation in the world exceeds $2 billion. A designated RD&E project will be established with this capability. Individual cells will be separated from the central region of the plant's leaf-like structure or "thallus", by special enzyme (from stomach of shellfish), and allowed to grow individually. Projects will also be carried out to produce disease-free hybrids. This work will set the foundation for turning seaweeds into seawater crop plants. Long-term relationships will be established with the University of Maryland Marine Biotechnology Center to transfer technology and develop mutually supportive programs.

5. Detection, Prevention and Control of Ulcerative Disease Among Economically Important Cultured Fishes Can Be Achieved Through Biotechnology

Location: Mahidol University, Chulalongkorn University
Institute of Inland Fisheries

This work will be coordinated with work now underway, but will bring a biotechnology focus. While other projects are completing studies on the cause of the disease, time will be allowed to develop new and improved techniques derived from biotechnology to be instituted for detection, prevention and control of infectious diseases, including the development of suitable monoclonal antibodies.

Water quality designated RD&E will also be established at Chulalongkorn University. This work will include the mass spectrophotometric identification of highly contaminating, disease-causing fractions. It is assumed that highly contaminated water causes the stress for infectious agents to work.

Aquatic biotechnology will also be used at Mahidol University to explore the development of marine pharmacology, initially screening marine organisms

for biologically active products and cloning into bacteria and/or yeasts for production. Chemicals produced by marine organisms that may be of biological fine chemical and/or bulk chemical value will also be explored.

6. Improved Culture of the Giant Prawn Can Be Accomplished Through Hormonal Control

Location: Chulalongkorn University
Mahidol University

The demand for shrimp is rising rapidly and outpacing the increase in supply. The traditional technologies of ocean farming of shrimp are believed to have reached their maximum sustainable yields. Thailand is leading exporter of shrimp, however Thai production is by either artesian cultivation with sea water in coastal ponds, or by capturing female shrimp with eggs and raising the post-larvae in ponds. Utilizing the latest technologies of hormonal manipulation, it is believed possible to achieve key breakthroughs that would set the stage for large scale production of giant prawns. If the technology helped gain 10% of the projected expanding market, it could add $115 million to export earnings. The technology of spawning in captivity to produce post-larvae for commercial shrimp production the year round will be transferred from Texas A&M University and absorbed and improved. Marine biotechnology will be transferred from the Maryland Marine Biotechnology Center. Shrimp are in short supply. A market exists and a need exists. Thailand has the environmental and natural resource base to capitalize on it.

7. New Uses for Cassava Can Be Developed Through Advanced Bio-Product Processing

Location: TISTR
Kasetart University
Chulalongkorn University
Khon Kaen University

There is a need for coordinated interdisciplinary studies to be carried out, jointly with an industry partner, on cassava flour for food, enzyme production, adjuncts in paper fiber and textile industries, and adhesives. Studies will also include fermentation to increase protein content, produce alcohol, citric acid and amino acid. Technology will be evaluated for converting stems to fiberboard or charcoal. Cassava starch may be modified to give the chemical and physical properties of imported potato starch (about 10,000 tons are imported each year). The technology of transferring Pharmaceutical Grade dextrose (anhydrous) for medical use will be explored. Nearly 500 metric tons are imported into Thailand each year. Hot and cold extrusion techniques will be explored to yield blended and enriched cassava and cassava mixed snack and breakfast cereals.

8. Cassava and Other Renewable Resources Can Be Converted To Value-added Product Potentials Through Bioconversion Biotechnology

Location: TISTR
Kasetsart Kamphaengsaen Campus
Chulalongkorn University
Chiang Mai University
King Mongkut University
Prince of Songkhla University

The lack of new outlets for cassava results in excess raw material, inadequate industrial use, poor income, and inadequate jobs. The intent of this problem area is to focus the new biotechnological techniques for improved conversions for animal feed, feed supplements, food, alcohol, organic acids, and amino acids.

9. Fresh Products Can Be Bio-Processed To Higher Value Preserved Products

Location:

Cashew Nut Processing:	Khon kaen University
	TISTR
	Prince of Songkhla University
Juice Processing:	TISTR
	Prince of Songkhla
	Chiang Mai University
	Kasetsart University
Vegetable Processing:	Chiang Mai University
Milk & Meat Processing:	Khon Kaen University
Cocoa Technology:	Prince of Songkhla University

Cashew nuts are sold in whole shells, for processing outside Thailand. Cashew nuts have been singled out in the marketing study as a crop with immediate potential. Shelling technologies could be modified and adapted to make this a Thai business. Tropical fruits are gourmet items, and as indicated in industrial surveys, they could have, if produced and processed in a quality way, appeal the world over and become known as a "Landmark of Quality" and part of Thailand's product image. This could fulfill an elite export market. Juice technology RD&E could be centered in TISTR and Kasetsart University. Quality control procedures also have to be developed and used. The fresh vegetable handling in Thailand is wasteful. Lettuce produced in the mountains loses 80% of its commercial utility before it is marketed. High quality vegetables in fresh form, can be processed into high quality processed vegetables. Chiang Mai University has a very adequate physical facility and will be equipped for raw product evaluation and canning and freezing. Cowpea processing could be scaled up at Khon Kaen. Quality control procedures will be necessary to ensure a quality image. Thai milk consumption is increasing. The technological change has already begun with European foreign assistance and has found a high degree of acceptability by Thai consumers. The application and modification of ultra-high temperature processing will make it possible to more nearly meet Thailand's needs in its tropical climate. The northeast also has an animal industry potential, but the technology of meat

processing is limited. The technology applied to the transformation of muscle to meat will improve fresh meat quality and its processing potential. The development of meat technology could include studies on the impact of differing animal feed compositions on meat quality, introduction of technologies to maintain quality during handling and processing, and technology application technology to produce high quality processed products for domestic and export markets. This effort could be spear headed at Khon Kaen University. Worldwide, cocoa is exported as fermented dried beans. The practice results in wastes and need for fumigation of beans at the point of export and import. Thailand has great opportunity to transfer and modify the technology to partially process cocoa beans into chocolate liquor, chocolate butter and cocoa. The technology will include, control of fermentation, determination of conditions of roasting, and development of expertise in semi-processed products.

10. Bio-Product Packaging Costs Can Be Reduced Through Modern Packaging Technology (i.e. Retortable Pouch)

Location: TISTR, Kasetsart University

Metal can production is an energy intensive process. Metal production equipment is costly. All standard development units have rapid output, and require large volumes for competitive operations. Retortable pouches are easily produced, easily shipped, lower in cost and lend themselves to a much slower rate of production. The technology of construction, the technology of filling and the technology of controlling package/product interaction need to be partially transferred, but specifically adapted to potential conditions for production.

11. Boxing and Crating Technology Can Modernize Handling and Preserve Fruits and Vegetables

Location: TISTR
Chiang Mai University

The major problem with the woven bamboo basket has been its inability to allow respiration and remove latent heat, as well as its poor supporting structure for stacking.

The "wirebound crate packaging unit" can be developed with indigenous materials for the domestic handling, export, and packaging of fruits and vegetables. The fabricated crate can ultimately be produced by a small craft industry, in the rural area, with technology input. The Department of Industrial Promotion can implement its use. Excessive losses are clearly evident. However, during Project implementation, detailed statistics will be compiled on post-harvest losses as the foundation for making continued investments in improved packaging systems.

12. Applicable Process Technology and Control Can Reduce Raw Product Spoilage and Product Rejection

Location: Kasetsart, Chiang Mai
: Chulalongkorn, Prince of Songkhla and Khon Kaen Universities and TISTR.

All locations selected have adequate pilot facilities. A coordinated program will be evolved to transfer technology and maintain industrial preparedness with Technology Task Force Teams for modification, standard specification, training and solution to bio-product problems limiting development. Losses in many cases exceed 50% of current production potential. Maturity indices will be established for fresh fruit. Guidelines will be established and implemented for reducing loss and retaining quality.

13. Control & Standard Procedures Can Improve Vaccine Quality

Location: Department of Medical Sciences

Lack of procedures for biologics control. The most important complementary asset in vaccine development and production is a technically sound, independent quality control unit. Confidence cannot be achieved in human vaccine without superb control procedures. Technical procedures for control must be developed simultaneously with those in the development of the vaccines. In other words, the development of a credible vaccine production capability will require a strong quality control service. Fair and efficient application of Thai product registration regulations by the FDA is related to the quality control function.

Designated funds will be provided for short-term training, equipment and procedure establishment in line with the guidelines provided by the Bureau of Biologicals, Food and Drug Administration as described by E. Fitzgerald and C. Mannclark.

14. Advanced Bioscience Activities Can Support Vaccine Development

Low Cost Rabies Vaccines: Tissue Culture

Location: Red Cross Institute & Chulalongkorn University

This activity will focus on tissue culture for cost control.

Low Cost Hepatitis B. Vaccine

Location: Chulalongkorn University

Need to immunize high-risk individuals such as newborn of hepatitis B positive mothers, spouses and household contacts of hepatitis B carriers, prostitutes, dentists and clinical laboratory personnel. Vectored technologies, not plasma-derived antigens, will be developed and cost-comparison and efficacy trials carried out. Recombinant DNA technology will also be utilized.

15. Development of Effective Dengue Vaccine

Location: Mahidol University

Dengue hemorraghic fever causes severe illness and death, with a high incidence in infants and children. In 1984 there were 58,520 reported cases of dengue fever in Thailand. Down time and hospital costs together totalled $7.4 million. Thailand has a cutting edge advantage with the development of the vaccine. Dr. Natth, Rector of Mahidol University, is perhaps the world's leading scientist, in the development of such a vaccine. His prototype vaccines against three of the four serotypes have already undergone initial testing in human volunteers. Designated development of these laboratories can greatly expedite industry development.

Computer networking to "Medline" and "Medlars" will also be developed. This support and technical assistance will be vital to help Thailand take this first important step for industry collaboration. Efforts will be directed toward technology assistance for rabies vaccine production in cooperation with PATH. The Thai Red Cross Society has new relationships with the Chulalongkorn faculty. Thus this Project will support the centers, attached to Mahidol University and extend the work to the Red Cross Society.

16. Application of Recombinant DNA and Monoclonal Antibody Technology To Biotechnological Problems

Location: Mahidol University, Chulalongkorn University

The need is very apparent to intensify and expand capability in recombinant DNA and monoclonal antibody work. This is fundamental to evolvement of biotechnologically-based industries in Thailand. While immediately useful for vaccines and diagnostics in the medical biotechnology area, the technologies are also vital for industrial biotechnology and aquatic biotechnology and aquatic biotechnology - with longer term implications in plant biotechnology. A methodology - Hands-on Laboratory will be developed at Mahidol and Chulalongkorn. They will be staffed by highly qualified professionals, who in the course of conveying their methodology to other professionals, will also meet the teaching requirements of their universities. The laboratories will be professionally equipped and serve as a base for scientists from home or abroad to come in and work on problem resolution, while advancing their grasp of the technology, for short-term periods.

17. Application of New Technologies to Classical and Industrial Ceramic Industries Center

Location: Chiang Mai Ceramic Engineering Laboratory
Chulalongkorn University Department of Ceramic Science
TISTR
Department of Mineral Resources

New technologies can improve ingredient quality, firing, glaze stability, and crystal structure. Linkages will be formed with the Ceramic Engineering

Laboratory, Rutgers University and other public and private institutions through which technology can be transferred. Specialists will spend 3-4 months in university laboratories and private plant pilot facilities to acquire more hands-on experience with the technical problems limiting development and with instruments and procedures used to monitor consistency in development. Emphasis will also be placed on preparation of high quality glaze compositions.

18. Introduction of Improved Benefication for Raw Material Quality Enhancement (i.e. Kaolin)

Location: Department of Mineral Resource
TISTR
Department of Science Service

The development of a high quality kaolin source would not only be of great benefit to the ceramic industry but would be of equal importance in the paper industry where such clays must now be imported. Approximately 15 million Baht of kaolin were imported last year for some of the industry needs. This designated activity would also pioneer in the modification of technologies to improve the processing of all raw materials.

19. New Product Development for Industrial Ceramic by Introduction of New Technologies (Spark Plugs, Dental Porcelain, Glasswool Insulation and Abrasives)

Location: Chulalongkorn University
Chiang Mai University
TISTR

Approximately $45 million of spark plug ceramic components are currently imported from Japan. Other products are also imported in large quantities and not produced here. Equipment needs include strength testers, polishers, microscopes, presses, brightness and abrasive testers, drills, and viscometers. Higher quality raw materials and better technical management is needed. The needs for developing industrial ceramic technology seem enormous, but before proceeding with specific technologies, STDB will develop appropriate economic analyses.

20. Introduction of Technology to Produce Fine China

Location: Chulalongkorn University
Chiang Mai University

At the present time fine china products (tableware and objects d'art) are not produced in Thailand, even though there is a broad based ceramic industry with ample local raw materials. Modern technologies can be produced to make production of such products competitive in the world market.

21. Enhanced Capability for Testing and Analysis of Industrial Products

Location: Department of Science Service (MOSTE)

The Department of Science Service needs essential equipment, i.e., furnaces for firing at above 1200°C, and physical analysis instrumentation for surface area of powder, thermal coefficient of expansion and X-ray diffraction to provide effective low-cost modern service to the small and medium sized industries.

22. Explore the Feasibility of Introducing a Modern Machine and Tool Industry in Thailand

Location: Coordination of project: TISTR.

In order to provide machine and tool technologies which can be effectively transferred to Thai industry units, entreprenuers and uninversity specialists, it will be necessary to have a plan for improving technology and expanding technologically improved industries. Before facility and equipment funding can be developed and arranged for a focused development, a number of factors must be studied, including market size, machine size, etc., in order to establish the feasibility for doing such. Subsequently, the project may then be considered for technology funding under this project.

23. Development of a Machine and Tool Pilot Center and Transfer of Machine and Tool Manufacturing Technology

Location: TISTR
IFCT

On the assumption that the previously referenced feasibility study concludes that such on industry is feasible, a machine and Tool Pilot Center will be established. Management of the "Center" will be by contract with the Thai private industry. The project will go forward only if the plan to be developed in (22) above is found feasible and is funded, the facility constructed, and the equipment provided.

The "Machine and Tool Center" would be most effective if managed by the private sector - and near a private sector foundry. It would simultaneously make a small number of machines and tools. The machines and tools produced could be purchased by Thai government units. STDB could also provide the technology, either by way of an American firm desirous of ultimately becoming a joint-venture partner or by buying the technology from an American firm(s) interested in selling it. The machine and tool center would have a Board of Directors of industry members, with representation from the RTG, but chaired by industry. After 3 years, if successful, the Board may buy the RTG equity and turn it into a private venture. If the latter were to occur the proceeds would return to STDB. The requirement will be that the technology come from an American firm(s), and that Thais from other industries, government agencies and universities be provided with training and fundamental technology transfer. The engineering faculties in Thailand would have a special linkage with the "Center". The details would be evolved and approved during Project No. 22.

24. Transferring Technology for Production of Machine Control and Gauges

Location: King Mongkut University
Chulalongkorn University
Khon Kaen University

Because this sector does not have the technical back-up capability that exists in biology, special efforts will be made to more broadly base the RD&E toward technology transfer, absorption and strengthening. Significant emphasis will have to be placed on indirectly strengthening the indigenous capability to provide the fundamental manpower training - this becomes a key part of the engineering component of RD&E. Equipment at major universities, particularly regional faculties of engineering and science, are inadequate to assist trainees in grasping fundamental principles. Students now have inadequate "hands-on" training in the practice of scientific and engineering skills. Khon Kaen University is in the poorest area of Thailand and has about 1,000 students studying engineering, in a faculty grossly underequipped. This is just an example, but the needs for emphasis at this level are greater in material technology than in biotechnology.

25. Development of Materials Testing Capability

Location: TISTR

Thai industries need to know how to measure the properties of manufactured products. They also need to know the sources of error in processing and manufacturing these products and in nonconformance to specifications. Local industry is at a serious disadvantage because of this deficiency.

26. Laboratory Support Capabilities for the Mining Industry

Location: Prince of Songkhla University.

The objective of the development of a Mining Research and Industry Support Center is to provide RD&E aimed at improving the mining industry and solving their operating problems. The center will carry out RD&E on Southern Thailand mine problems. It will serve as a base for transferring, and modifying advanced mine technology to Southern Thailand. Technical expertise (U.S) will be provided to design the details of the center and its linkages, and provide technology transfer seminars.

Equipment needs include X-ray diffraction, X-ray fluorescence, atomic absorption and polarized microscope. Field survey and rock mechanic equipment will also be needed.

27. Technology and Design to Manufacture Mobil Drilling Equipment Needed by Mining Industry

Location: Phuket (Department of Mineral Resources)

The need exists for mobil drilling equipment (industrial type) to do test boring of up to 300 ft. Technology is readily available in the US for

production of such mobile units. The technology will be introduced to enhance this capability to produce such equipment.

28. Develop an RD&E Capability To Service the Rubber Industry

Location: Prince of Songkhla University.

The need exists for a comprehensive and coodinated technical solution to rubber production and processing inefficiencies. This will be an effort to use the essential components and talents on hand at the university, for the enhancement of this most vital industry in the region. Biotechnology will involve tissue culture, biosynthesis of natural rubber and related plant studies (discussed in the Bioscience & Biotechnology section). The Faculty of Science will provide development information or chemical and physical properties of rubber. The Faculty of Engineering will work on problems inherent in the polymeric processing of rubber product development. The Faculty of Management Science will be linked with STDB Technology Information Access Center. Short-term assistance (one month duration each) will be provided twice per year by each of three specialists in various areas of rubber technology. This institutional approach to the problem will provide a foundation for raising the level of technology to a state-of-the-art status, from which further RD&E will have a foundation for impact.

29. Introduction of Improved Plastic Extrusion Technology and Quality Control

Location: TISTR
Khon Kaen University

Plastics are defined as synthetic organic materials that can be shaped as required by the application of heat and pressure, on the basis of their polymeric structure. Thermoplastics are resins which can be repeatedly softened by heat and hardened by cooling. There are now over 1600 manufacturers of plastic products. Most are small manufacturers, with unsophisticated equipment. The value of exports has risen from 8.6 million Baht in 1971 to 713 million in 1980. Among the major export items are PVC and acrylic sheets, raincoats, tableware, artificial flowers and plastic toys. Imports have also steadily risen and were 630 million Baht in 1982. Among the main articles imported are pipes, building materials, containers and adhesive cellophane tapes. These industries suffer from a lack of technology, a lack in the human resource professional base, and lack of quality control.

30. Effective Utilization of Computer Hardware Can Enhance Industrial Productivity

Location: MOSTE
ISEC/NIDA & KMIT
Chulalongkorn University
Chiang Mai University
Prince of Songkhla University
Khon Kaen University
Mahidol University
Kasetsart University

The computer and electronics personnel of Thailand, taken collectively, may be viewed as a pyramid. Thailand has a limited number of highly capable people with computer expertise. At the base of the pyramid, however, are the "common folk" who have no knowledge about computers at all. The overall goals of the technology applications enhancement activities proposed are (1) to 'broaden" the pyramid, and (2) to "lift" the pyramid, that is, to upgrade the level of knowledge at all levels.

The computer application needs must be met through a coordinated designated RD&E activity. This activity will have a critical component at KMIT where increasing numbers of professionals will be trained through post-doctoral levels. Computer application awareness enhancement will be provided for key managers in government and industry through the ISEC/IBM partnership program. The equipment has been provided by IBM. Computer application enhancement at the working levels will be provided for government at MOSTE and for regional government and industry professionals and semi-skilled workers at regional based institutes. This will be a long slow process, because the needs are enormous if industrialization is to be achieved. This is believed to be a critical mass level, and anything less than this level of effort will probably fail to achieve success, and Thailand will fall further behind in this area.

31. Enhanced Capability for Software Development

Location: KMIT

On March 13, 1984, the government of Thailand agreed in principle for the Ministry of Science, Technology and Energy to promote the development of a computer software industry. Apart from following the example of other nearby nations, most notably Singapore and Malaysia, this makes imminently good sense for Thailand. In contrast with the electronics industry which requires large amounts of capital investment for manufacturing as well as research and development, computer software requires relatively little capital. Instead, the principal requisite for the development of computer software is intelligent and hard-working people. Education is also important, especially if one does not wish to squander one's efforts in "re-inventing the wheel."

Software developers are in short supply worldwide, so it is unlikely that multi-national companies will develop on their own the applications software packages which will fully satisfy Thailand's local needs. The recent emergence of locally-developed software to handle Thai language is but one example of what can come of local initiative. There are probably many other local "niche markets", possibly incluing nearby countries whose alphabets resemble that of Thai, which can be served best by local companies. They merely need public sector back-up support. Furthermore, the cost of software is exceeding that of hardware in advanced countries, so Thailand can hope to exploit its comparatively low skilled labor costs, which are estimated to be only one-fifth that in advanced countries, by developing quality software for export. However, it must be quality software. It must do the specified tasks using no more than the specified amount of hardware resources (i.e. processing time and memory space). It must not contain too many serious errors which

will yield the wrong results or cause the program to fail. It should be delivered to the customer on schedule and within the allocated budget, both the customer's and the developer's. It should be properly documented so that people can easily learn how to use it. It should be constructed (and documented) so that it can be easily "maintained" -- that is, so that program errors can be corrected as they are discovered through usage and/or program modifications made to accommodate to evolving requirements.

Although these techniques are well known to software engineering researchers, they are still relatively unknown throughout the computer user community. Even where they are known, they are not used as much as they should be, and the quality of software suffers as a result. The principal exceptions to this are a few leading computer makers -- IBM, and the three top Japanese firms, Fujitsu, Hitachi, and NEC -- and perhaps a handful of very sophisticated computer users.

Because of this, and in light of "quality assurance" activities in other components of the S&T Project, software engineering should be a priority area of technology transfer, initially to the designated RD&E project and thence to the rest of Thailand via the "network" described in the technology information access section.

32. RD&E in Solar Energy Conversion

Location: Chulalongkorn University

Solar Conversion is ideally suited for Thailand's climatic conditions. Yet there is only one manufacturer that can produce solar cells to convert solar energy into electricity.

A large percentage of the 60,000 villages in Thailand remain without electricity. Current photovoltaic cells are expensive (plans have been made by the RTG to install four experimental stations). The goal of this designated work will be to fabricate semiconductor materials and test these materials for their stability as solar cell and other device material. State-of-the-art technology will also be transferred through this designated RD&E activity.

APPENDIX 2
ANNEX G

LISTING OF CONFERENCES, WORKSHOPS, SYMPOSIA, COMMISSIONED AND PROJECT DIRECTED REPORTS

- Thai S&T Pattaya Conference

Approximately 100 leaders presented sector data and discussed areas of concentration which could give the best development thrust.

- First National Science Congress

In March 1984, five hundred leading Thai scientists from industry, government and universities, met to review sectoral needs and area priorities.

- Thailand Science and Technology Program Advisory Council (TSTPAC)

This group of six key leaders met repeatedly to debate area selection and relative emphasis that should be given to each. Membership consists of two former ministers (currently President of PTT and President of the Thailand Development Research Institute, respectively), a University Rector (outstanding scientist and advisor to the Prime Minister), a leading Economic Entrepreneur (who also serves as Senior Vice President of the Development Bank), a "Center Director" and one of the most highly regarded Permanent Secretaries in the RTG.

- Asian Institute of Technology Seminar with Thai Industry Leaders

A two-day workshop was held with 25 leaders from industries, government agencies and universities to discuss areas of concentration.

- Numerous Studies were Commissioned or Project Developed:

  - Status of Science and Technology in Thailand
  - Constraints to Development: Role of Science and Technology
  - Key Problems in Science and Technology in Thailand
  - Thai Research Institute Analyses
  - Medical and Biomedical Overview of Needs
  - Business Aspects of Science and Technology
  - Handling and Packaging Fresh Triopical Fruits for Export
  - Marketing Survey of Thai Processed Fruits and Vegetables
  - Computer Laboratories in Thailand and Their Needs
  - Policy Review Framework for Scienctific and Technological Development
  - Biotechnology Programs and Projects at Major Institutions in Thailand
  - Diseases of Cultured Fish in Thailand

- Utilization of Cassava
- Control of Aflatoxin in Corn
- Plant Cell Culture and Alternative Crops
- Mineral & Metallurgical Industries in Thailand
- Food Processing Needs in Thailand
- Recombinant DNA and Monoclonal Antibody Technology in Thailand
- Packaging Technology Development Progress
- Survey of Computer and Applied Electronics Technology in Thailand
- Metrology and Standards Infrastructure in Thailand
- Potentials for a Machine Tool Industry in Thailand
- The Development of the Thai Ceramic Industry
- Vaccine and Immunodiagnostic R&D
- Semiconductor Manufacturing in Thailand
- Quality Control in Thai Industry
- Directory of Major Scientific & Technological Institutions in Thailand

These studies represent input from and interviews with virtually hundreds of leading Thai scientists, technologists and industrialists. Key outside experts with knowledge of Thailand were also interviewed. Pertinent World Bank studies were also reviewed.

The studies also included reviews of the analyses that had been performed during the development of the 5th 5-Year Plan (National Economic and Social Development Board).

- National Academy of Science/National Research Council Science and Technology Development Team

Eleven distinguished professionals from American industries, universities or government agencies worked in Bangkok and throughout Thailand for up to two weeks to discuss areas of concentration, priorities and programs.

- Thai/U.S. Science and Technology Program Development Workshop

One hundred and thirty scientists, technologists and organizational leaders from Thai industries, universities and government agencies met for two days to discuss areas and linkages.

- American Experts Visiting Thailand for Science and Technology Project Paper Preparation (See Appendix 3, Annex G).

APPENDIX 3
ANNEX G

AMERICAN EXPERTS VISITING THAILAND FOR SCIENCE AND TECHNOLOGY PROJECT PAPER PREPARATION

1. Dr. William H.B. Bauer, Professor, Department of Ceramic Science and Engineering, Rutgers University.

2. Dr. Robert W. Becker, Senior Quality Control Consultant, W.A. Golomski and Associates, Chicago, Ill.

3. Dr. Arden L. Bement, Vice President of Technical Resources, TRW, Inc.

4. Dr. Susan Campbell, AAAS Fellow on Biotechnology.

5. Dr. Rita Colwell, President, American Society for Microbiology.

6. Dr. George Curlin, Associate Director, International Research, Office of International Health, US Public Health Service.

7. Dr. James E. Dahlberg, Professor, Department of Physiological Chemistry, University of Wisconsin.

8. Dr. Urban Diener, Professor, Department of Botany, Plant Pathology and Microbiology, Auburn University.

9. Dr. Joseph Von Elbe, Professor, Department of Food Science, University of Wisconsin, Madison, Wisconsin.

10. Dr. John Eriksson, Deputy Assistant Administrator for Research, Bureau of Science and Technology, US Agency for International Development.

11. Dr. David Evans, Associate Director for Research, DNA Plant Technology Corporation (New Jersey).

12. Dr. John Fryer, Head, Department of Microbiology, Oregon State University.

13. Dr. John Gmitro, Manager of Engineering Research, Kraft Inc.

14. Dr. Ronald Henrick, Department of Aquatic Resources, University of California, Davis.

15. Dr. Richard Herrett, Director of Research and Development, ICI Americas Inc., South Carolina.

16. Dr. George Inglett, Chief Cereal Science and Food Laboratory, Agriculture Research Center, USDA, Peoria, Illinois.

17. Dr. Richard Johnson, Eisenhower Professor of Neurology/Biotechnology, John Hopkins University

18. Dr. Michael Ladisch, Laboratory of Renewable Resources Engineering, A.A. Potter Engineering Center, Purdue University.

19. Dr. George E. Lindamood, Burroughs Co., Ltd., Tokyo, Japan.

20. Dr. Charles MacVeagh, Senior Partner, Price Waterhouse Inc.

21. Dr. Michael McDonald Dow, Deputy Director, Board on Science and Technology for International Development (National Academy of Sciences).

22. Dr. A.J. McLaren, President, McLaren Machine Tool Industry Consultants, Inc., Florida.

23. Dr. Hans Oser, Senior Scientist, National Bureau of Standards.

24. Dr. Hugh Popenoe, Director of International Programs in Agriculture, and Director, Center for Tropical Agriculture, University of Florida.

25. Dr. John Riganati, Director Systems Component Division, National Bureau of Standards.

26. Dr. Frederick Robbins (Nobel Laureate), President of Institute of Medicine, National Academy of Sciences.

27. Dr. Paul R. Schmidt, (former Director of Packaging, General Mills, Inc.)

28. Dr. Nickolas Themelis, Professor of Mineral Engineering, Henry Krumb School of Mines, Columbia University.

29. Dr. Sylvan Wittwer, Michigan State University Experiment Station, Director, Emeritus.

30. Dr. Raymond W. Wright, Professor of Cell Biology, Department of Animal Science, Washington State University.

ECONOMIC ANALYSIS

I. INTRODUCTION: SCOPE OF ECONOMIC ANALYSIS

Traditional approaches to economic analysis of projects, especially analysis of costs, benefits and rates of return, do not have much to contribute to formulation or appraisal of a science and technology development project. In addition AID, the World Bank and other organizations have had limited experience thus far - only a handful of projects altogether - in comprehensive projects designed to have substantial impact on the development of a country's total S&T infrastructure and processes. As a result, the efforts to assess a country's S&T situation and needs, and assist in the process of planning and promoting substantial S&T development, have had relatively little guidance from analytic models, compared with project development work in standard fields.

On the other hand, there has been a substantial amount of analytic work in recent years on the economic characteristics and determinants of successful performance of S&T-intensive economic activity. In agriculture in particular, rate of return analysis has been applied, where it has been possible to demonstrate the direct and powerful relationships between expenditures on research into specific yield-affecting plant characteristics, and the resulting productivity change. In addition, economic research into farm-level response to changes in available technology has demonstrated the interactions among technology and economic factors, and drawn powerful generalizations for economic policy respecting marketing, pricing, input access and other determinants of the extent to which farmers adopt a new technology and are able to capture its potential effects on farm productivity.

In industry also, there has been a great deal of analytic work on the relative contributions of technological change, capital formation and labor productivity, to growth in economic output. Most of this work has focused on recent decades of industrial country development. Still, the implications for developing countries are substantial, in terms of the significance of investment in human capital and in the institutional infrastructure that supports the capability and efficiency with which people and the organizational forms of economic activity use accumulated capital and new knowledge. In addition, a vast literature has grown up on institutional and legal aspects of technology in economic development, and a much smaller (in fact, still nascent) literature is becoming available on: (a) the role of technology change in LDC manufacturing and export growth, (b) some of the determinants of successful mastery of technology, (c) distinctions between the characteristics and dynamics of small-scale "appropriate technologies" compared with "modern sector" and "high" technologies; and (d) on the interactions between technology generation and application and the economic policy framework and enterprise characteristics in developing countries.

For the purpose of Project development, the upshot of this varied set of approaches to the costs, benefits and dynamics of S&T in economic development,

is that the role of economic analysis has been to combine straight economic aspects with institutional and process analyses. As will be the case here, both the assessment and the drawing out of implications for policy and program, take the form of a synthesis that goes beyond the standard confines of economic analysis. At the same time, the standard attempt to measure economic costs and benefits has much less scope, or reality, than is the case with projects in most other subjects, especially projects financing discreet physical facilities.

The reason is obvious. While any one line of research may lead to a blind alley and zero benefits, a successful effort (as with high-yielding wheat varieties) can yield benefits many multiples of the research cost, even after netting out the costs of other inputs needed to utilize the specific knowledge output of the research. The potential outputs and cost/benefit relationships of any research program are not entirely subject to chance of course, or to scientific uncertainty. Research lines can be chosen in light of previously tested research techniques and previously developed knowledge giving a basis for estimating possible outcomes. In addition, the specific research objectives should be selected on the basis of criteria measuring the relative importance of the social benefits that would result, or the potential economic gains in light of economic circumstances and comparative advantages. The research lines chosen for emphasis under this Project have been developed through procedures designed to take such considerations into account. More important however for the institution-building objectives of the Project, are the processes and criteria reevaluation this Project is expected to help establish as permanent elements of Thai planning with respect to publicly financed R&D.

Finally there is the unavoidable ambiguity in the nature of the subject. Although the role of application of knowledge for economic development is widely recognized as critical, the specifics of manpower development, institutional structure, policies, research programs, etc. cut across the traditional sectors that comprise the analytic and organizational frameworks. This makes it difficult to nail down the subject in ways precise enough to support measurement and analysis. Even the development of indices of country status (capabilities, resource inputs, R&D output levels, S&T application, import and export of technology, etc.) is at a very early stage. And in countries where coordination of action and coherence of policy across ministerial and institutional lines is always difficult (generally more so among developing countries, and especially so in Thailand), S&T planning appears daunting because of its cross-cutting character. This difficulty is only partially relieved by the creation of S&T coordinating boards, ministries or other units designed to yoke S&T development together in some operationally efficient manner.

II. THREE ANALYTIC FRAMES

Although the development of human and institutional capacity in S&T cuts across all economic sectors (and many non-economic activities), Prof. T. Schultz has gone so far in recognizing the importance of R&D as to label it an "endogenous sector" critical to the viability of modern economies. This

perspective has led to much effort over the past 10-15 years in particular to: (a) describe S&T infrastructure as a coherent set of inter-acting institutions and cadres, (b) collect data meaningful for measuring the status and growth in a country's S&T resources, activity and outputs, and (c) trace the processes by which economies acquire, generate, adapt and apply new technologies.

The analytic frames that have been developed to provide systematic descriptions and ordering of this cross-cutting "sector" can be divided conveniently into three groups. The groups are distinctive according to their different relationships between the technology suppliers or sources, and the technology users or beneficiaries.

One group includes health, educational, meteorological and other technologies where governments provide socio-economic services free of charge or for user fees. The government or institutional suppliers are found ahead of the users, so to speak; user acceptance is an object of government policy, to be urged (as for example in primary health preventive technologies), or made compulsory (primary education), or freely offered (weather information) or sold for user fees (water or transport services).

A second group is typified by agriculture technology, where the diffusion process depends heavily on economic, marketing and other factors quite apart from the scientific quality of the suppliers or the technology being offered. The users must see the technological changes proposed as being in their interest. Again the source of the new knowledge is top-down. The R&D effort is a necessary condition for the creation of the new opportunities, but the decisions of a massive body of potential users is equally a necessary condition for the technology to have any application. While pre-scientific agriculture has been characterized by generations of slow technical change and adaptation by the users themselves, rapid diffusion of modern agriculture technology, in economies with large numbers of small operators, poses major diffusion challenges often more daunting then development of the technologies.

The third category comprises industrial technologies. The relationships between formal S&T institutions, basic and applied research activities, and the technical application behavior of industrial users in private and market-oriented or mixed economies differs radically from the first two categories. In advanced economies, much of the applied research and engineering adaptation (and even in some lines, the basic research) is conducted by the users themselves searching for new knowledge that will be commercially advantageous through proprietary protection. Where basic scientific advance opens up opportunities for entirely new products or improved processes, the supply of basic knowledge can create its own demand for application (again, conducted or financed by user enterprises); the exploitation can follow so quickly that the innovation process itself is an engine of growth (as spelled out decades ago by Schumpeter in his theory of long-period business cycles generated by major waves of innovation).

In contrast, developing economies are characterized by less technology-intensive product mixes, less developed S&T resources, and a growth pattern of exploiting opportunities for technology import and ratcheting up as

industrially more advanced countries shed product lines as part of their own processes of structural change. Under these conditions technological change in manufacturing is largely demand-driven. Technological needs are typically for adaptation and application, testing and other services; R&D is less important than E. The most typical weakness appears to consist of the poor linkages between the local formal S&T structures and the individual firms. The major sources of technological change are external. These observations have led S&T analysts to construct frameworks for understanding the dynamics of industrial technological change that embrace a much larger and different set of institutional policies and processes than is the case for the first two categories.

In the sections below, we will attempt to rough out the dynamics of industrial sector technology change in Thailand, draw some implications for priority needs in building S&T infrastructure and processes at this stage, and then draw some conclusions for the S&T planning process itself in Thailand.

III. TRENDS IN TECHNOLOGY INTENSITY

For the reasons given above, the analysis will be limited to S&T designed to serve industrial (including food processing) activity, excluding health or other social services and research into technical problems of public sector physical infrastructure.

A quick scanning of salient aspects of Thai economic growth will suffice to show its increasing technology-intensity. Compared with most middle income developing countries, Thai economic growth has been unusually high and sustained, averaging 4.7% between 1960 and 1980. The structure of production also changed rapidly during this period; agriculture as a percentage of GDP declined from 40% in 1960 to 25% in 1980. Although outpaced by Korea, industrial growth was above average for the middle income group.

Export growth remained a key engine of development, with exports of goods rising much faster than overall GDP growth (over 11% average annual increase in volume in the 1970s). Exports underwent substantial diversification, with manufactured goods rising from 5% of merchandise exports in 1970 to 30% in 1980.

The technology intensity of Thai agriculture emerged during this period as a critical problem. The long projected end of Thailand's extensive pattern of agricultural production growth has come about. Apart from capital deepening (in irrigation) and diversification into new crops, Thai agriculture has yet to reap significant benefits from large-scale application of modern technological intensity in the form of agriculture inputs. While agriculture has been the dominant area of public sector investment in research facilities and programs over the past three decades, both the effectiveness of this structure and the economic and other conditions determining farm-level technology change continue to pose problems.

Diversification of the manufacturing sector, both for import substitution (largely in consumer goods) and export, has begun to transform the earlier,

simpler, requirements of the Thai economy for supporting engineering, scientific and technological services and capabilities. While the product composition of much of this manufacturing growth was able to emerge with only modest technological requirements (e.g. early stage food processing; wood, rubber and leather working; assembly and repair of motor vehicles for domestic use), electronics assembly and the development of Thai off-shore gas deposits are examples of higher-stage industrial activity that will require more sophisticated and elaborate technological support in future. In contrast, Thai capital goods and intermediate manufactures production are still very modest in relation to imports of these categories.

Especially significant has been the role of exports as a source of growth for manufactures. According to IBRD estimates, export demand as a share of overall expansion in manufacturing output rose from about 6% in 1966-1972 to about 35% in 1978-1980. The explanation of this rise is put to Thailand's sustained labor cost advantage compared with the countries that had benefited in the 1960s and 1970s from the search of foot-loose export-oriented industries for lower cost production locations (mainly Korea, Taiwan, Singapore).

Thai policy makers and business are acutely aware of the implications for Thailand of the relative rise in labor costs in other countries of this region, of the "sunset" industries off-shore investment interests of Japan, and the relative ratcheting up in manufacturing sector product composition that is occuring in the industrially and technologically more advanced countries of the region. If Thailand is to follow along and take advantage of the trade prospects opened up by this regional pattern (within the developing country area experiencing the most rapid and sustained growth and transformation in the world, apart from a few oil exporting countries), it will be essential for the country to develop at the same time much more effective and sophisticated capabilities and processes for supporting industrial research, improved testing and other services, and an institutional framework and set of policies for technology transfer and development processes. The technology-intensive character of the next round of industrial transformation is so integral to its products and processes, that a successful transition to this next phase in movement toward "newly-industrializing" status could not be sustained without major advances in the country's technological resources *per se*.

While Thailand is evidently entering a transitional period of industrial development in which product mix and the requirements for export competitiveness will call for a rapid increase in technological capacity, the manufacturing sector is still dominated by enterprises not very sophisticated in their technologies.

An important determinant in Thailand of the ability of individual enterprises to make major shifts in technology is the continuing predominance of family firms. Family enterprises typically face two constraints on their technological flexibility. First, they often persist in keeping management and senior technical decision-making positions within the family. This denies the firm access to the general pool of advanced technicians and technical

managers. Second, their ability to expand their capital stock or replace old vintage equipment is limited by their self-denying lack of access to non-family equity participation.

For enterprises launched as publicly held companies, or for family enterprises that do go, or would like to go, public, the very thin market for securities in Thailand and the persistent weakness in that market's structure and operations, plus certain aspects of the corporate tax system, pose further constraints.

Nevertheless, a modern, technologically more advanced and dynamic manufacturing sector is emerging alongside the more traditional pattern. The gas and chemical industries are most conspicuous for their technological (and capital) intensity. The gas-based enterprises projected for the Eastern Seaboard complex will involve major technological jumps. Use of computers and automated office systems is expanding. Technology-intensive products like agricultural and textile machinery and Thai language computer software have begun to be produced in recent years. Even in cassava, where the contraction of the EEC market is creating a major export and agriculture adjustment problem in the immediate future, new investment has been taking place in more advanced pelletizing processes that will enable the enterprises involved to remain competitive.

IV. THE NEXT ROUND OF TECHNOLOGICAL CHANGE

It is always hazardous to predict specific product or process changes that might occur in an economy in the next 10-15 years and the implications for technological growth, i.e. the needs for research, development or adaptation, or engineering or application. Yet some trends appear likely that would have a large determining impact on Thailand's technological needs.

First, Thailand's comparative advantages in agriculture are likely to lead to rapid expansion of exports of non-traditional commodities, partly at the expense of market shares of competing countries whose production costs are rising relative to Thailand's. Development of these commodities represents a shift from the pattern of extensive agricultural expansion that has characterized Thailand's agricultural history. Besides the more modern agricultural technologies required for successful commercial-scale cultivation of these commodities, new and more sophisticated food processing technologies will also be required.

Second, the major source of, and opportunity for technological advance in Thai industries is likely to be the reduction of so-called X-inefficiency, i.e. increase in the efficiency with which manufacturing enterprises use their core technology as already embodied in their existing capital stock. Recent studies of technological change and application in some dynamic NIC sectors (e.g. in Korea and Brazil) have shown that a major source of actual incremental application and utilization of new technical knowledge and equipment at that level of industrial development, has been the steady accumulation of small improvements in the ability to utilize the technology in the 5-10 years after its initial installation, combined with small adaptations

and further improvements and changes through the adjustment of the initial equipment investment and/or the addition of small, peripheral new process (and the minor capital expenditures required for the acquisition of the equipment involved). In Thailand, the existence of substantial scope for raising a technology-intensive sector to the much higher production-possibilities horizon than it has actually achieved, has been documented in a World Bank study of the country's engineering industries. The on-the-ground observations on which the IBRD study's conclusions in the respect were based, were paralleled (on a smaller scale) by the field visits to rural manufacturing enterprises undertaken by USAID in the preparatory studies for the Rural Industrialization Project.

The IBRD study applied a simple methodology (also used in engineering studies in several other LDCs) to measure the extent of X-inefficiency. The approach and results are summarized by F. Moore:

> On the basis of visits to a sample of plants, evaluations were made of the technical capabilities of the plants and their competitive positions. The evaluations included specific attention to seven functional areas: the plant layout and flow of work; operating practices in production; maintenance programs; product qualities; the capability to do product adaptation, design and testing; the use of labor and its effects on productivity; and management. In each area, the plant was given a score comparing it to efficient practice in industrial countries. The results clearly indicate the extent and the principal sources of inefficiency in the use of existing resources. For example, among Thai firms the overall score of the plants that either involved joint ventures or had technical engineering skills in management were significantly higher than those of Thai firms that did not have these skills. This is an indication of the importance of technical information and competence in the competitiveness of industrial firms. The aggregate (weighted) scores were as follows (a score of about 90-95 represents efficient practice in industrial countries).

Type of Firm	Score	Interpretation
Thai firms without engineers	72.0	Unsatisfactory; serious deficiencies.
Thai firms with engineers	81.6	Acceptable for expansion in local market.
Joint venture	84.3	Acceptable for local mkt; may be able to export.

Two factors emerge from this study (and those in other countries) as key determinants of effective utilization of industrial technologies: the firm's command of information, and the extent of its technological mastery (i.e. ability to apply the technology as it was intended). The differences between firms having direct access to external technology through joint venture or

generalized access through internal engineering staff capability, and those dependent on local (at least for first step access) intermediary organizations (government or private), are striking. The importance of step-by-step learning within the enterprise as a route to technological mastery is especially clear in the Korean experience which relied relatively little on joint ventures or licensing. Korean enterprises acquired mastery through a sequence of incremental adaptive changes, own problem-solving, and informal transmission of technical advice from foreign industrial firms to whom the Korean enterprises were selling intermediate inputs or final products to specification.

Moore's conclusion, applicable to Thailand: "The existence of inefficiency and the lack of technological mastery pose two challenges to policy makers: (1) to design programs that will lead to efficient use of existing resources, including adjustments in current practice, and (2) to establish a basis in RD&E activities that are appropriate to the environment in the country, so that progress can be maintained, at least to the extent of creating informed buyers." In sum, the key factors are acquisition choice, local adaptation and efficient application. Instead of RD&E in that order, we find, A(acquisition)E&D, with R further down the road.

Third, there is clear evidence of innovative talent and technological ingenuity among Thai medium and even small-scale entrepreneurs. While this phenomenon has not been systematically studied, there are well known and widely spread examples of incremental technological change that illustrate the potential in Thailand for a repeat of the technology learning processes that have been so important in more advanced NICs, as noted. (Examples include the hand-guided tractor adapted for Thai field conditions; locally adapted rice mills; locally designed, low-cost, provincial production of trucks combining unusual mixes of new and reconditioned imported and domestically manufactured components; small engine adaptations to Thai farming operations; and local area adaptations of small farm implements.) Copying and adapting of imported equipment, manufacture from scratch based on catalogues and sales literature, acquisition of know-how from equipment suppliers, and learning by doing are major processes through which these incremental technological advances have come about.

Fourth, the structural adjustment through which Thai economic policy makers have been guiding the economy in recent years is export-oriented. Continuation of the earlier import-substitution incentive structure would have in of itself constituted a significant constraint on Thailand's technological advance in manufacturing, both for the limited potentialities for product mix and the absence of competitive pressures for avoiding technical stagnation. Thus the industrial development strategy envisages Thai manufacturing travelling a route similar to that of the Gang of Four - a route requiring very efficient processes for technological change and adaptation.

V. IMPLICATIONS FOR S&T PLANNING

Aside from the apparent need to increase the speed and efficiency with which the Thai economy increases its technological basis, the above trends

have important implications for the directions and priorities for Thai S&T policy and institutional development. While these implications go beyond the scope of this Project, we will attempt a preliminary outlining, partly to indicate the framework within which the decisions on Project content have been made, and partly as a contribution to the process of S&T planning still at an early stage in Thailand.

The evolution of S&T-based economic activity may be viewed from two simplifying perspectives. First is typological: technology is produced and used by different types of institutions, cadres and economic actors, linked together in complementary relationships. This infrastructure comprises laboratories and other facilities for generating S&T knowledge; information banks, institutions and trained individuals for storing and mobilizing the stock of knowledge; institutions for educating and training human capital in S&T disciplines; technology delivery and transmission systems (e.g. extension; consultancy companies); technology service agencies (testing, standards); and final users. These components have been mapped out in the S&T literature, and the nature and dynamics of their linkages have been described.

Second is timing and sequencing: for any given economy at some period in its economic development, some components and linkages are more important than others. The task of S&T planning appears to focus on a) understanding the current infrastructure and its operations in relation to the current stage of economic development and its technical needs; b) anticipating the near-term direction of economic evolution and the implications for domestic S&T infrastructure and processes; and c) planning a sequence in time of investment in S&T capabilities and of development of facilitating policies and measures to encourage efficient linkages. The distinction between infrastructure, or domestic institutional capabilities, and process, or the channels through which technology gets applied to economic activity, is fundamental, especially for a developing country. With scarcity of S&T resources, and vast scope for drawing on trade in technology already available in more advanced sectors in other countries, a country faces "make or buy" choices in the S&T sector as in other sectors, complicated by the long time-frame required for institution-building of S&T capacity, especially for research.

We may illustrate the relation between structure and process-and how greater relevance of some processes, at some stages of economic growth, implies differential needs for aspects of S&T infrastructure capabilities - by comparing Figures 3 and 4. Figure 4 (taken from Kim) was apparently mapped as an infrastructure guide for developing countries, but could equally apply to an industrially advanced economy. It illustrates an hierarchy of institutions that appear to be logically related in the hierarchical sequence shown. The structure is topped by overall policy making, coordinating and funding bodies. The second level includes the institutions generating new knowledge. The third level comprises technology transmission and service functions. The whole structure rests on a base of educational and training institutions that produce the people capable of manning the structure above it. Although this particular diagram does not distinguish between research and development, or between basic and applied research, it implies a traditional top-down logic running from R to D to E. New technology is first generated, then developed

for use under operating conditions, then applied in practice by the using enterprises.

The sequence we have described above however would turn these steps upside down. User recognition of need would initiate the process, followed by Acquisition mainly from (initially, mainly foreign) commercial rather than institutional sources, then enterprise-level Application ("E") and learning. Local institutional "D", general adaptation research, plays a relatively small role, followed by "R" as a final maturation of the role of the science community. Technological service (for "E") emerges early in the process, especially to support viability of competitiveness in manufactured exports.

In Figure 3 we have rearranged the structural diagram into a flow or linkage illustration that appears to reflect more accurately the relative role of different sources of technology for the Thai economy at present. The diagram also identifies some of the factors (policies, intermediary services, etc.) that determine the efficiency with which the links are operating.

We have already noted some of the important factors operating in Thailand: X-inefficiency, weakness of institutional likages, and the constraining effects on technological change in family-owned enterprises. Figure 3 also reflects the weakness of other linkages that should be significant transmission belts between enterprises and technology sources. With suitable information in hand that would enable one to develop a refined picture of the actual situation currently, and a "target" diagram indicating the next stage of needed infrastructure elements and improved linkages, based on the likely path of Thailand's industrial evolution, the schema would represent the kind of S&T infrastructure mapping and sequencing that should lie at the heart of S&T development planning.

Figure 3 adds a fourth category to the traditional RD&E, viz. Acquisition. The most important determining decision takes place when an enterprise chooses and acquires its technology, acquisition normally consisting of buying machinery and equipment in which the technology is embodied, or buying the rights to employ a technology (product or process). The engineering ("E") stage is labelled Application, the process over time in which the enterprise works the technology, learns how to use it, and gradually achieves technological mastery through reduction of X-inefficiency. This learning process involves such activities as improving operating and maintenance practices, improving machine tolerances and equipment life, and improving plant lay-out and materials handling. The "D" stage we have labelled Adaptation: the use of engineering skills to make incremental changes in the technology, e.g. by adding additional pieces of equipment to the original core process, stretching equipment capacity, developing uses for by-products, minor product design and styling changes, adjusting production process to a change in raw material sources which changes the physical properties of the material inputs. Finally, there is the "R" stage, defined here as Applied Research for developing new products and processes.

At an early stage of industrial development, the activity is mainly on the right hand side, i.e. the Acquisition, Application and Adaptation of existing

technology, and much of the policy content of S&T (illustrated in the list of factors at bottom determining the efficiency of the links and processes) concerns AE&D. Scientific institutions have a potentially important role in E (in testing, standards, and consulting), but must be built up fairly early to help the industrial sector develop potential comparative advantages through exploitation of domestic raw materials and through research into new industrial processes under local conditions, that can lead to significant reductions in domestic resource costs.

The top half of the Figure shows domestic sources manufacturers can draw on for AE&D, the bottom half, foreign. Small and Medium scale enterprises are shown separately because their technological characteristics are different from large-scale or hi-tech enterprises. SMEs have little direct relation with foreign technology sources. It is noteworthy that few of the major sources of technology change in industry in advanced economies are significant at this stage: consulting services, formal S&T institution, enterprise own-engineering or research. The development of sub-contracting between technologically advanced prime manufacturers and smaller less advanced suppliers warrants particular attention as a powerful transmission mechanism not yet significant in Thailand.

VI. IMPLICATIONS FOR USAID PROJECT

A full-scale effort to develop a strategy along the above lines (which are a further adaptation of methodology employed in IBRD S&T sector assessment work) would go beyond the planning required for this Project. The specific components proposed for US assistance at this stage have been chosen based on their relative importance and leverage for promoting the development of Thai S&T capacity, especially in the problems of application, of linkages between users and technology suppliers, and of linkages among researchers, service organizations and users that must be greatly strengthened in Thailand to bring even the existing S&T establishment closer to its development potential. A major element of the Project however would assist the RTG develop a strategic planning capability, where the planning scope and sophistication would be raised to a level commensurate with the essential role modern S&T will have to play as Thailand moves into NIC status.

a. An Initial Policy Research Agenda

While we have stressed the usefulness of a conceptual framework that tries to capture the significant determinants of technology flow and application, it would be a mistake to initiate strategic S&T planning in Thailand with an excessively broad agenda. The literature on S&T tends to emphasize comprehensiveness of this cross-cutting subject, winding up with complex methodologies based on the observation that "everything is related to everything else". For example, Kim quotes one researcher who found that in France, Germany, U.K. and Japan, industrial R&D managers believe that "general government policies (economic and otherwise) and general market and competitive conditions have a more significant impact on research, development and innovations decision-making than specific incentive programs". While this is probably true for Thailand (as it appears to have been for Korea), it would

probably be more useful if macro-economic levels of determinants of technological dynamism continue to be left for NESDB to take into account in a broad manner, and for the S&T policy research function per se to limit its purview to linkages that are readily identified, describable and related to specific S&T actions.

Our first cut list of priority subjects would be as follows:

1) Development of descriptive indicators and information, as basis for S&T sector analysis: resources (skill inventories, R&D spending levels and patterns, utilization of scientific and technical personnel, brain drain, private sector R&D, public sector S&T investment, etc.); technology generation and flow (patents, non-proprietary innovation, external acquisition - licensing, royalties, information access systems, direct investment technology transfer, outputs of domestic research institutions, expatriate technical personnel); surveys of domestic enterprise attitudes and practices concerning changes in production technology; growth of consulting engineering sector; technological characteristics of industrial product composition and enterprises; etc.

2) Analyses and monitoring of the effectiveness of the linkage and flow processes, including informal transmission processes known to be important in other countries.

3) National S&T planning. Infrastructure and domestic capability requirements should be consistent with and supportive of the structural changes underway in the economy, and those anticipated and being promoted in the country's five-year development plans.

4) Examination of fiscal and regulatory policies affecting the efficiency of technology flows and applications, and the incentive structure for development of R&D by individual enterprises.

5) Recurrent evaluation of the coordination between S&T institutions and productive sector users, and of the development of demand-linked research outputs.

6) Anticipatory scanning of new technologies with potential applications that should be brought to the attention of potential users and S&T adaptive research facilities.

b. Multiplier Effect of Linkage Activities

Over the past three decades, Thailand has made substantial investments to build up its scientific capabilities. Large numbers of Thais have been trained in science subjects, including thousands trained abroad at bachelor and graduate degree levels. Science faculties have been built up at several universities. Numerous RTG ministries and agencies have cadres of scientific and technical personnel carrying out technical administration, research, extension. Linkages have developed with scientific communities in the ASEAN region, bilaterally with major donors, and through the UN system

with international cadres in many disciplines. The engineering diversification in industry has required employment of large numbers of engineers in private enterprises.

In a very real sense, the return on this investment has been well below its potential, difficult as it may be to arrive at any quantitative indication of the magnitude of this shortfall. There has been little research on potential new products from local resources, or technologies for countering environmental degradation under local conditions, or cost- reducing adaptations of manufacturing processes. While Thai agricultural scientific capabilities - not surprisingly, much more extensive than industrial scientific capabilities - remain significantly underutilized and below potential, the underutilization of hard science industrial S&T resources (education aside) appears much more severe. University research on agricultural production is widespread, and is connected (albeit not sufficiently) with informal and formal networks between researchers, extension and irrigation project officials, to the final farmer users. For industry, the extension network is still rudimentary, and direct relations between enteprises and university research resources are rare. The considerable university potential for trouble-shooting consulting services is untapped.

The weak state of these linkages is illustrated in Figure 3. As indicates by the dotted lines showing only incipiently active linkages between enterprises and domestic scientific research institutions for the conduct of contract research, or realizing further productivity gains through "D" (development and adaptation of an installed technology through incremental technical changes), or for industrial research by institutions for licensing and promotion to the private sector, and by the absence of any link with scientific research institutions for consulting services aimed at reducing X-inefficiency, these potential services remain largely unrealized.

Local engineering consultant firms are also used only to a very limited extent for the application and adaptation processes. The only significant sources are learning and own-engineering inside the firm, technical participation and assistance from partners in the joint venture sector, and informal plant inspection and technical advice from foreign buyers of Thai manufactured products. As noted above, foreign buyers have been a major technology information source for Korean export industries. The extent to which this belt is also operating with Thailand's more modest industrial exporting sector is unknown, but it is likely that is is significant as the principal means for buyers to ensure suppliers meet specifications and delivery schedules.

As Korea and other NICs have recognized, further advance in their manufacturing sectors would be severely hampered if they failed to develop an institutional framework to mobilize scientific resources more systematically and comprehensively to address production problems and potentialities. In any particular case, the extent of economic gains will depend on the enterprise product, process and local economic and physical conditions. Generalization on the economic costs to Thailand of failure to bring technology mastery closer to the technology horizon (the substantial shortfall has been described

for the engineering industries, as noted above) is not possible. However, an indication of how substantial such costs may be - and conversely how substantial the gains may be from an investment in activating the enterprise - S&T institution linkages - is given by Westphal who cites several case studies of the experience of industrial infant industry enterprises. These cases suggest the possibility that "the cumulative sequence of technological changes which has been observed to follow the establishment of a new activity may be more important than the initial establishment of the activity". Thus the economic impact, measured by reductions in the resource cost of production, of replacing old technologies by new ones, in these cases, was less than the cumulative impact of the gradual improvements as technological mastery was slowly achieved and the initial technology improved through incremental adaptation and innovation.

Westphal suggests the possible conclusion that - if indeed domestic resource costs of production in "efficient" infant industries may initially be up to twice the value of foreign exchange saved (from the foregone imports), then protection would be justified over the 5-10 years it appears to take to achieve mastery at initial effective rates of up to 100%. This is a possible policy conclusion that differs very substantially from the concensus view regarding trade and industrial incentive policy. For the purposes of this Project, it needs to be stressed that a) the activation of links between such infant industries and a country's S&T institutions is a necessary condition for the realization of much of these gains, especially for the non-joint venture sector, and especially during early industrialization where, as in Thailand, there is limited experience with enterprise use of own engineering staff for such purposes; and b) where a respectable S&T cadre has already been developed, as is the case in Thailand, the marginal benefit/cost relationship for activities establishing linkage processes should be quite high.

In sum, assuming successful operation of the explicit and implicit linkage functions of the Project, the application of Thai S&T resources to industrial investment and production on a significant scale should yield major benefits for relatively modest up-front costs.

Similar considerations apply - especially in the non-joint venture sector - to the proposed activities for linking Thai enterprises to information sources for acquisition of existing technology. For all their commercial acumen and production ingenuity, Thai entrepreneurs cannot build a modern industrial sector based on copying imported manufactures, drawing on equipment catalogues and sales literature, and on informal local technical exchange with suppliers and peers who are essentially at the same technical level. These links will be especially valuable for existing import-substitution industries and for entrepreneurs seeking out technological alternatives for new ventures but without a foreign joint-venture partner. Even for exporters with close contacts with foreign buyers, the Korean example points to an impact more on application and adaptation rather than initial technological choice and acquisition. (The extent to which the informal learning processes are at work in Thailand's export manufacturing sector, and how they actually operate, is not clear. This would be an important area for policy research). Again, noting that resource savings from the

acquisition/installation of a substitute technology for an earlier technology (in the studies cites by Westphal) were roughly equal to the substantial benefits from the incremental learning/adaptation process, the successful activation of information access behavior by these industrial sectors could lead to large economic benefits in relation to the investment in the access services.

Economic Benefits from Individual RD&E Projects

Extensive analysis of the benefits likely to result from the various Project components would be difficult, if not misleading, because:

a) the specific content of the non-designated RD&E is deliberately unspecified until the activity gets underway;

b) the potential effects of some areas where S&T capacities will be strengthened will be too widespread for realistic benefit estimation (e.g. testing and standard setting); and

c) the potential benefits of some activities will depend on subsequent responses to opportunities created (e.g. some of the rubber research, as explained below.) In addition, some of the designated RD&E proposals would need further work on the economic and commercialization aspects to supplement the technical work already done.

Nevertheless, it is possible to give some indications of benefits for a number of components. These should be seen as preliminary ideas that will be worked out in greater detail during the RD&E evaluation procedure that will be required by STDB.

The rate of return on agricultural research.- the increased output in a single year compared with the cost of the research investment behind (say) a new variety - has averaged 50% in developing countries in recent years. In some cases it has ranged as high as 100%, far beyond the returns normally obtained from investments in equipment and capital projects. Using the new high-yielding varieties, some countries have been able to raise their cereal production growth rates to over 3% a year, sustained over many years.

Of course the results of any one line of research cannot be predicted with any certainty. However the potential impact of the research planned for the first annual designated research program illustrates the potential leverage, even assuming only a small number of the efforts produces early pay-off. For example, if the application of these advanced techniques solves the aflatoxin problem, it could eliminate the 15% average discount Thai maize is believed to sell for on the world market. Gains of this order would mean an increase in maize export earnings form an average of Baht 8.4 b. per year in the past three years (on roughly comparable volumes) to Baht 9.7 b. An increase of earnings amounting to roughly $ 50 m. annually would be upwards of 150 times (in a single year) the cost of the research effort that might be required to generate an aflatoxin solution. To the extent that aflatoxin control requires other complementary investments (for example, in maize drying or other

approaches being researched under other projects), the returns to the biotechnology research alone would be of a lower magnitude. But the initial approach would be an attempt to reduce aflatoxin incidence to commercially acceptable levels through developing plant resistance by itself.

The potential impact of rubber research would be less straightforward for calculation. Reduction of fungus would lengthen tree life and reduce replanting costs and the periods of non-producing immaturity on plantations. Increases in yields would translate into increased exports only slowly as world markets for rubber grow. It would be unrealistic to project Thai production increases capturing much of Malaysia's predominant market share in natural rubber. However, significant yield increases would enable Thailand to produce its market share on reduced land area, and switch redundant acreage into different tree crops and/or high value fruits or vegetables.

The initial program includes a number of research projects to develop new uses for cassava - starch, acids, cereal blend, conversion of the stems for charcoal or fiberboard, etc. A variety of possible products might be technically and economically feasible, mainly for import substitution domestic uses. While it is too early to attempt to quantify the possible outcome on total cassava usage, the urgency and size of the cassava overproduction problem are so great for the Thai economy in the short run (an estimated 800,000 farm families are producing cassava) that priority effort should be given to the possibilities for solutions from these new biological technologies.

Shrimp is a major food product in world trade in which demand is rising very rapidly and is outpacing the increase in supply. Because the traditional technologies of ocean farming of shrimp are believed to have reached their maximum sustainable yield, world demand growth needs to be met through major expansion in shrimp aquaculture. The producers who first solve the technical problems now inhibiting more rapid growth of aquaculture will be in position to capture much of the growth potential of this lucrative market.

Aquaculture (pond) shrimp production is now about 10% of the wild catch. (The wild catch is expected to experience no growth, perhaps even a decline due to marine pollution and destruction of nursery areas.) The Asian Development Bank predicts an increase in demand for shrimp in Japan, the USA and Western Europe alone of 168,000 metric tons by 1990, and concludes that this demand can be met only through increased aquaculture production.

Thai marine shrimp production rose rapidly in the 1970s, but declined from the 1978 peak of 143,000 metric tons to 121,000 tons in 1981, for a number of reasons. At the same time, Thai aquaculture shrimp production has been rising. Thailand is now the world's fifth largest producer of marine shrimp and prawns and is well positioned to attempt to supply a good fraction of the projected expansion in market demand. The technical problems have been identified and should be solvable by modern research technologies, Thai scientific and commercial aquaculture capabilities are already in place for overcoming the problems facing a major expansion, and a detailed research proposal has been developed in cooperation with world-class expertise.

The core technical problem is to develop a method to produce a reliable, inexpensive and adequate supply of "seedstock", i.e. immature shrimp, to replace the traditional reliance on the wild catch. Such a method in turn relies on development of a process for inducing spawning and maturation of shrimp in captivity. Building on the current state-of-the-art, and utilizing latest technologies of hormonal manipulation combined with experimentation on different feeding regimens, environmental variations and other factors, an RD&E project has been envisioned to achieve key breakthroughs that would set the stage for large-scale production of immature shrimp that could then be distributed to commercial shrimp farmers for bringing up to commercial sizes in preparation for export sale.

The cost of the RD&E project would be approximately $200,000. This is a very small fraction of the potential earnings to the Thai economy. Thai marine fresh chilled and frozen shrimp exports in 1983 amounted to 20,000 tons, earning $137 m. in foreign exchange.

By way of illustration, if Thailand could supply 10% of the projected growth in the US/Japan/West Europe market over the next few years, this would nearly double Thai export earnings by adding roughly $115 m. of sales (at 1983 prices).

The economics of dengue fever in Thailand has not been studied in detail but a few numbers and assumptions can give a sense of the magnitude of benefits that could result from the development of an effective vaccine. In 1984 there were 58,520 reported cases of dengue fever in Thailand. The age distribution of these cases was roughly half adult, half children. A bout of dengue puts an adult out of work for a week. Although dengue is also prevalent in urban areas, if we make the most conservative assumption that the average daily economic loss equals the rural daily agricultural wage (say Baht 25), the total economic loss from adult down time from dengue would amount to Baht 5 m. Most dengue victims go to hospitals. The average cost per in-patient in a provincial hospital in Thailand is about Baht 400 per day, or Baht 2,800 per patient per bout. At 1984's incidence, the hospital costs amounted to about Baht 165 m. Down-time and hospital costs together then totalled Baht 170 m or $7.4 m. The actual figure would be significantly higher if data were available to estimate actual wage losses; if account were taken of travel costs to and from hospitals; if the daily economic loss could be calculated taking into account the current minimum wage levels (Baht 70 a day in Bangkok, Baht 65 in other major towns and cities, Baht 59 elsewhere) which are adhered to more in major urban areas than elsewhere.

Since vaccination programs typically target on children and include all adults only where the disease is heavily endemic in particular areas, the time profile of benefits from a dengue vaccine program would be complicated to estimate. Benefits would grow and cumulate over time. Once established, the ratio of benefits to costs of most vaccine programs is very favorable.

Thailand imported Baht 13 m. worth of kaolin for the ceramics, chemical and paper industries in 1983. Domestic kaolin reserves are sufficient to substitute for imports for many years but require beneficiation to meet the

needs of these industries. More importantly, the availability of higher quality domestic kaolin and other clays could help increase the commercial viability of domestic production of a number of products that depend on high quality technical ceramics. The largest single such product is the ceramic components imported for Thailand's major integrated circuit export business. While the potential impact of an upgrading of local ceramics technology appears to be substantial, proposals for RD&E work on technical upgrading beyond beneficiation, to meet the requirements of these ceramic uses, will be based on careful studies of economic in addition to technical feasibility.

The mining industry in Thailand is concentrated in the southern peninsular region. There are over 1400 mines in the country, mostly small labor-intensive operations. RTG geological services benefited in their early years of post-war development from technical assistance from th USGS under US aid financing. In the sequence of steps in the mining and metallurgy sector in Thailand - exploration, mining, processing (separation, beneficiation), metal extraction (smelting, recovery from slag), and fabrication - current levels of technology are behind the state-of-the-art, with a few important exceptions. In the preliminary analyses conducted in the course of Project design, a number of specific needs were identified, in terms of technologies and associated testing and other equipment. Given the wide spread-effects that could result from upgrading of the institutional/technological basis for mining and metallurgy in Thailand (i.e. the large numbers of small mines and fabrication enterprises) it would not be feasible, without detailed market studies, to estimate potential economic benefits at this stage. The prima facie arguments for a high multiple of benefits from productivity improvements are strong however. The institutional base for the industry is already well developed and largely concentrated in two centers in the main mining region (aside from academic facilities in Bangkok). Modern equipment needs are not great, while substantial technical transfer should be possible from modest amounts of technical assistance, seminars and other forms of professional exchange. Linkages between these two institutions and the mining industry already exist and will be strengthened. Market feasibility will of course be the determining factor in the potentialities for further downstream development of this sector as the technological and product quality base expands. While such expansion of the base will not be a sufficient condition for any specific forward linkage investment possiblities, it is certainly a necessary condition.

In 1981 Thailand spent an estimted $61 m. on direct payment for technology, including $37 m. for royalties and license fees and $20 m. for fees for various forms of commercial technical assistance. These payments have been growing (the comparable total for 1972 was only $6 m.) as one would expect in a newly industrializing country, and are a healthy sign for rising domestic manufacturing activity and diversification.

On the other hand, the RTG is concerned that these payments may be excessive. The Ministry of Industry has just floated the idea of forming a unit to screen new joint venture agreements to ensure they do not contain disadvantages for Thailand.

There is no way of knowing whether Thailand is overpaying for its technology imports by substantial amounts, quite apart from the question of agreements for use of proprietary technology that (as in many countries) may be binding the lessee to restricted uses that limit the actual returns. It would be surprising however if the country's current system of information and technology acquisition, in which individual enterprises have to undertake extensive searches beyond the commercial flow of information of suppliers currently operating in Thailand if they want to scan the field for all relevant alternatives before making a major technology choice, were resulting in an optimum pattern of choice. The TIAC is designed to greatly reduce the random element of technology acquisition and choice in Thailand. It is a virtual certainty that over a group of TIAC users, previously unknown (foreign and domestic) technological options (other suppliers of similar equipment that might be less costly, technologies that may be significantly cheaper and/or more appropriate for Thai conditions because they are more labor-intensive or already discounted because of being slightly under state-of-the-art, etc.) will be selected by some enterprises, resulting in financial benefits fo the users and economic benefits for Thailand (in terms of foreign exchange saved, greater employment generation, more appropriate factor proportions, etc.) The intent is to demonstrate the usefulness of the service to the whole of ATI membership, i.e. a large fraction of Thailand's manufacturing sector. If alternative options had been sought out and chosen in the past few years resulting in (say) a 10% saving on the current technology service foreign exchange bill, this would amount to $6 m., compared with the annual operating cost of TIAC of $0.4 m. The comparison obviously is not a projection, but serves to illustrate the order of magnitude of returns that would not be unreasonable to expect from the introduction of this service.

Diagnostic Service. As pointed out above and reflected in Figure 3, the experience of Korea and other NICs suggests that economic gains from improvements in the application of (and incremental enginering adaptations of) new technologies, in the initial years after acquisition/installation, can be as great as the gains from the initial installation. As we have stressed, Thai industry has virtually no experience in the utilization of specialized engineering and management expertise, on a consulting or trouble-shooting basis, to help enterprises speed up the internal process of learning-by-doing. Nor do most enterprises have the in-house engineering staff (or use the engineers they do employ) for systematic work on adjustmental changes to the core technology, design adjustments, expansion in capacity or other technological changes through addition of complementary processes, etc. Technical expertise that can perform such services has been building up in Thailand, but is seldom used in this manner.

The diagnostic service is intended to introduce the concept and practice of consulting services for reduction of X-inefficiency, i.e. more efficient use of the technology in current use. The actual productivity gains in terms of cost reductions in specific firms, or development of new uses for existing machinery, etc. that result from (say) the first five years of operation of the service are obviously not quantifiable at this stage. As has been the experience of the only other such service in Thailand thus far (being offered by IFCT only to its own borrowers), providers of such services will have a

primary function of demonstration to educate the potential clientele about the value of engineering consulting. The service can expect to start with a relatively small demand, but should be able to generate a greater flow of requests, and eventually a completely self-starting demand for such services. The potential pay-off to any single consultancy-diagnosis can be very considerable. As a rule of thumb, engineering consultancy should be expected to enable a client to reduce costs and/or raise returns by some 5 times the cost of the consulting fee in the first year, when operating on a completely unsubsidized basis. If the diagnostic service, working in coordination with IFCT, hooked into the entire Thai manufacturing sector through ATI, succeeds in bringing about systematic attention to the reduction of X-inefficiency, most likely a decade or more before this function might otherwise begin to develop in Thailand's modern industrial sector, the potential economic benefits could be very substantial compared to the cost of the service.

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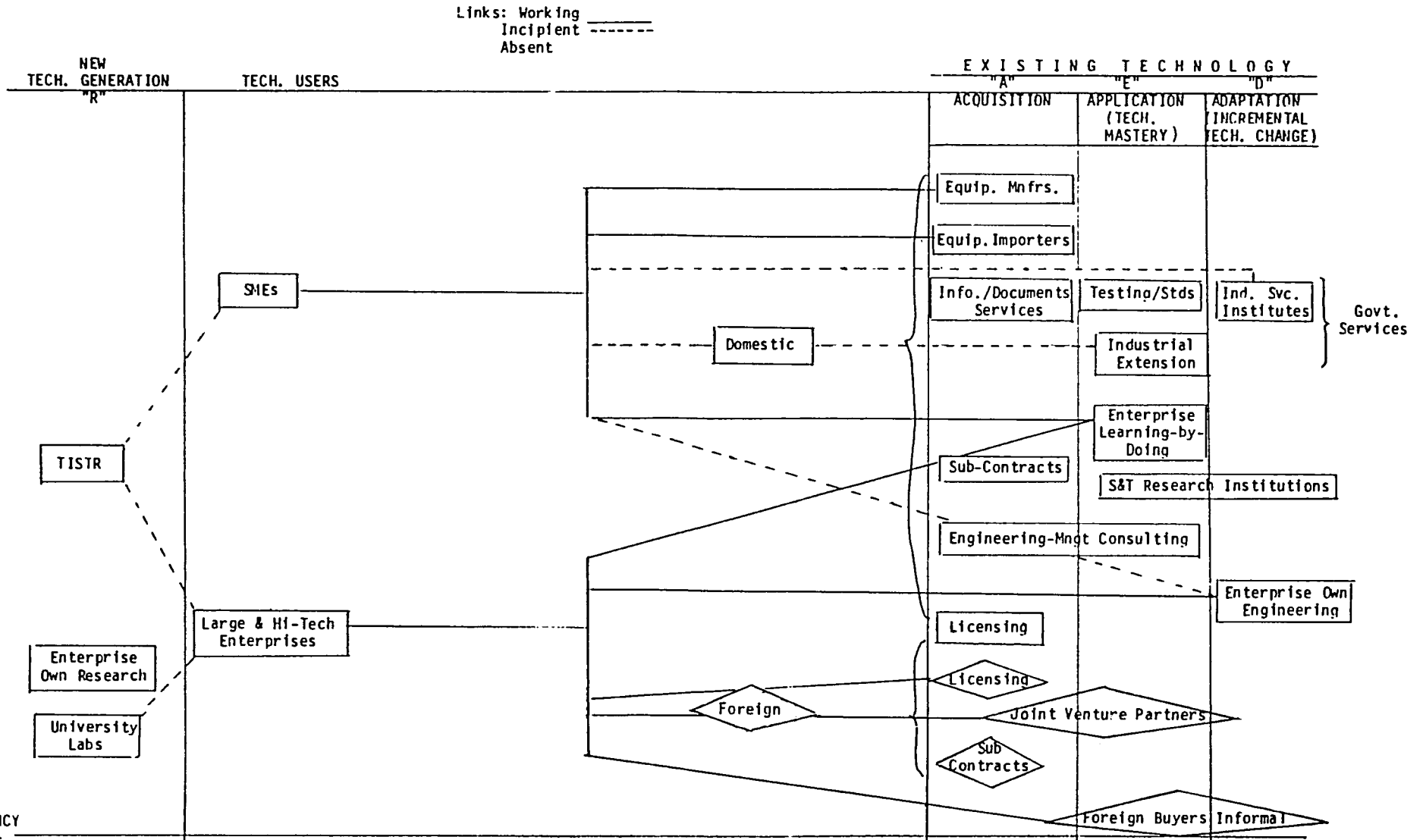
Westphal, Larry E., "Empirical Justification for Infant Industry Protection", World Bank Staff Working Paper 445, 1981.

Figure 3 (H)
Industrial Technology Structure - Sources & Linkages



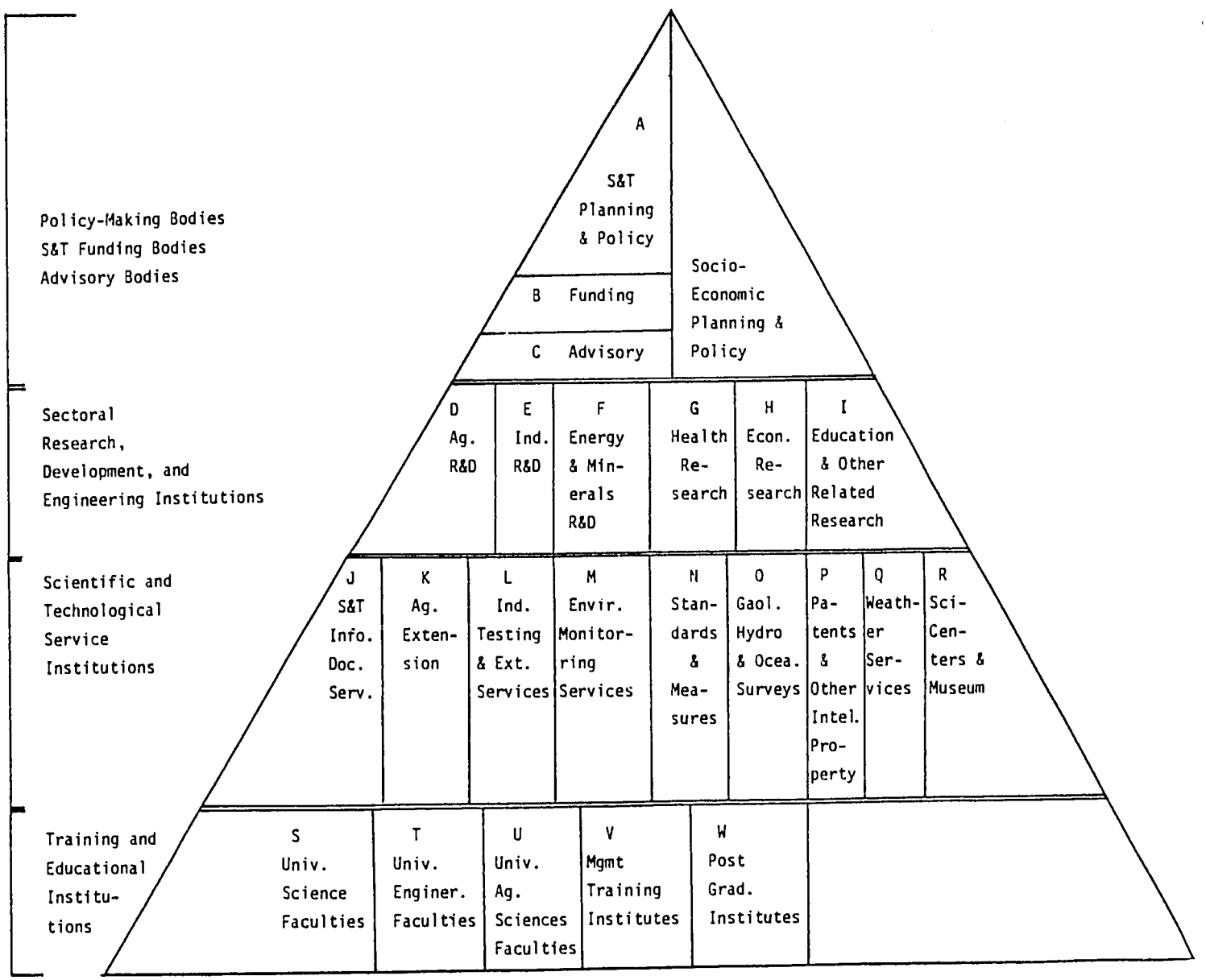
EFFICIENCY FACTORS		"A" ACQUISITION	"E" APPLICATION (TECH. MASTERY)	"D" ADAPTATION (INCREMENTAL TECH. CHANGE)
S&T Wages	Venture Capital/Non-Collateral Credit	x		
Wkg conditions	Fiscal Incentives	x		x
Coord.	Trade Policies	x	x	x
Res. Policy	Foreign Investment	x	x	x
Res. Program	Sub Contracting	x	x	
Incentives for	Patent Law	x		
Private Sector	Capital Mkt./Corp. Law	x		
Linkages	Specific Industry Policies	x	x	x

Long Run Factors - S&T Ed. in Primary/Secondary
Policy in Industrial Safety-Catastrophic Risk-Environment

ANNEX H

FIGURE 4 (H)

A GENERALIZED DIAGRAM FOR ASCERTAINING S&T INFRASTRUCTURAL NEEDS



NOTE: Adapted from H. Brown, "Science, Technology and the Developing Nations," Bulletin of the Atomic Scientists, Volume 26, number 6, 1971.

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SOCIAL SOUNDNESS ANALYSIS

A. SOCIOCULTURAL CONTEXT AND FEASIBILITY

Thai society and government are primed for a major effort to develop science and technology in Thailand. Perhaps most important, the government is anxious and now organized to lead such development. The current five-year plan (1982-1986) for the first time includes a chapter on S&T development. The drafts of the next five-year plan not only further refine this effort, but also propose using technology broadly as a tool for development. Legislation has been proposed for the establishment of a Council of Science and Technology Advisors. The Ministry of Science, Technology, and Energy has assumed an activist role in facilitating and popularizing S&T development.

Thailand has traditionally been and continues to be a society where patronage, family and ethnic ties are important. Recently, however, such elements have weakened in their influence making way for the gradual but significant emergence of a technocratic and entrepreneurial elite. The Chinese business community is becoming Sino/Thai; family managers are being replaced by technical managers; traditional enterprises are becoming more modern in technology and management techniques; government bureaucrats are increasingly going into business. In short, social mobility on the basis of technical ability to deal with new developmental problems and competitive pressures is beginning to replace some of the advantages of patron, family, ethnic, and school connections. In the process, the traditional separation of Thais into government work and Chinese into business, for example, has disintegrated more here than comparable separations have anyplace else in Southeast Asia. This is helped, of course, by the fact that the Chinese in Thailand have been integrated into Thai language and culture.

Such changes should help the gradual evolution from low technology, traditional, and low quality production in Thailand to high technology, modern, and high quality industrial production, which the S&T Project envisions facilitating. Thailand has a socio-cultural environment and history that favors such a development. Having never been colonized and having a recent history of not being overpowered by outside forces, Thais have a quiet self-confidence that has disposed them to incorporate Western and modern ideas and practices gradually and steadily over the past century and longer. In spite of traditional cultural mores that temper open argument, there has been continual debate about the process of modernization including the role of science and technology. Such debate promises integration into Thai society that will not be imposed, but be deep and permanent.

B. SPREAD EFFECT

The spread effect of the results of the Project will depend primarily on the competitive market economy and on the efforts of government agencies, both of which are fairly extensively developed in Thailand. There are two specific issues, however, which should be noted in terms of this process in Thailand.

The first is that in the spread of research and technological innovation, there is always a conflict between the personal benefit of the creator versus the unimpeded spread of benefits to others. In Thailand, patent and copyright laws are quite ineffective, thus the rapid spread of the benefits of new information is very possible. This, however, mitigates against the creation of the new information in the first place. One of the policy dialogue concerns fostered by the Project is the determination of an optimum balance for Thailand.

The specific spread effect potentialities of this Project will vary substantially among the different components. The RD&E activities that concern agricultural production (e.g. cassava substitutions, new cassava-based products, improved fruit and vegetable packaging, etc.) will have wide effects in different parts of the country depending on the crops involved. The efficiency and speed of the process of diffusion of RD&E results that must be applied by individual farmers will depend, as they always have, on extension services, the private transmission through agro-processing enterprises, and on indirect interactions of such technologies with other input and marketing systems, such as credit, storage, etc. While some of these related systems continue to need strengthening (and are the subjects of a wide range of RTG and technical assistance improvement efforts), they have generally advanced substantially over the past two decades. The speed of transmission of new agricultural technologies in some products that have been developed through agro-business initiatives, working with large numbers of farmer-suppliers through contract and other arrangements, is a powerful demonstration of the potentialities for new technology diffusion in Thai agriculture under favorable conditions.

Some of the RD&E work will focus on technologies that would need to be adopted by relatively concentrated producing units, e.g. the southern coastal areas where shrimp production is concentrated. Spread effects should take place rapidly, while secondary effects of the very substantial income generation inherent in this case would be very wide in terms of regional income and expenditure, government revenue, etc.

The technology service components are being designed to ensure appropriate connections with provincial outlets and networks to the extent such exist.

The Technical Information Access Center (TIAC) and the Diagnostic/Research Design Service will extend their services into the rural areas in three ways: (1) the Association of Thai Industries (ATI) has a nationwide membership (1,600 members) and will build its own channels into various industrial centers of Thailand, (2) the TIAC will be linked with the electronic data processing communications network linking Thailand's universities, allowing rural manufacturers to communicate directly with them, and (3) ATI will build links with similar efforts supported by other aid donor agencies now operating in rural Thailand, such as the UNIDO activity in Udorn.

The proposed AID Rural Industrialization Project will focus on information and technology linkages (in addition to financial) to provincial industries. The technology information services of this Project will be linked directly

into the components of the Rural Industry Project.

The location and spread of RD&E work respecting industry generally cannot of itself counterbalance the enormous economic and social forces that have resulted in the concentration of 80% of Thai industry into the greater Bangkok area. The intent will be to ensure that rurally located industries are not underserved, as noted above, and to incorporate concern for the character of technology choices, especially the search for labor versus capital-intensive options, into the workings of the technology services and the criteria for selection of RD&E subjects and their design.

C. SOCIAL CONSEQUENCE AND BENEFIT INCIDENCE

As noted in the economic analysis, and in the preceding section, benefits and social consequences will be too varied to submit to easy or useful generalization. The social consequences of cushioning a cassava contraction involving tens of thousands of families at a minimum, can only be positive compared with the alternative of undiminished income contraction. Similarly the social consequences of income enhancement, and all that it implies in rural Thailand in terms of diet, children's education, access to modern media, social mobility, etc., is readily apparent, especially in those locations where agro-processing industries using highly intensive modern production technologies have enabled the associated farmers to experience very substantial income increases.

The social impact and benefit incidence of the impact of S&T on productivity and investment levels in urban industry are obviously difficult to identify in the abstract and complex in fact. Development of new products which will be attempted by some of the RD&E work, or creation of new investment opportunities through creating the technological basis for import substitution of products now imported despite the presence of the necessary local raw materials, will translate into incremental job creation, assuming the economics of these potentialities is also favorable. Employment based on mining and beneficiation will be located in rural areas at and near the raw material sites. Activities to improve the efficiency with which technologies are employed, or to develop new technologies that are not tied to provincial locations (for material and transport reasons) will have their effects wherever other forces have determined the investments take place.

The Project will create a multitude of non-farm employment opportunities through S&T developments beginning in such areas as bio-product processing (particularly food processing and packaging), improved metallurgical industries, refinement of natural resources and improved ceramic and rubber production and control, and health-related industries. A major expected benefit will be to raise the level of technology in Thai industry to increase productivity, and improve quality, so as to be better able to retain and/or expand export markets. Thai society is becoming more open and participatory, resulting in more pressure for higher wages. Higher levels of technology, increased productivity, and higher quality, higher valued raw materials or processed products are needed to support more in-country investment, hence more employment.

Developments in biotechnology in such areas as reduction in aflatoxin contamination and control of disease in fish production, affect the poor as producers and consumers. The development of new or improved fruits or vegetables which would be disease or pest resistant, would allow reduced application of pesticides - hence lower residue contamination. This again would help make it possible for the rural poor to have access to safer products. Reductions in losses of fresh produce through improved packaging would benefit both small-scale producers and consumers. Vaccines for rabies, Japanese encephalitis, hepatitis, dengue hemorrhagic fever, and other diseases that need special attention in the Thai environment would also carry great health benefits to the rural poor. Vaccine production of course wi'l also have widespread benefits, by its nature, but is especially beneficial to the poor who have fewer resources to deal with illness and can least afford the income loss from inability to work.

Taken most broadly however, the flow of industrial technology in Thailand will continue to reflect the urban bias of industry (a phenomenon not limited to Thailand). Apart from the important question of labor versus capital intensity, the technology flow in industry is not in itself an important determinant of the distribution of the economic gains accruing to its users, compared with the conditions of skilled and semi-skilled labor supply, RTG minimum wage regulations and their enforcement, etc.

In sum, S&T is by nature an endeavor that must be conducted in the first instance by highly trained, relatively advantaged people. Its effects can be virtually universal on a society, depending on the specific technology involved, the efficiency of diffusion, and on the economic and social framework and the equity with which that framework allows assets and income to be generated and shared.

Taken very broadly the application of S&T in the transformation of any economy from agricultural to semi-industrialized means that industrial S&T contributes to, or facilitates labor force transition out of traditional employment. Historically, the move into organized factory working conditions has often entailed unhealthy and exploitative conditions, especially for women and child labor. To a considerable extent, the technologies per se are neutral with respect to these problems. Factory working conditions and associated worker housing reflect economic, social and regulatory conditions and the state of labor organization and of management responsibility, i.e. the social framework within which the technology is implanted. In some aspects however, the introduction of new technology is not neutral in this regard, e.g. safety. Technical alternatives can have significant differences with respect to things like exposure of workers to moving parts or to factory air pollution or effluent generated by a particular industrial process. To take account of these potential negative effects of new technologies, both the STDB RD&E financing, and the operations of the information and diagnostic services will have appropriate built in criteria and awareness.

ADMINISTRATIVE ANALYSIS

I. STATEMENT OF THE PROBLEM

The critical contributions which this Project is expected to make to the resolution of the S&T development problem are a) facilitating changes to be instituted in Thailand's resource allocating process for S&T, and b) encouraging linkages and opportunities for interaction between industry and the producers of RD&E. Changing the resource allocation system will result in funding being directed to a different set of priorities (production problem solving) than in the past. New linkages generated by these activities between technical personnel in RD&E, and investors/producers, will encourage the utilization of available human resources to meet the technical needs of the economy and the commercialization of the RD&E results. It is intended that the private producers, the university academics, the public sector RD&E personnel, the government administrators and policy makers will be induced to interact through the proposed implementing mechanism to create the broader institutional framework discussed above.

The Project requires a single funding and coordination unit to give direction to the network of public and private institutions comprising the S&T community in Thailand in order to enhance the efficient allocation and utilization of RD&E capabilities.

The implementing organization will: 1) finance such RD&E activities identified as being demanded by Thai producers and are consistent with Thailand's development priorities; 2) upgrade the capabilities of existing Thai institutions to perform RD&E, provide opportunities for these facilities to engage available trained manpower and employ them on priority activities; 3) promote the use of indigenous RD&E and market the results of its products under an active publicity and sales program; 4) facilitate the establishment of a framework which provides and expands opportunities for public and private sector cooperation; and 5) support the RTG efforts in improving the overall policy environment to make it more conducive to investment in S&T activities.

The implementing organization required to administer Project activities should have the following characteristics:

- an independent body linked with an RTG ministry to enable it to receive RTG financial support, yet one which receives heavy managerial and technical inputs from the private sector in all aspects of its operations;

- an organization financed by the RTG with foreign loan and grant funding and government budgetary support but one that acts with a large degree of independence from standard RTG financial controls;

- a legal entity that has authority to invest in RD&E for its own account and risk using funds provided by the RTG, take possession of intellectual property derived from such investment and sell or licence such property to others.

. an entity which has the capacity to deal with and enjoy the confidence of both the private and public sector organizations;

. an organization which is run by professionals with both public and private sector orientation and experience in technology development, financing, marketing and commercialization; and

. a body which provides an institutional and financial mechanism to enable private and public sector S&T organizations (domestic and foreign), to work together in resolving technology related constraints to Thailand's development

Finally, the implementing agency should be a small, and responsive organization which serves as a focal point for managing diverse Project activities and controlling RTG and USAID financial resources. The implementing agency should not be overburdened with operational responsibilities, pulling it away from its catalytic role.

Within the scope of the S&T for Development Project, this organization should be able to discharge a set of specific functions as listed in Appendix 1 to this Annex.

II. ISSUES AFFECTING SELECTION OF ADMINISTRATIVE STRUCTURE

The following questions were considered in evaluating the suitability of the available choices for an administrative structure of the implementation mechanism:

1) Should the organization be a public sector body (either as a part of a ministry or a state enterprise); or should it be a non-government entity, such as a private foundation or association?

2) Is it possible for an existing institution to take on the necessary functions or does a new institution have to be created? If a new institution needs to be created, is it possible to do so within the proposed implementation time frame of the Project?

3) Is the implementing institution to be a temporary organization whose functions will end with the completion of the Project, or is there a known or perceived need for a permanent organization, to continue to perform the intended functions after the Project is completed?

III. ALTERNATIVES CONSIDERED

A. RTG Government Entities

If it were deemed to be desirable for the implementing agency to be an RTG ministry there are three possibilities to house the responsibility for discharging the required functions. With the strong focus on industry demand

for technology, the Ministry of Industry is a potential choice. With the focus on longer term development of science and technology human resources, the Ministry of University Affairs is a possible option. With the Project purpose of enhancing public and private sector application of S&T on a multi-disciplinary basis, the Ministry of Science, Technology and Energy is a possible choice.

1) Ministry of Industry

The logic of housing this Project in or affiliating it directly with the Ministry of Industry is more apparent than real. The link required is between industries themselves, RD&E institutions and the RD&E process, not to bureaucratic intermediaries or ministries which regulate the activities of industry. While the Ministry of Industry does carry out functions which are designed to stimulate investment by small industry, particularly outside Bangkok, it is more a regulatory body than a promotional one. In any event, this Project is more interested in innovation on the production line than in investment promotion and regulation. This process should eventually take place automatically as a result of market forces without the intervention of a bureaucratic intermediary.

2) Ministry of University Affairs

The Ministry of University Affairs could logically be considered a potential home for this Project in view of the large RD&E element related to universities *inter alia*. The problem, however, is similar to the one with the Ministry of Industry, but in this case with the supply side of technology rather than the demand side. The supply of technology should come from research, development and engineering operations whether they are conducted in industry itself, in research or technological institutions, or in the universities, or if technology is transferred from abroad. The focus is on investor access to technology. It is not on research *per se* and certainly not on university research as such.

3) Ministry of Science, Technology and Energy

The Ministry of Science, Technology and Energy is responsible, for linking S&T supply with demand. It was established in 1979, with the objectives of formulating, operating and developing science and technology activities. The Minister of Science, Technology and Energy has been one of the prime movers in getting this Project underway. He is convinced that this Project will help fulfill the overall ministry's responsibilities. However, RTG regulations governing ministry operations would make it extremely difficult to provide for the flexibilities needed by the implementing agent. Moreover, private sector participation would be severely limited if the implementing agency were within an RTG ministry. An organization chart for MOSTE is found in Figure J-1.

B. Non-Ministerial Gov't Entities

There are two organizations affiliated with the Ministry of Science, Technology and Energy which at first glance would appear to have many of the

attributes necessary for administering this program. They are the National Research Council of Thailand (NRC) and the Thailand Institute of Scientific and Technological Research (TISTR).

1) The National Research Council

The National Research Council was originally established in accordance with the National Research Act of 1956. At that time the NRC obtained permission to determine its internal organization but did not receive funding. Consequently its functions covered only research conducted and funded by various government departments and organizations. Over the years attempts have been made to improve the operations of NRC, resulting in minor alterations and reforms.

In 1979, the Office of the National Research Council was placed jurisdictionally under the newly formed Ministry of Science, Technology and Energy. MOSTE serves functionally as secretariat for Council meetings. The Office of the NRC is currently staffed by over 200 government employees in 9 Divisions as follows:

Office of the Secretary
Research Project and Coordination Division
Research Registration Division
Research Policy and Planning Division
Library and Documentation Service Division
Translation and Foreign Relations Division
Research Evaluation and Project Analysis Division
Research Promotion Division
Remote Sensing Division

Constraints inhibiting NRC's operations are an inadequate budget, a large staff responsible for diverse functions and an absence of priority focus on activities resulting in a lack of flexibility and productive output.

2) The Thailand Institute of Scientific and Technological Research

TISTR was created in 1964 as an autonomous agency by special legislation and was originally known as the Applied Scientific Research Corporation of Thailand. TISTR is presently a non-profit state enterprise under the Ministry of Science, Technology and Energy, with a Board of Directors comprised of 11 experienced professionals from both the public and private sectors. The institute has grown steadily over the years and now has a staff of over 500 employees working in a broadly based organizational structure under 5 major groups as follows:

Governor's Office
Administration Office
Policy and Planning Office
Service Group
Research and Development Group

The R&D Group alone is comprised of 12 technical divisions and 3 specialty centers, each with their own laboratory facilities.

TISTR's budget is derived from 2 sources. Approximately 80% is received in the form of a government subsidy with the remaining 20% originating from service fees, research and other sources. Total resources for Fiscal Year 1985 are projected at roughly 107 million baht.

Despite TISTR's substantial resources and its wealth of experience, the institute has sometimes been criticized for what is perceived to be its limited impact on development programs in Thailand. There has been a growing concern among senior officials to see what can be done to improve TISTR's impact and cost-effectiveness.

The present 5-year National Development Plan (1982-1986) calls for TISTR's reform in its structure, operations and management. At TISTR's own initiative, a series of studies by TISTR's planning team are being carried out in order to evaluate its operations in relation to cost effectiveness and the country's needs with the aim of streamlining its operations and improving its public image.

Some issues and problems identified by the studies include the following:

- Although TISTR's Legislative Act provides for necessary operational flexibility, TISTR itself has established a multitude of rules and regulations which limit that flexibility.

- There is a shortage of capable staff at the project management level.

- There is a need for modern scientific equipment.

- Incentives for retaining trained and qualified professional personnel are inadequate.

TISTR's present objectives are three fold:

1. To be an instrument of the RTG in conducting comprehensive S&T research and development and disseminating results to the industrial sector in order to resolve the socio-economic problems of the country;

2. To be a focal point in research and development, technology transfer, and S&T services for the maximum benefit of the country;

3. To fully develop the capacity of TISTR as a center of excellence in scientific and technological research and development in Thailand and the region.

An organization chart for TISTR is found in Figure J-2.

C. Non-Government Foundations or Associations

There is no existing non-government foundation, scientific or business association that has the scope and stature to take on the responsibility for the proposed functions. Moreover, such an entity, were it to be created, would not be acceptable to AID as the borrower of the AID loan without an RTG repayment guarantee. The RTG would find it extremely difficult to extend such a guarantee, or to provide RTG contributions to such an entity.

The alternative of breaking the program into individual pieces and administering each piece through a different organization such as through institutes, universities, and private sector organizations, was considered impractical and unacceptable to both the RTG and USAID. There must be a strong interrelationship among the various program activities for there to be a reasonable prospect of success. Therefore, the RTG and USAID have concluded that a single control point is essential. However, as can be seen in the Project Description, different existing institutions that are part of the business and S&T community will be designated agents of the new implementing organization to take operational responsibility for discrete segments of the Project under the overall direction of the implementing organization.

Discussion

Based on this review and discussions with senior RTG officials, including of the Minister of Science, Technology and Energy, and the Secretary General of the National Economic and Social Development Board, it has been concluded that no single existing organization currently has the managerial and technical capacity or the organizational flexibility and authority to manage the diversified activities included in the Project.

The implementing organization needs greater flexibility than can be provided if it were a Thai government agency. It also requires extensive private sector participation in its management. On the other hand the character of AID loan funds, the intended uses of the funds and existing tax laws would rule out a purely private, non-government organization as borrower and manager. However, state enterprises have a significantly greater degree of operational flexibility than government ministries, and do allow private sector participation in their management.

A state enterprise now exists, the Thailand Institute of Science and Technology Research, that has the requisite legal framework. However this institution (TISTR) also has other responsibilities (i.e. the operation of 14 laboratories) that would create a conflict of interest in its management of the tasks intended for the implementing agency. It is also in a period of transition to overcome certain managerial problems that might impede its effectiveness in assuming new responsibilities.

The alternative of creating a new organization and thereby more government, is not attractive either. However, new institutional and financial mechanisms will be required to forge effective public and private sector collaboration.

The Project design team has obtained agreement from all parties (RTG, TISTR) that the implementing mechanism will be a new independent sub-unit of TISTR, entitled to operate with all the authorities and flexibilities bestowed on TISTR by the Parliamentary Act in performing the designated functions, yet will be free from interference in its decision making by the TISTR officers and Board.

It has therefore been decided that a Science and Technology Development Board (STDB), with the desired characteristics and the authority to perform the requisite functions will be created under the authority of the TISTR Act of 1979 (included in Appendix 2). TISTR's Legislative Act would provide the necessary flexibility for STDB's operations. STDB would be granted certain exceptions from RTG regulations to give it the necessary flexibilities to carry out its functions in a timely manner. At the same time it would be linked with TISTR and through it with MOSTE, thereby enabling it to receive RTG funds and AID grants, as well as AID loan funds to RTG. It would receive its direction from its own Board of Directors representing a broad spectrum of public and private entities (for details, see Appendix 1).

STDB will be designed to manage all Project functions with a small staff to support each activity. This fixes responsibility for line functions clearly and practically. STDB will have the ability to disburse funds and act promptly by its delegated authority as outlined in Appendix 1.

In an effort to attract highly qualified professionals to STDB's staff, salaries competitive with the private sector will be offered to candidates selected for employment. It is envisaged that the professional staff would not exceed 20 individuals with expertise in the S&T related areas necessary to effectively implement this Project. Additionally, STDB will be supported by a Technical Advisory Committee and both long and short term technical services as described in Appendix 1 and in the Implementation Plan section of this paper.

As STDB will not be conducting operational Project activities such as RD&E, the management capabilities of the principal organizations involved will be very important. Examples of institutions with RD&E management capability include Kasetsart, Khon Kaen, Chulalongkorn, Chiang Mai, Prince of Songkhla and Mahidol Universities as well as TISTR, TDRI, KMIT and NIDA, among others. This capability has been confirmed through other USAID financed activities such as BOSTID research grants, the Khon Kaen University Research Development Project and the Agricultural Technology Transfer Project and visits to all of the institutions by Project design experts during June 1984 to January 1985. Impressive levels of competence have been observed in multidisciplinary fields of RD&E both through individual and collaborative efforts. For further details, see Annex G - Technical Analysis.

In summary, the adminstrative structure selected for the implementation mechanism answers the three critical issues (Page 2 above) as follows:

1) the implementing organization (STDB) will be operating under the legal framework of a state enterprise (TISTR) that will have been given

additional flexibility to allow selective exemption from those RTG regulations that would inhibit prompt performance of its assigned functions. However, TISTR as presently organized, is not operationally suited to act as the implementing agency.

2) An existing institution (TISTR) will provide the legal corpus for the STDB. However, the STDB will be a newly created sub-unit of TISTR, with independence from the board and officers of TISTR with respect to the performance of its assigned functions. The only action required to create STDB is passage of a resolution to do so by the Board of TISTR at one of its regular monthly meetings. Funding can then be provided by MOSTE and recruitment of staff can begin.

3) It is clear that the functions assigned to STDB be continued, but the administrative and organizational structure may subsequently take a different form (e.g. a private foundation). The RTG is understandably reluctant to establish a permanent entity at this time, which may later be difficult to dismantle. Given the scarcity of models available to guide the design team in structuring this highly innovative, broad scoped, multisectoral activity, it has been concluded that the STDB approach offers the greatest chance for success in initiating this activity. It is anticipated that the evaluation, scheduled for 1989 will provide a basis for determining the future course and structure of STDB.

The establishment of STDB as proposed, should permit the successful administration of this Project.

Appendix 1

Science and Technology Development Board (STDB)

I. OBJECTIVES

The objectives of STDB will be to:

. advance the scientific and technological development of Thailand, particularly in those areas which will result in improved industrial processes and products,

. enhance the RD&E capacity of Thailand's private and public sector S&T organizations,

. foster public sector RD&E efforts to serve the real needs of the private sector,

. promote the private sector use and application of RD&E, particularly that of Thai S&T organizations,

. provide a forum to enable private and public sector (within various ministries) S&T organizations to come together in resolving technology related constraints to development,

. provide financial mechanisms to enhance private and public sector joint efforts including domestic and foreign joint ventures in the development and commercialization of technologies, and

. administer Project funds inclusive of US Loan, Grant and RTG contributions.

II. FUNCTIONS

The functions of STDB will be to:

. perform as a decision-making body;

. establish and fund services and programs to address priority S&T needs;

. set its own priorities, criteria and operating procedures;

. survey RD&E needs and solicit expressions of interest from the private sector to participate in RD&E activities;

. invite, commission, fund, monitor and direct RD&E activities;

. promote and fund private and public sector Thai and foreign joint venture RD&E activities;

- establish a fund to finance company-directed RD&E activities;

- act as a funding conduit for the public and private sector organizations to perform RD&E;

- market RD&E results, obtain title to intellectual rights when appropriate, sell/license these rights or take equity, collect revenues and share royalties with RD&E institutions and researchers;

- set user charges for services rendered;

- set its own personnel policies inclusive of recruitment and dismissal, remuneration and benefits;

- prescribe its own contracting, procurement and sales rules and regulations; and

- exercise any powers necessary or incident to the exercise of the powers above enumerated.

III. ORGANIZATION

The STDB shall be established under the authority of the 1979 TISIR Act. The STDB shall have a private and public sector Board of Directors and Executive Committee, a Project Director, a Technical Advisory Committee, and such other officers, staff and panels/committees as may be considered necessary by the Board of Directors.

1. Board of Directors

The Board shall consist of at least twenty (20) but not more than thirty (30) members. The Minister of the Ministry of Science, Technology and Energy shall serve as the Chairperson of the Board. Unless otherwise indicated, other members of the Board will be comprised of one representative each from the following agencies and organizations: Ministry of Science, Technology and Energy (4 members), Ministry of University Affairs, Ministry of Agriculture and Cooperatives, Ministry of Industry, Ministry of Public Health, Council of University Rectors, Board of Investment, Industrial Finance Corporation of Thailand, Thai Bankers Association, Association of Thai Industries (3 members), National Economic and Social Development Board, Ministry of Finance, DTEC, Budget Bureau, Council of Science and Technology Associations of Thailand (2 members) and the Thai Chamber of Commerce. The Project Director will serve as a non-voting member and Secretary to the Board. Representatives from other organizations may be appointed as members at the discretion of the Board. At least one-third of the members on the Board shall represent the private sector. Each ministry, public agency and association shall be free to appoint its own representatives. The Board shall meet at least once a year.

2. Executive Committee

The Board shall appoint an Executive Committee from its membership comprised of nine (9) members. The members of the Committee will include four representatives from the private sector, two from MOSTE and one each from the Ministry of Finance, NESDB and DTEC. The Chairmanship of the Committee, decided upon by the Board, will alternate between the public and private sectors on a biennial basis.

The Committee shall meet at least four times during the year. The Executive Committee shall exercise broad powers in managing the activities of the STDB, and these powers shall be delegated to the Project Director for effective implementation.

3. Project Director, Deputy Director, Officers and Staff

The Director shall not be a civil servant, or be a political official or hold a political office or receive compensation from other sources. The Director shall be appointed by the Executive Committee. The actual appointment of the Director will be contingent upon the Board of Directors' concurrence by postal ballot. The Deputy Director, remaining officers and staff shall be recruited by the Director and subject to approval by mechanisms established by the Executive Committee of STDB. Long and short term contract personnel will provide technical and managerial support in strengthening operations.

Technical Advisory Committee

A Technical Advisory Committee shall be appointed by the Executive Committee to render advice on technical matters. The Committee of seven (7) experts shall be composed of private and public sector Thai and expatriate representatives as follows:

MOSTE Representative
NAS Team Leader (Advisor to the Committee)
3 Private Sector Representatives
Ministry of University Affairs Representative
Chief, RD&E Office
USAID Science Advisor (observer)

The Technical Advisory Committee's recommendations shall merit the highest consideration by the Executive Committee. The Technical Advisory Committee shall have the power to appoint Technical Review Panels to assist the Committee on technical matters. Technical review panels will be established for bioscience/biotechnology, materials technology and applied electronics technology. Each panel will consist of 3 technical experts in the field encompassing the specific RD&E proposal being reviewed. There will be a Thai private sector technical expert, a Thai public sector technical expert, and an NAS short term technical expert. The RD&E Office will backstop the panels.

Transitory Provisions

Immediately following the establishment of STDB, appointments shall be made to the Board of Directors which in turn shall appoint the Executive Committee from its membership.

Until such time as the Project Director is able to recruit employees, the officers and staff may be seconded on a temporary basis, to STDB by the Ministry of Science, Technology and Energy and other agencies of the Government.

Figure 5 (J)

ORGANIZATION STRUCTURE OF STDB

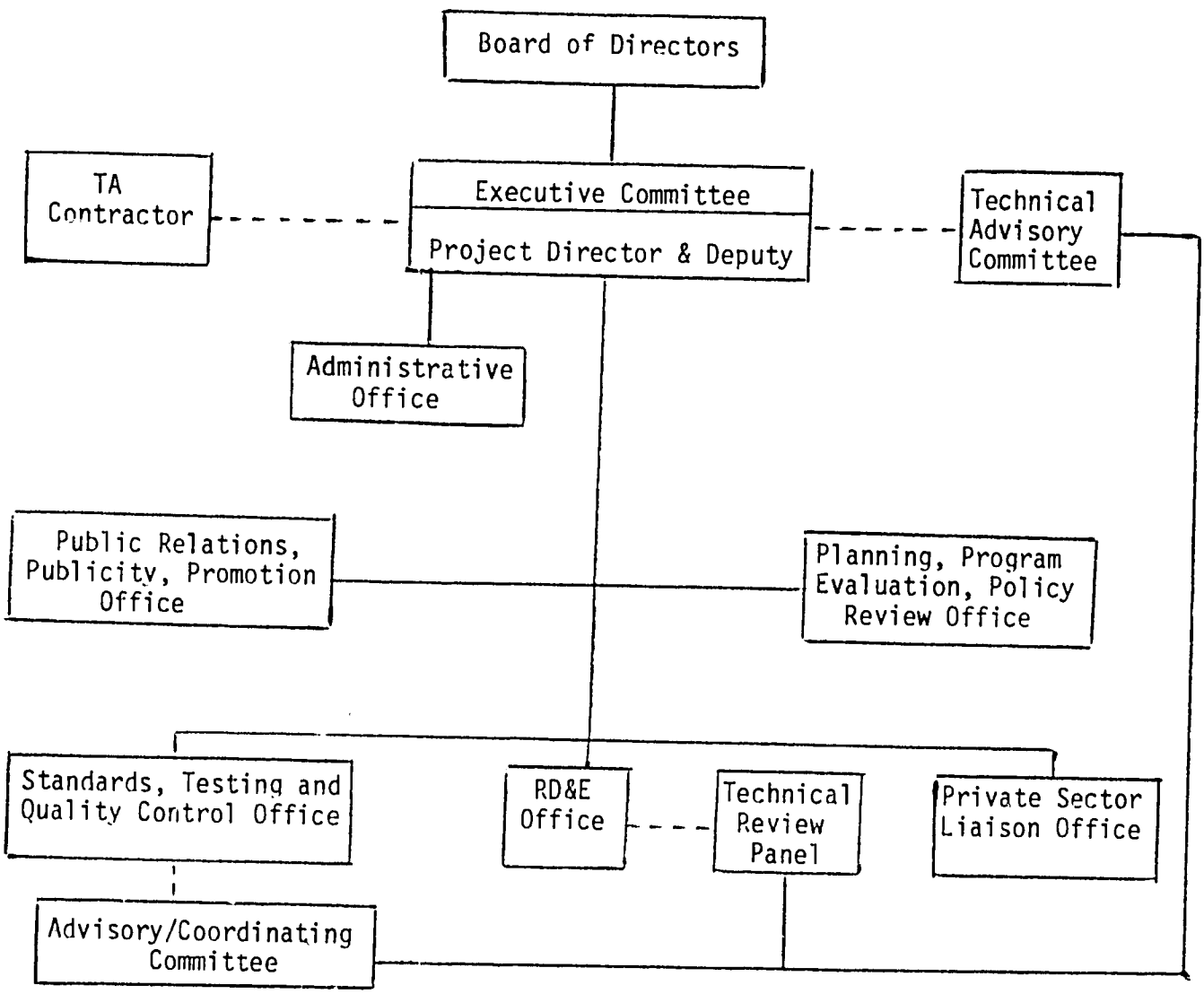
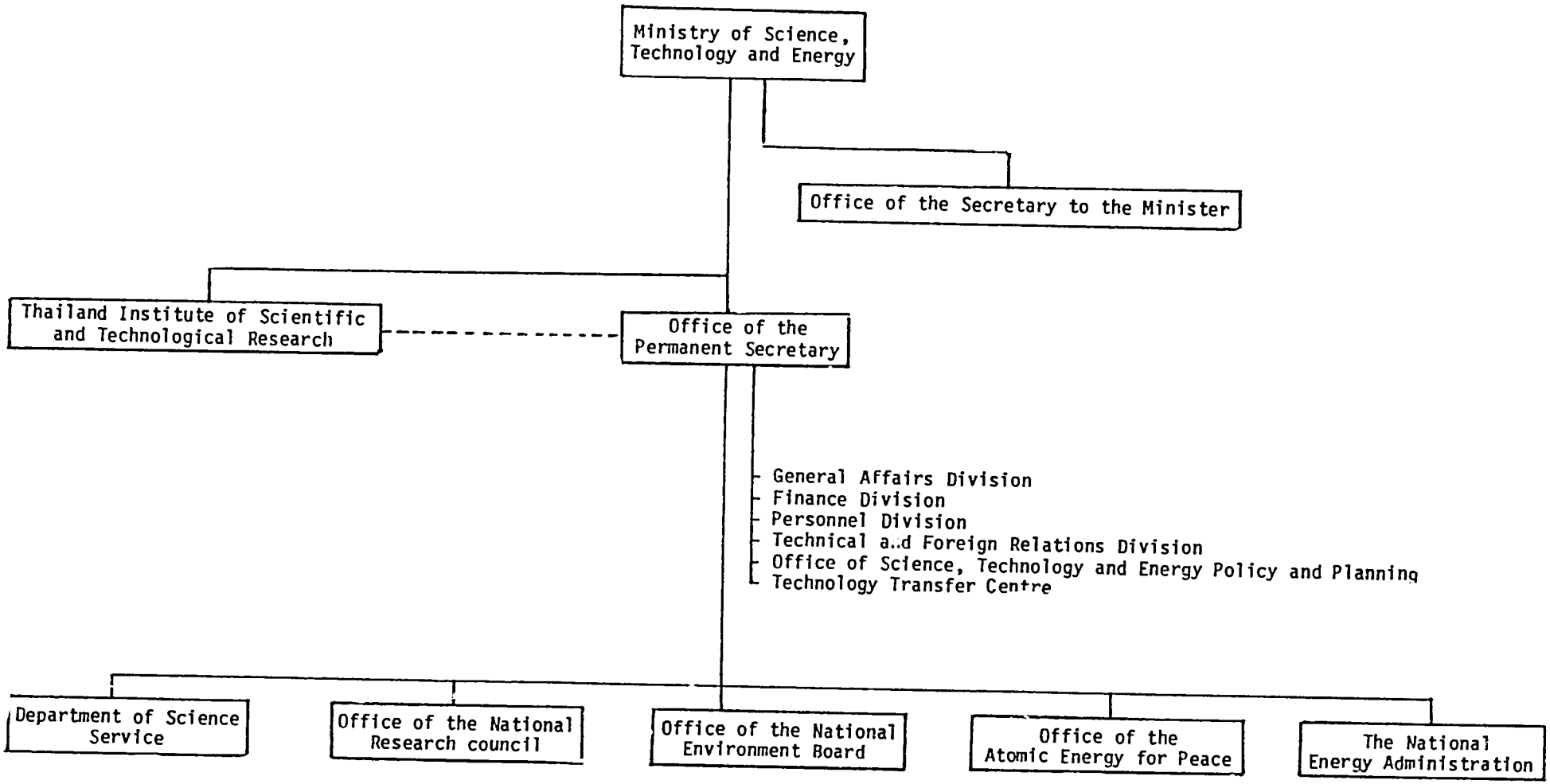


Figure 6 (J)


Ministry of Science, Technology and Energy
Office of the Secretary to the Minister
Thailand Institute of Scientific and Technological Research
Office of the Permanent Secretary
General Affairs Division
Finance Division
Personnel Division
Technical a..d Foreign Relations Division
Office of Science, Technology and Energy Policy and Planning
Technology Transfer Centre
Department of Science Service
Office of the National Research council
Office of the National Environment Board
Office of the Atomic Energy for Peace
The National Energy Administration

(Organizational Structure)

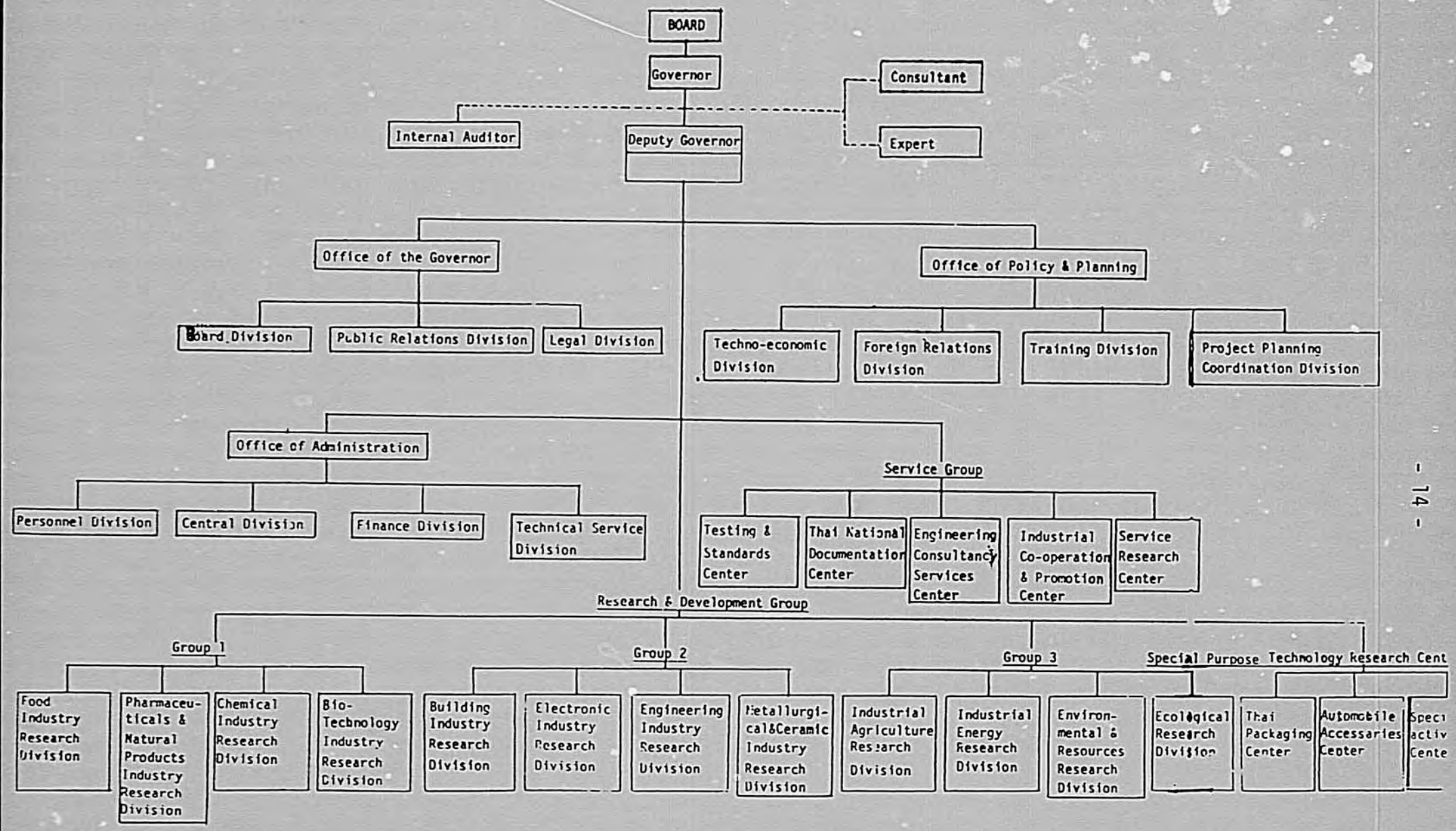


Figure 7 (J)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH ACT, B.E. 2522 (1979)

BHUMIBOL ADULYADEJ, REX.,

Given on the 25th day of February B.E. 2522;

Being the 34th Year of the Present Reign.

His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that:

Whereas it is expedient to revise the law on Applied Scientific Research Corporation of Thailand

Be it, therefore, enacted by the King, by and with the advice and consent of the National Legislative Assembly acting as the National Assembly as follows:

Section 1. This Act is called the "Thailand Institute of Scientific and Technological Research Act, B.E. 2522".

Section 2. This Act shall come into force as from the day following the date of its publication in the Government Gazette.*

Section 3. The Applied Scientific Research Corporation of Thailand Act, B.E. 2506 slall be repealed.

Section 4. In this Act:

"Institute" means Thailand Institute of Scientific and Technological Research;

"Board" means the Board of Thailand Institute of Scientific and Technological Research;

"Governor" means the Governor of Thailand Institute of Scientific and Technological Research;

"scientific and technological research" means the scientific and technological study or discovery as well as the development of the results of the study or discovery in order to effect appropriate practical benefit to the economic, social and environmental development of the country;

"Minister" means the Minister having charge and control of the execution of this Act.

*Published in the Government Gazette Vol. 96, Part 40, Special Issue, dated 23rd March B.E 2522 (1979)

Section 5. The Minister of Science, Technology and Energy shall have charge and control of the execution of this Act.

CHAPTER I

Establishment, Objectives, Powers and Duties

Section 6. There shall be established an institute called "Thailand Institute of Scientific and Technological Research" which shall be a juristic person having the following objectives:

(1) to initiate and conduct research and to provide scientific and technological services for economic and social development of the country to state agencies and private enterprises;

(2) to conduct scientific and technological research in order to promote the utilization of natural resources appropriate for the economic condition, environment, health and welfare of the people;

(3) to encourage the increase of product in accordance with the Government policies by propagating the results of scientific and technological research for use in creating benefit for the country in agriculture, industry and commerce;

(4) to train scientific and technological researchers;

(5) to provide for the testing and measuring services and other scientific and technological services.

Section 7. The Institute shall have the power and duty to carry out matter within the scope of its objectives as specified in section 6, which shall include the power and duty;

(1) to sell, construct, procure, transfer, accept transfer, hire, let, buy or sell on hire-purchase, exchange, have ownership, possessory right or real right, and dispose of movable or immovable properties within and outside the Kingdom as well as accept property granted or donated to it.

In the case of disposing immovable property, it shall require prior approval of the Council of Ministers;

(2) to accept the remuneration for research and fees for services rendered within the power and duty of the Institute as well as to conclude an agreement and prescribe conditions relating to such remuneration and fees;

(3) to establish, operate and improve the agencies for scientific and technological research;

(4) to co-operate with other agencies, whether they are state or private agencies, with respect to the activities relating to scientific and technological research and utilization of the research results;

(5) to provide for and maintain the national physical standards for the purpose of measuring various quantities and qualities;

(6) to collect and propagate the scientific and technological information;

(7) to publish scientific and technological documents as well as processes in or relating to the science and technology and other documents relating to the work of the Institute;

(8) to borrow, lend with sureties or securities, or invest; provided that it is for the scientific and technological research only.

Each borrowing, lending or investing, if being in excess of five million Baht, shall require prior approval of the Council of Ministers.

(9) to co-operate with other countries, organizations or other foreign agencies in scientific and technological activities;

(10) to provide for and grant scholarships and scientific and technological research fellowships.

Section 8. The incomes of the Institute are

(1) subsidies allocated by the Government;

(2) financial aids from other sources and money donated to it;

(3) remuneration and fees received under section 7 (2);

(4) interests and other benefits derived from lending money, investment and property of the Institute;

In the case where the income is insufficient to meet operating cost of the Institute and other appropriate charges, and the Institute is unable to obtain money from other sources, the State shall allocate money to the Institute in such amount as may be necessary.

Section 9. The Institute shall open an account with a bank in accordance with the rules of the Board as approved by the Ministry of Finance.

Section 10. Property of the Institute shall not be subject to the execution of judgments.

CHAPTER II

Supervision, Control and Management

Section 11. The Minister shall have the power and duty to exercise general supervision of the activities of the Institute. For this purpose, he may order the Institute to furnish statement of facts, opinion, to submit reports or to refrain from carrying out any act which is contrary to the policy of the Government or the resolutions of the Council of Ministers, and has the power to order that an act be carried out in compliance with the policy of the Government or resolutions of the Council of Ministers and to order an inquiry into facts concerning the conduct of works.

Section 12. Any matter to be submitted to the Council of Ministers under this Act shall be submitted through the Minister.

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Section 13. There shall be a Board of Thailand Institute of Scientific and Technological Research, to be called "B.S.T." in brief, consisting of a Chairman, Secretary-General of the National Economic and Social Development Board, Secretary-General of the National Research Council, Secretary-General of the Board of Investment, Governor and not more than six qualified persons, as members.

The Governor shall be secretary of the Board.

The Minister shall appoint the Chairman, Governor, and qualified persons upon advice of the Secretary-General of the National Economic and Social Development Board, Secretary-General of the National Research Council and Secretary-General of the Board of Investment.

The Minister may appoint not more than five other qualified persons as advisers of the Board.

Section 14. The Board shall have the power and duty to lay down policies for general management, control and supervision and shall be responsible for the activities of the Institute, which shall include the power and duty to:

(1) to prescribe the number of positions, salary scales, wages and other remuneration of the officers and employees;

(2) to issue regulations on recruitment, appointment, increase of salaries or wages, removal from office, disciplinary measures, punishment and appeal against punishment for officers and employees;

(3) to issue regulations on petitions of officers and employees;

(4) to issue regulations on the aid fund or other aids for the welfare of officers and employees and their families;

(5) to issue regulations on the finance of the Institute;

(6) to issue other regulations on the conduct of works of the Institute.

In carrying out the aforementioned powers and duties, the Board may entrust the Governor to carry out the works in accordance with the regulations prescribed by the Board.

Section 15. Qualified members shall be appointed from among persons with knowledge and experience in science, technology or other branch relating to scientific and technological research.

Section 16. The Chairman and qualified members must:

(1) be of Thai nationality;

(2) not be over sixty-five years of age;

(3) not be a bankrupt;

(4) not be an incompetent or quasi-incompetent person;

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(5) not have been imprisoned by a final judgment or lawful order to a term of imprisonment, except for an offence commited through negligence or petty offence;

(6) not be a political official nor hold a political position;

(7) not be an officer or employee of the Institute except for the person holding the office of Governor;

(8) not have direct or indirect interest in any contract made or business done with the Institute except for being the shareholder for the purpose of *bona fide* investment in the company making the contract or doing the business with the Institute.

Section 17. The Chairman, qualified member or adviser shall hold office for a term of two years.

In the case where the Chairman, qualified member or adviser vacates office before the expiration of his term, the person appointed to replace him shall hold office for the remaining term of the person he replaces.

In the case where the Minister appoints an additional qualified member or adviser during the term of appointement of the qualified members or advisers, the appointee shall hold office for the remaining term of the qualified members or advisers already appointed.

The outgoing Chairman, qualified member or adviser may be re-appointed.

Section 18. Apart from vacating office at the expiration of the term under section 17, the Chairman, qualified member or adviser vacates office upon:

(1) death;

(2) resignation;

(3) being removed by the Minister on the ground of misconduct;

(4) lacking any qualification or being under any prohibition under section 16.

Section 19. At a meeting of the Board, if the Chairman does not attend or is not present at the meeting, the meeting shall elect one among the present members to preside over the meeting.

Section 20. At every meeting of the Board, the presence of not less than one-half of the total number of members is required to constitute a quorum.

The decision of the meeting shall be by majority of votes. Each member shall have one vote; in case of an equality of votes, the person presiding over the meeting shall have an additional vote as the casting vote.

Section 21. The Board may appoint a sub-committee to carry out any matter as entrusted by the Board.

In the meeting of a sub-committee, section 19 and section 20 shall apply *mutatis mutandis*.

Section 22. The Governor shall be appointed from among the persons qualified in science or technology.

Section 23. The Governor must

(1) not be over sixty years of age;

(2) devote full time to the Institute;

(3) not be a Government official, local official or political official nor hold a political position including member of the local assembly and local administrator;

(4) possess qualifications and not be under any prohibition under section 16 (1) (3) (4) (5) or (8).

Section 24. The Governor shall hold office for a term of five years.

The outgoing Governor may be re-appointed.

Section 25. Apart from vacating office at the expiration of the term under section 24, the Governor vacates office upon:

(1) death;

(2) resignation;

(3) being removed by the Minister on the ground of negligence of duty, misconduct or inability;

(4) lacking any qualification or being under any prohibition under section 23.

Section 26. The Governor has the power and duty:

(1) to administer the activities of the Institute in accordance with the law, regulations and policies prescribed by the Board, and to be the superior official of all officers and employees;

(2) to be responsible for the management and operation of the Institute as entrusted by the Board;

(3) to communicate, exchange knowledge and co-operate in respect of scientific and technological research with state agencies, organizations, institutions or persons within and outside the country;

(4) to seek popularity and recognition for the Institute as well as to procure scholarships from various sources for the interest of the operation of the Institute;

(5) to recruit, appoint, remove, promote or reduce or cut the salary of, as well as impose disciplinary punishment on the officers and employees in accordance with the regulations prescribed by the Board; provided that in the case where such officer or employee is of the rank of Deputy Governor, chief of a division, adviser, specialist or the equivalent thereto, a prior approval must be obtained from the Board;

(6) to prescribe rules on the conduct of works of the Institute, in so far as they are not contrary to or inconsistent with the regulations prescribed by the Board;

(7) to entrust the officers to act on his behalf with the approval of the Board.

Section 27. In respect of its external relations, the Governor shall act as representative of the Institute, and for this purpose, the Governor may delegate the power to any person to execute a specific work on his behalf in accordance with the regulations prescribed by the Board.

Section 28. The Chairman, Governor, qualified members, advisers and members of sub-committee shall receive remuneration as prescribed by the Council of Ministers.

Section 29. A discovery, invention and improvement in the process, equipment and machinery made by the person employed by the Institute and also the rights in all these things, shall become the property of the Institute; provided that they shall not affect the right of the third party under a juristic act made with the Institute.

CHAPTER III

Appeal and Aids

Section 30. The officer and employee shall have the right to petition and appeal against punishment in accordance with the regulations prescribed by the Board.

Section 31. The Institute shall establish an aid fund or other aids for the welfare of the officers and employees and their families in the event of retirement, accident, sickness, death or other cases deserving aids.

The establishment of an aid fund or other aids under paragraph one, contribution to the aid fund, classification of eligible persons to receive aids, payment of the aid fund and the administration thereof shall be in accordance with the regulations prescribed by the Board with the approval of the Council of Ministers.

CHAPTER IV

Accounting and Auditing

Section 32. The Institute shall set up and maintain an appropriate accounting system, classifying the main categories of works, and keep books of accounts with entries of receipts and expenditure, assets and liabilities, which shall represent the actual and appropriate conditions in accordance with their categories together with the particulars which are the sources of such entries. There shall be internal audit of accounts at regular intervals.

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Section 33. The Institute shall prepare and submit a balance-sheet, working account and profit and loss account to the auditor within one hundred and twenty days after the end of accounting year.

Section 34. The Office of the Auditor-General shall be auditor of the Institute, and shall audit, examine and certify all categories of accounts and finance of the Institute for each fiscal year.

Section 35. The auditor has the power to examine all books of accounts and documents of the Institute. For this purpose, he shall have the power to interrogate the Chairman, members of the Board Governor, officers and employees of the Institute.

Section 36. The auditor must submit a report on the result of the audit with respect to the accounts and financial standing to the Board within one hundred and fifty days after the end of the accounting year in order that it may be submitted by the Board to the Minister

The Institute shall publish the annual report of the preceeding year, showing the balance-sheet, working account, and profit and loss account duly certified by the auditor together with the achievement of the Institute in the preceeding year and the future working plan for the coming year within one hundred and eighty days after the end of accounting year.

Transitory Provisions

Section 37. All the powers and duties of Applied Scientific Research Corporation of Thailand under the Applied Scientific Research Corporation of Thailand Act, B.E. 2506 shall be transferred to Thailand Institute of Scientific and Technological Research under this Act.

Section 38. All activities, properties, liabilities, officers and employees of Applied Scientific Research Corporation of Thailand Act, B.E. 2506 shall be transferred to Thailand Institute of Scientific and Technological Research under this Act. The said officers and employees shall hold the same offices and receive the same salaries or wages in accordance with the offices and the salary or wage rates as those held or received on the date of the publication of this Act in the Government Gazette, and the status and period of employment of the officers or employees so transferred shall be regarded as continuing without interruption.

Section 39. The Board of Applied Scientific Research Corporation of Thailand which is in office on the date of the publication of this Act in the Government Gazette shall continue to be in office until new Board members are appointed under section 13.

Section 40. The Governor of Applied Scientific Research Corporation of Thailand holding office on the date of the publication of this Act in the Government Gazette shall continue to be in office untila new Governor is appointed, and the Governor shall proceed with the appointment to Board members by the Minister under section 13 not later than ninety days as from the date this Act comes into force.

Section 41. All regulations issued under the Applied Scientific Research Corporation of Thailand Act, B.E. 2506 which are in force on the date of the publication of this Act in the Government

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Gazette shall continue to be in force, in so far as they are not contrary to or inconsistent with the provisions of this Act until the regulations issued hereunder shall come into force.

Countersigned by:

S. Hotrakitya

Deputy Prime Minister

Certified correct translation

Taksapol Chiemwichitra

(Taksapol Chiemwichitra)

Office of the Juridical Council

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ANNEX K

CRITERIA AND OPERATING PROCEDURES FOR RD&E ACTIVITIES

I. CRITERIA AND OPERATING PROCEDURES

A. Designated RD&E Activities

1. Criteria which Must be Met

. proposals are technically appropriate, cost effective and socially sound,

. institutions have the basic human and physical resources for successful development of the activity, or show evidence that such will be realized during implementation,

. institutions are appropriately located, both in terms of raw material availability, and in terms of organizations to provide inputs,

. institutions show evidence of interaction with the private sector or other end-users or have documented their plans to bring about and maintain that interaction, and

. proposals show evidence of strong administrative and institutional support.

2. Criteria which will Bring Additional Consideration

Preference will be given to proposals which meet most of the following requirements:

. projects demonstrate potential for creating employment opportunities,

. projects are centered around individuals with evidenced outstanding abilities or have documented plans to recruit highly qualified outstanding individuals,

. proposals show evidence that the institutions are appropriately linked with external institutions with established excellence in similar topics and technologies,

. proposals show plans to disseminate and enhance the use and state of the technology, and

. program activities have potential for ongoing support or future self-sufficiency.

3. Operating Procedures for Designated RD&E Activities

. proposals will be submitted in accordance with suggested format (to be developed), identifying all costs inclusive of any TA and/or equipment needs,

. these proposals will be submitted to the RD&E Division within STDB,

. the STDB RD&E Office will do the initial screening and then send to the Technical Advisory Committee (TAC). TAC will review the RD&E plans submitted and convene the appropriate Technical Review Panel (TRP),

. the TRP's will screen all proposals and make recommendations to the TAC,

. the TAC will review the TRP recommendations and make final recommendations to the STDB Executive Committee, and

. the STDB Executive Committee will review for concurrence and direct the RD&E Office to prepare the notification and grant signing documents.

A formula will be developed for sharing intellectual rights of patentable developments, between STDB, the investigators and the parent RD&E institution.

B. COMPETITIVE RD&E ACTIVITIES

All competitive RD&E activities will be handled in a two step process. Using criteria and operating procedures outlined below, problems to be focused on will be chosen first and then the appropriate RD&E institutions will be invited to submit proposals.

1. Criteria Essential for Selection of Problem Areas

. problem solution will result in new/improved process(es) and/or product(s),

. problem solution is appropriate in view of Thailand's existing or potential resource base,

. problem solution will improve the state-of-the art technology currently present in Thai industry,

. problem reflects an actual, real or demonstrable need,

. problem pertains to the current focus and technical areas that have been prioritized for this Project,

. problem can be clearly defined,

. problem has company/industry or other end-user expressed willingness to participate in activity,

. problems have relevance to generating employment opportunities, and

. problems have relevance to other development needs (i.e., increasing export, expanding equity/income distribution, or will contribute to a more regionally balanced industrial growth).

2. Criteria which will Bring Extra Consideration to Selection of Problem Areas

. problem has company/industry expressed willingness to provide monetary support,

. problem solution will have spread effect,

. problem solution will have downstream investment potential,

. problem area is currently causing annual economic loss significantly greater than estimated cost of anticipated remedial RD&E,

. problem area has the potential to significantly impact annual sales, cost-savings and/or productivity,

. policy constraints impacting problems have recently been at least partially removed by RTG, and

. problem has been proposed by small/medium scale rural industries in non-Bangkok areas.

3. Criteria to Evaluate Competitive RD&E Proposals

a. Criteria which Must be Met (Evaluating Proposals)

Technical assessment

. approach being recommended is technically sound,

. technological understanding is at stage of maturity where finite input can potentially result in crucial progress,

. principal investigator has demonstrated a clear understanding of the problem, and

. principal investigator and collaborators are collectively professionally capable of achieving success, or if a deficiency exists, it is covered by a plan to correct it.

Economic assessment

. approach recommended seems to be the most cost-effective for either short or long-term gains,

. total costs seem satisfactory and reasonable,

. individual cost estimates are realistic, in line with local norms, and

. facilities, on hand, are adequate and equipment is adequate or appropriately budgeted.

Social assessment

. approach as submitted is socially sound.

Participation assessment

. RD&E proposals contain a clear plan to effectively involve company/industry or government agency identifying the problem.

b. Criteria Which Will Bring Extra Consideration (Evaluating Proposals)

. proposals demonstrate optimal use of labor,

. proposals show that users will collaborate or effectively use results,

. company/industry agrees to invest some of its own resources in the proposed project (in terms of percentage of cost of RD&E),

. company/industry is willing to participate (i.e., personnel assigned) in RD&E project, and

. projects are centered around individuals with outstanding qualifications and proven records of performance.

4. Procedures

Identification and Selection of Problems

a. This aspect of the Project will be widely publicized by the STDB Office of Public Relations and Publicity.

b. Problems will be solicited from private and public sector organizations or individuals in a suggested format (to be developed).

c. RD&E Office of STDB does the initial screening.

d. All remaining steps are as previously described on page 2.

Invitation of RD&E Proposals

a. The STDB Office of Public Relations and Publicity will widely publicize the selected problem areas of the RD&E activity and invite proposals in suggested format (to be developed).

b. All remaining steps are as previously described on page 2.

Use of Technology Developed or Tranferred

When revenue-recovery potentials evolve, the benefits will be shared between STDB, the participating organization, and the individual (formula to be developed).

C. COMPANY-DIRECTED RD&E

1. Criteria for Company-Directed RD&E Loan Application Review

a) The Borrower:

. has applied technical consulting services (either in-house or external) to diagnose his problem and has produced a research design to solve the problem;

. has financial and technical capacity to apply solution developed by proposed research in his production process (i.e. undertake necessary investment);

. is prepared to contribute at least 50% of cost of proposed research in cash or in-kind; will guarantee repayment of the loan principal and interest if research project fails or succeeds ; and will agree to pay 1% of sales revenue out of production/sales as royalty to STDB as its share of the intellectual property rights if research project succeeds (or 25% of sale of rights);

. has had satisfactory banking and credit experience; is not subject to civil or criminal action which may effect his ability to satisfy his commitments;

. is a member in good standing of Association of Thai Industries.

b) The Proposed Applied Research/Technology Development Effort

. falls within the Project technical priority areas;

. contributes towards enlarging employment opportunities;

. if successful would result in a commercially viable product for which the market demand, (size and price limits) have been tested;

. is designed to be accomplished within realistic cost estimates; equipment/facilities needed are available;

. would seek to apply the results of completed research and/or adapt a known and tested technology to conditions applicable to Thailand;

. would utilize technology appropriate to Thailand;

. would focus, if possible, on products which would achieve foreign exchange savings or earnings at a level of effective protection consistent with the Thai tariff policy under the structural adjustment program;

. would enhance Thailand's capacity to perform RD&E thereby contributing to Thailand's self-reliance in S&T.

Procedures

Proposals which give assurance of 50% company financing will normally receive favorable consideration. However, the implementing agent for the program, one of Thailand's financial intermediaries, will be asked to evaluate proposals using the following criteria to the extent they are applicable to assure that the objectives of the program are being served.

- level of government laboratories' involvement in proposal;
- economic benefit to Thailand;
- potential market;
- qualified company management;
- enhancement of company R&D capability;
- level of company commitment;
- social benefits to Thailand;
- level of technical and commercial risk;
- coincidence with national priorities;
- advancement of scientific knowledge;
- contribution to Thai regional development.

The RTG has established a special fund to provide loan financing for private sector RD&E. The current Thai annual budget allocates Baht 15 million to the MOSTE for this purpose. AID funds in an equivalent amount ($550,000) will be made available each year to the STDB. The AID funds will be administered jointly with the MOSTE loan funds and will be made available to private companies on a "venture capital" basis.

The fund would be titled in the STDB and operated for the account and risk of STDB by a Thai bank as their agent. Proposals submitted to the bank by Thai companies would be reviewed by the bank in accordance with the criteria described below together with normal bank lending practices.

There would be no "Peer Review", nor would there be a "competition" between different applicants for the available funds. Each application would be considered on its own merits and approved or disapproved in the same manner that banks normally handle applications for loans.

The research may be performed within the borrowers own facilities or in laboratories selected by the borrower (private, university or public sector). The approach is similar in concept and purpose (although not in its mechanics) to the Canadian "Program for Industry/Laboratory Projects" (PILP). It is designed to encourage companies to take advantage of technology in the form of scientific and engineering knowledge and resources existing within government laboratories and universities. It is hoped that university and public sector labs will market their services to the private sector in order to gain access to these funds, thereby forging new institutional linkages and developing an attitude towards the private company as their "client". Enforceable confidentiality agreements will have to be developed to assure that the results of the research will remain the property of the client.

The company would agree to meet 50% of the research project costs with its own resources if the project is approved. 25% of the research cost would be financed with RTG loan funds at 10% APR, the RTG prescribed rate of interest. The remainder (25%) of the cost would be financed with AID funds. These AID funds will be provided by STDB to the company as a credit to be utilized for specified costs of the research Proposal. Payment will be made directly by the banking agent of STDB to the supplier of the services upon authorization. This investment of funds by STDB will entitle STDB to a 25% equity interest in any intellectual property rights derived from the RD or E. STDB may pass on these rights, or a portion of them, to the participant university or government RD&E laboratory.

The AID funds would buy a 25% interest in the results of the RD&E work. If successful, the company would pay royalties to STDB. If the RD&E work results in failure, the company would have no further obligation to STDB, other than repayment of the MOSTE loan.

The loan/grant will be serviced by a financial institution as agent for STDB. It is hoped that the repayment formula for the RTG funds incorporated in the "criteria" plus the equity interest acquired by STDB through use of the AID funds, will result in a "no loss, no gain" for the fund. Given the anticipated loan duration (2-3 year grace for development period followed by 3-4 year repayment period) the RTG revolving fund will require capital of 6-7 times annual loan activity to sustain itself. The AID funds to be provided to the company will have to be replenished each year until royalty payments generated from successful activities are sufficient to sustain the effort. Further refinement or modifications in the terms of the incentive structure described above may result from subsequent discussions among USAID, STDB, and the agent bank. Initial experience with the program, in which company demand for such financing begins to manifest itself may also suggest desireable changes in the ratios of the different funding sources. It may also be possible to persuade the agent bank to take a participation in the loan. The program will be structured to allow for adequate flexibility to tailor the terms to suit the demand.

This Project budgets $9 million for this activity comprised as follows: AID loan $2.25 million; RTG loan 2.25 million; and private sector participation $4.5 million.

One can envision that any returns on the commercialization results of the designated research program and the competitive research program would be fed into the STDB fund over time. As the Thai industry develops confidence in the ability of Thai R&D efforts, one can expect increasing demand for funding from the fund for company-directed RD&E.

Joint ventures between US firms and Thai firms for technology development (along the lines of the US - Israel Binational R&D Foundation model) would also be eligible under this program. An additional requirement for promotion of such joint ventures would be a facility to assist Thai companies in locating suitable US partners for the joint venture. This service can be linked with the Technology Information Access Center. It has been shown that a most efficient manner to facilitate development of in-house company R&D is to encourage joint ventures between companies in LDC's in partnership with companies in developed countries that have their own R&D capacity, to engage in a joint research effort. The two companies would jointly manage the research, use each others facilities and personnel, sub-contract to others those aspects of the work that can be most efficiently performed outside, and share the rights to the output in some predetermined proportion.

ANNEX L

TECHNICAL INFORMATION ACCESS CENTER

I. STATEMENT OF THE PROBLEM

The industrialized nations, the United States among them, attest to the importance of knowledge in the development of their own economic and social systems. In these nations, application of scientific and technical knowledge is perhaps the key factor responsible for their present level of industrialization, rate of productivity, and standard of living. For the developing nations of the world, which are embarking on programs of national socioeconomic development, efficient access to existing knowledge resources is a matter of major importance.

In Thailand, there is a growing awareness of the importance of current information and the need for improved access to such data by all sectors of the economy. In a recent interview, reported in the Bangkok Post December 16, 1984, Dr. Anat Arbhabhirama, President of the newly created Thailand Development Research Institute (funded by a $3 million grant from Canadian Aid) said that TDRI was established to promote "policy research", as distinct from technical and scientific research and development. He stated, "TDRI will act as a treasury of information....." and will bring this knowledge together to aid the government in formulating its policy.

But there are other unmet or inadequately served information needs in Thailand, that are particularly relevant to the achievement of the development objectives of this Project:

a) Scientific and technical research is being undertaken in Thailand without adequate information about the results of other related research that has been completed or is underway in other countries;

b) "Buy or Make" decisions, with regard to undertaking problem solving research in Thailand, are being made without current and reliable data on the availability of technology in Thailand and/or other nations.

c) Investment decisions to purchase foreign technology are being made without adequate information about the technological choices available to the Thai investor and to their relative costs and benefits:

d) It is likely that investments in important economic sectors are <u>not</u> being made because of the investor's inability to obtain reliable information about the state-of-the-art and his perceived risk of undertaking an investment in a manufacturing process that may be obsolete or not appropriate to the Thai context.

Throughout the course of this Project design effort, examination has been made of the "felt need" or perceived demand for technical and scientific information in the private, academic and government sectors. Consistantly

individuals have expressed frustration at the absence of readily accessible, low cost information about local Thai technical capacities as well as technological choices available in the international markets. Different Thai organizations are attempting to respond to these needs by establishing piecemeal data bases, which if pulled together into a compatible network and complemented by a link to overseas information sources, might offer the kind of comprehensive data sought by them.

For example, separate micro data systems are now being established to collect and compile data about Thailand's producers by Ministry of Commerce Export Service Center, Department of Business Economics, Industrial Promotion Department, Board of Investment, NESDB, IFCT and numerous other organizations. The World Bank is financing, through the Board of Trade an industrial census of Thai producers. These efforts stem from a recognition that Thai investors, policy makers and researchers are operating in the dark and that the lack of complete and accurate information is costly to the concerned individuals, research organizations companies and to the economy as a whole.

The activities contemplated under this Project depend on access to both primary (bibliographic), and secondary (problem-oriented) databases. Much of this information is readily available at low cost in the US if one understands how to access the data, how to screen the data and interpret it in the context of the users needs, and is able to pursue the information trail until the users requirements are adequately met. A number of related activities have been inaugurated in Thailand over the past 20 years, (several financed by AID), to meet different aspects of this need. These efforts have met with varying degrees of success. The proposed "Technology Information Access Center" will build on and supplement existing facilities and services to create a modern information facility to provide reliable, low cost, high speed service to the Thai investment decision maker, whether he be in the private sector, in the academic research community or in government.

II. THE CONCEPT OF TIAC

The TIAC can be viewed as a "suspension bridge", with one pier in Thailand and the other in the US, linked by a high speed communication channel. The purpose of TIAC is to twofold:

a) to provide the Thai business and academic community with rapid and reliable access to technical, commercial and scientific information from overseas sources; and

b) to develop a comprehensive data base of similar information sources in Thailand.

The "pier" in Thailand would provide an access point for the Thai business and academic community to the vast and widespread technology data sources located in Thailand and abroad. It would utilize existing S&T data bases (TISTR's National Documentation Center; the compilers of various private and public trade and product manufacturing indeces, business publications,

government data sources, data from producers associations, etc.) and enhance these primary information sources with its own data base, to arrive at a comprehensive compilation of Thai S&T and production information, with an ability to retrieve that information rapidly.

The "pier" in the US would be a designated representative of the Thai TIAC who would secure access to the multifold networks of data bases and S&T information sources in the US. The designated representative would not create its own data base; rather it would build access to a network of information sources that would allow it to be responsive to requests from Thailand. Some of the sources will be automated, others will be human, and accessible via telephone.

The "link" between the two "piers" would utilize, as appropriate, special satellite channels, commercial telex, international courier service, and international mail. The objective would be to provide turn around service in 7 to 14 days from inquiry to full response. Facsimile transmission is expected to reach a speed of one second per page in two years. It should be possible, at that time to transmit technical literature from capital equipment suppliers, scientific literature from technical libraries and other such material from the source, or from the US representative's office to Thailand virtually instantaneously.

III. THE "PIER" IN THAILAND

There is, at this time, no reliable and comprehensive source of such information in Thailand. The TISTR "National Documentation Center", established in 1964, is a science library. Other science libraries are located in various universities. These libraries have only recently begin to utilize automated data processing technology to organize, store and retrieve their material. Each library operates independently and is not networked electronically with the others, making it difficult and time consuming for researchers to locate the required information.

Several Ministries whose responsibilities lie in support of Thailand's production, investment and trade have recently undertaken to establish ADP data bases. These include NESDB, Ministry of Commerce Business Economics Department, the Export Service Center, Ministry of Industry, Ministry of Agriculture, Board of Investment and Bank of Thailand. Much of the data contained in these data bases is company specific and therefore of a confidential nature. But the unrestricted segments of these records can form the basis of a comprehensive directory of Thai producers, such as the Thomas register in the US. Such a directory for Thailand would be exceptionally useful as a starting point to identify indigeneous technological capacities.

Private economic and industrial data bases may be found among the banking institutions (including International Finance Corp. of Thailand), Business Associations (such as the 1,000 member Board of Trade and the 1600 member Association of Thai Industries), and business publication houses (such as Business Publication of Thailand, Business Information and Research, Intertrade Publications of Thailand, International Business Research, etc.).

But there is no common pool or comprehensive data bank that can be accessed for a fee by the various users of such information, such as business houses or consulting firms. It is believed that a well organized data base on business related information, networked with other data bases in Thailand would serve several important development objectives in addition to facilitating access for the Thai industrial producer to foreign technological information.

A. Categories of Data

The TIAC would assemble information on its own data base, or secure electronic access to other data bases in Thailand, for the following categories of information:

Scientific Data

- S&T manpower, by speciality
- Laboratory facilities
- Research projects recently completed or underway

Production Data - for Thailand

- Company specific data by technical capacity[1]
- Employment by technical skills
- Private R&D facilities
- Industrial licenses issued, new investment and foreign collaborations
- Sales, exports,

Business and Professional Consulting Services

Industrial Standards and Testing Facilities

Macro Economic Data

Market Information

International Trade Data

Directory of Government Support Programs Available to Thai Industry

Investment and trade opportunities technology and trade fair participation opportunities, relevant data from BOI, Industrial Promotion Department, etc.

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1 The IBRD is currently funding an industrial census for the Ministry of Commerce, the study is being implemented by the Thailand Board of Trade, and is expected to be completed by end 1985.

B. Rural Outreach

ATI would use its own membership structure and make a special effort to develop other mechanisms to reach producers in cities other than Bangkok. In this connection it will make use of the EDP communication network which link the universities to the NDC. It will also develop means to link with other similar services to manufacturers located in the rural areas such as the UNIDO Project in Udorn.

IV. THE "PIER" IN THE US

In the US, a designated representative will act as "gatekeeper" for Thai inquiries. The gatekeeper will process all inquiries received from the TIAC in Thailand, utilizing in the first instance, automated data bases and then pursuing the appropriate channels of his network to produce a meaningful response for transmission to Thailand. Supporting the gatekeeper would be six part time consulting engineers with different specializations, kept on retainer to be available as needed to screen incoming requests, the proposed responses, and be in position to enhance the responses with information they can obtain through telephonic inquiries to the best sources of technical data available in the US, namely, the capital equipment manufacturers. Care will be taken to assure that the alternative technologies referred back to Thailand take into account factor costs in Thailand as they would effect labor or capital intensity.

The gatekeeper together with a small but well trained supporting staff would develop a sophistication to utilize, as appropriate, existing S&T information systems already available to those who know how to access them. He would also apprentice Thai personnel on a regular basis. These Thai personnel would return to staff the TIAC after completion of their training.

The US representative would also forward to TIAC, inquiries made by US companies about Thailand's technological capacities which might reflect opportunities for technological interchange or joint ventures.

US Information Systems to be accessed by the gatekeeper include:

Volunteers In Technical Assistance (VITA)

Individuals, institutions, and governments request technical information to solve common problems in developing countries. The information that is provided in response to specific requests is drawn from VITA's specialized collection of more than 40,000 documents, and from VITA's 4,000 volunteer experts. More than 3,000 requests are answered annually.

Each year VITA provides more than 150 technical consultancies and consultant name referrals to groups that need expert, on-site assistance.

Georgia Institute of Technology

Georgia Institute of Technology, which has received substantial support from AID, maintains an International Development Data Center containing

bibliographic holdings as well as technical experts who can respond to specific inquiries from LDC institutions. The Data Center specializes in solar energy, small industry development, light capital technology and related areas. At this time, the Center is implementing a program in Egypt for AID to establish a Technology Data Center.

National Technical Information Service

NTIS is a major general purpose bibliographic service supported by AID. It contains technical reports resulting from US government sponsored research as well as selected reports from cooperating institutions abroad.

US Department of Commerce

The trade opportunities program can locate US manufacturers of specified products. The Department of Commerce, with its commodity specialists and its field offices, can be an extremely useful source of information if one is sophisticated in accessing the system.

US Industry and Trade Associations

Industry and trade associations are repositories of a large variety of valuable information about their respective members and are useful in locating the appropriate companies that would be interested and qualified to collaborate with a Thai company to solve a particular problem or facilitate the transfer of a needed technology.

Control Data, Lockheed, Dvorkovitz and Associates and Other Private and Public Data Bases

A large number of private data bases can be accessed on a "for fee" basis by subscribers. A good planning figure is $50 per hour of access time. Dvorkovitz allows access to his system by LDC institutions without fee.

Industrial Research Institute (IRI)

IRI, located in New York City is a private association of 270 US corporations which represent approximately 85% (Dollar value) of US privately financed R&D. It has cooperated with the US government in developing links between foreign companies and US firms to undertake collaborative R&D.

International Executive Service Corps (IESC)

IESC, funded in part by AID, obtains the services of retired technical specialists and executives, on a volunteer basis, to assist LDC businesses with technical problems that occur in an operating context.

US Scientific Libraries and Public Data Bases

The Smithsonian Scientific Information Exchange, which assists clients in locating ongoing research in specified areas, should be accessible to TIAC.

Similarly, the US patent office and the National Library of Medicine, like many other US government agencies, have systems that can, at least theoretically, be accessed by TIAC.

UN Data Bases

It should be possible for the Bangkok and New York offices of the TIAC to gain direct access to the various data bases of the UN technical agencies.

V. STRUCTURE OF THE TIAC

TIAC must serve two primary sets of clients.

- It must serve the public and private sector research and academic community.

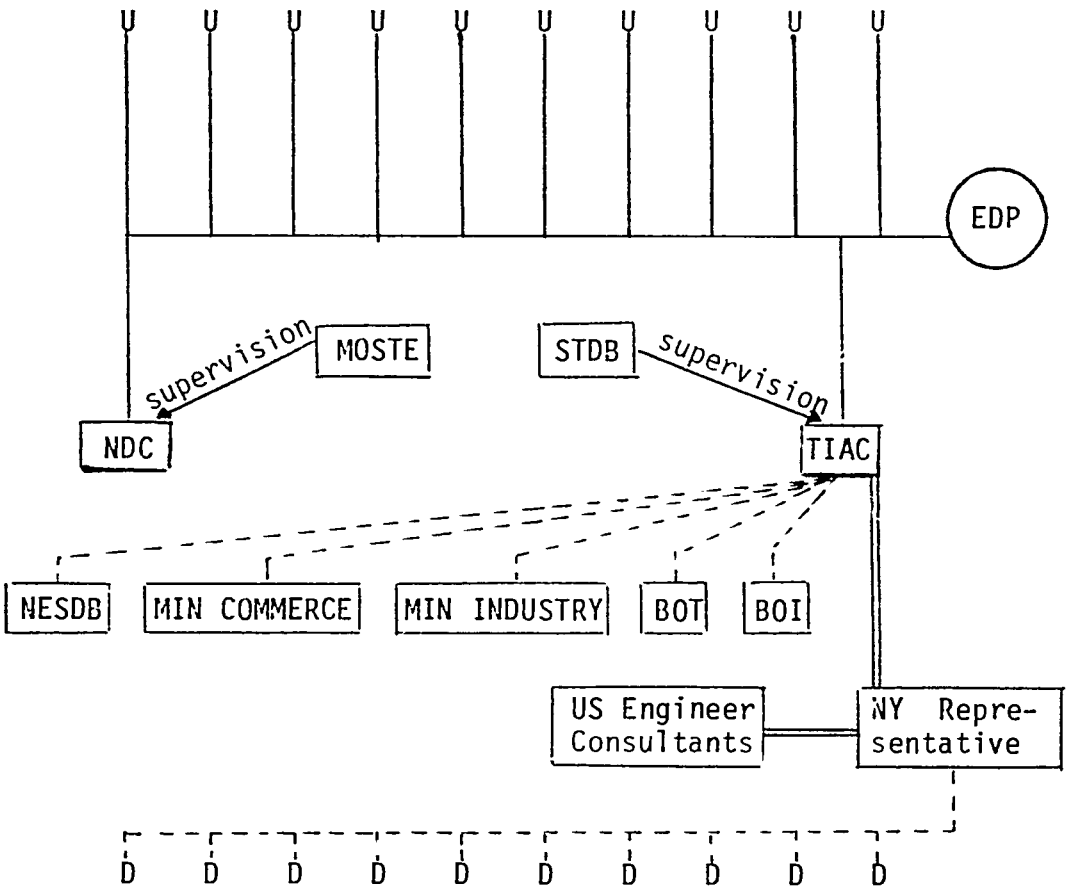
- It must serve the business and investment community.

The TISTR National Documentation Center, if suitably modernized and linked with other Thai university libraries, can be made to serve the research and academic community. A new Technical Information Access Center, located and managed by an organization such as the "Association of Thai Industries" (ATI), can effectively serve the business and investment community. The ATI would act as agent for STDB to establish and manage the TIAC. The National Documentation Center would be linked electronically with TIAC. Both would be linked to the "pier" in the US. Organizationally, the Director of TIAC would report to the STDB. The Director would be located at the ATI. He would have responsibility over the TIAC operation at ATI and the US Representative's operation. He will have authority to direct the work of TISTR's National Documentation Center, particularly those aspects dealing with their links to university libraries and their processing of scientific information requests to the US representative. Schedule of fees to be charged for services will be authorized by STDB upon recommendation of the TIAC Director. All fees collected will be retained by TIAC.

The following diagram of a possible network is included for illustrative purposes only.

Figure 8 (L)

Technical Information Access Center
Data Storage and Communications Network



CODE

U	=	University Science Library
EDP	=	Electronic Data Processing Center
D	=	US Data Base
═══	=	Direct Link
——	=	Network Link
---	=	Customer Access

NOTES:-

1) All Network Members can communicate with each other

2) Direct Link may be used by Network Members with approval of Link Control

3) Customer Access is available on subscription basis as controlled by access agreement

Start Up and Operating Costs

- The "US Pier" would have very low start up costs. A "gatekeeper" to serve as the designated representative for the TIAC would be employed on a full time basis to establish access to the various information systems that are already in place. A consulting engineering firm would be retained to serve the gatekeeper. A minimal amount of computer equipment ($30,000) will have to be acquired for communications and data storage. We estimate that the start up costs will not exceed $50,000. Annual cost of operations will, of course depend on usage, but is estimated as follows:

1986	$ 90,000
1987	140,000
1988	155,000
1989	165,000
1990	180,000
1991	195,000
1992	210,000

- The TISTR National Documentation Center will require microfilming equipment, EDP storage and communication facilities. It may be possible to utilize computer facilities at the AIT Data Processing Center by paying their fees and operating charges, rather than establish a data processing facility at TISTR or MOSTE. A feasibility study will be performed after execution of the Project Agreement to determine the most cost-effective means to secure these services. Reliance on microfilming may solve TISTR's "space" problem since a large portion of the TISTR facility is now taken up with hard copy storage for the Documentation Center. Modernization of the TISTR Documentation Center, EDP and communications equipment to link with university libraries and to enable it to serve the TIAC, and other start up costs are estimated at $400,000 ($100,000 for a microfilm library of periodicals; $250,000 for equipment and $50,000 to shift the present documentation center repository from hard copy to microfilm). Operating costs of the center should be met from the regular TISTR operating budget, supplemented by fees charged to university libraries that avail themselves of the services of the Documentation Center.

- The TIAC facility at ATI will have significant start up costs to staff and equip this new facility, to build its own data base and to link it with other data sources in Thailand. Segments of the data files now existing in various Government Departments will have to be refined to remove confidential information and reprocessed in formats suitable for TIAC's needs. Assuming no capital outlay for computer hardware (except for terminals and a micro system) and use of the AIT computer or another EDP facility, we estimate start up costs of $250,000 (furnishing of office facilities at ATI; building the data base; and about $125,000 for equipment). Operation costs will depend on usage but are estimated as follows:

1986	$185,000
1987	145,000
1988	180,000

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1989	200,000
1990	140,000
1991	150,000
1992	150,000

Charge for Services

The immediate objective of TIAC would be to provide R&D decision makers and entrepreneurs/investors with improved access to Thai and US sourced information. The cost to Thai entrepreneurs of access to this system is an "up front" cost, which must be incurred before one is certain the information will have value to him. TIAC must therefore offer the service at a low cost to avoid discouraging its potential clients from availing themselves of the service. USAID and the RTG would like to see this service become viable, self sustaining without need of further subsidy after the 5th year of operation. Yet if TIAC is to rely on "up front fees" paid by inquirors, it may tend to increase these fees, thereby discouraging use of the facility, once the subsidy is terminated. We propose that TIAC charge "up front" fees that would represent only a portion of the actual lost of the service during the first 5 years of operation. On the other hand, all information requests should be accompanied by some payment, even from academic researchers, lest the TIAC be overwhelmed by requests for "free" information.

The budget for this activity is as follows:

Year	Doc Center	TIAC	US Rep.	Misc	Less Fees	Net Cost
Start up	400 K	250 K	50 K	200 K	-	900 K*
1986	-	185	90	-	0	275
1987	-	145	140	-	30	255
1988	-	180	155	-	50	285
1989	-	200	165	-	75	290
1990	-	140	180	-	80	240
1991	-	150	195	-	170	165
1992	-	150	210	-	270	90
		1,400	1,185		675	2,500 K

* of which $400,000 represents equipment purchases.

US Implementing Agent for TIAC [1]

It is proposed that the locus of the Thai designated representative in the US will be the US/ASEAN Center for Technology Exchange, in New York City. AID has recently provided a grant in the amount of $1 million to establish this Center. A part of the ASEAN Center's mandate is to facilitate technical information flows between the US and ASEAN countries. A small amount of incremental funding (see Table above) to be provided to the Center under this Project to pay for a) the Thai designated representative, b) the retainer for the six part time consulting engineers, c) the data base subscription costs, and d) the communications costs, would be adequate to initiate the US portion of the operation. Implementation can be started very quickly in the light of the Center's predominant capability stemming from its existing mandate under the AID grant.

Project Management

The Association of Thai Industries (ATI) a well established association of the major 1,600 Thai manufacturers, should manage the activity under the overall responsibility of STDB. The Director of the TIAC should have oversight responsibility for the TISTR National Documentation Center with respect to their functions to request and receive data from the US representative to supply to Thai industry clients.

It would be desireable to structure the organizational and management responsibilities in such a way that ATI would have an incentive to keep the operating costs of the service low, and to market the service widely. The service function, and the equipment could be vested in them on a "Permanent Loan" basis. STDB could review the desireability of continuing this arrangement with ATI periodically, say, every 3 years. Fixed subsidy costs should be committed to the service by STDB. Profits from the operation should be retained by ATI. Fees charged by ATI for service should be approved by STDB in a similar manner that public utility rates are approved.

VI. THE LINK OF TIAC TO INVESTMENT PROMOTION

Experience suggests that technical information provided to prospective entrepreneurs/investors should be followed up to facilitate its utilization hopefully leading to new investment for productivity gains. VITA is now offering follow on services and will assist investors in locating US partners for a fee. This program is now operating in India. A proposal, prepared by VITA for a similar program to be undertaken in Thailand has been submitted to AID/PRE.

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[1] It may be possible for TIAC to negotiate direct communication access to European and Japanese S&T data sources through other bilateral aid programs after TIAC is operational.

The USAID Thailand Investment Promotion Project with BOI (implemented by A.D. Little) will also be integrated with and be supported by TIAC's activities.

AID's Bureau of S&T, Office of Rural Development is implementing a trial program (Market Technology Access Project, or MTAP) in Central America to test means by which "to develop improved channels for initiating collaborative ventures" between US small/medium enterprises and foreign firms. This AID/S&T Project now proposes to undertake a similar 3 year trial effort, estimated to cost $800,000 in Thailand. USAID Bangkok has agreed to contribute $65,000 per year for 3 years in support of this trial. About $400,000 is available from the S&T Bureau.

We propose to contribute the remaining balance ($200,000) from this Project and to incorporate the trial effort as part of the TIAC activity.

Information supplied to Thai entrepreneurs by TIAC will be followed up through the centrally funded S&T Bureau trial effort, and/or by VITA, to facilitate the process whereby the information provided will lead to a productive investment, possibly a joint venture.

Implementation Plan

After the Project Agreement is signed, the STDB has been established and sanctions implementation of this subactivity, it will be necessary, as a first order of business, to authorize the expenditure of funds to develop sufficient information to allow STDB to take the following actions.

a) Execute an agency agreement with ATI to establish TIAC on their premises.

b) Purchase equipment for TIAC-ATI.

c) Contract with a data processing center in Thailand to service TIAC requirements, including development of necessary software.

d) Modernize NDC and enable them to act as the center of the S&T data.

e) Lease telephone lines for linkage of TIAC-ATI with the TISTR National Documentation Center (NDC).

f) Purchase communications and data storage for each university on the network.

g) Execute a contract with US/Asean Center for Technology Exchange in N.Y. to act as US representative for TIAC.

Actions a, d and g would establish the core of TIAC. The remaining actions by STDB would provide supporting services to establish and service the network.

At this time it would appear that the actions outlined below would have to be taken by each of the 3 entities (TIAC-ATI; NDC; and N.Y. Office) to bring TIAC to operational status. Enhancement of facilities would continue after operations are initiated but operational status should be reached within 120 days after STDB has taken the actions described in a, d and g above. That means TIAC-ATI's doors would be open to receive requests for technical information from Thai manufacturers, consultants, or researchers with a reasonable expectation that a response from N.Y. will be available within 7 to 14 days. Technical data about Thai capability may not be available until a later date.

TIAC-ATI

- Purchase equipment (probably limited to 2 micro-computers with 20 MB hard disc storage each, 1 high speed printer, letter quality printer, 1 optical scanner, 1 facsimile communicator, one microfilm system including camera, reader and copier, misc. support hardware and basic technical reference library).

- Communications channel to N.Y. (US/ASEAN Office)

- Communications with NDC and through NDC to network with universities.

- Establish links to other Thai data sources (i.e. NESDB, BOT, BOI, IFCT, Ministry of Commerce, and Ministry of Industry).

- Develop specialized technology data base for Thai industry patterned after Thomas register.

- Develop data base of Thai technical manpower in industry.

- Begin marketing/publicity for TIAC service.

US Representative Office in N.Y.

- Purchase equipment (probably limited to 2 micro-computers with 20 MB hard disc storage each; one high speed printer, one letter quality printer, one optical scanner, one facsimile communications, one microfilm system including camera, reader and copier, misc. support hardware and a basic technical reference library.

- Subscription and access to US data bases described in Rudel report.

- Contract to retain US engineers.

- Link to BOI Office in N.Y.

- Communications facilities to TIAC Bangkok.

National Documentation Center at TISTR

- Purchase equipment (probably limited to 2 micro-computers with 20 MB hard disc storage each, one high speed printer, one letter quality printer; one optical scanner, one facsimile communicator, repair or replace microfilm system, misc. support hardware).

- Design network with Thai universities, determine equipment requirements for each university on network, standardize data storage for each university to access data processing center.

- Convert NDC hard copy into microfilm/digital storage.

- Develop data base of Thai technical manpower at government labs and universities.

- Develop additional data sources to be made available by NDC to network.

- Negotiate agreements with universities on network to share costs of system.

- establish communications link with TIAC-ATI as part of network.

DIAGNOSTIC/RESEARCH DESIGN SERVICE

Summary and General Concept

It has been said that correct identification and definition of a problem brings one halfway to its solution. Diagnosing technical problems encountered by Thai producers, and designing a methodology for research to solve those problems, is a major deficiency in Thailand today. It is also an essential ingredient to achieve success of this Project.

A small facility, offering well publicized low cost services to industry by providing local and foreign short-term technical advisors can help producers diagnose technical problems, identify technical needs, structure feasibility studies and design research projects to solve those problems. The service unit would have only a skeleton staff, but would draw on qualified Thai technical personnel at universities, government research labs, private consulting firms, and supplement these as needed with foreign technical advisors.

The work of this organization would produce technically competent and well designed research projects which will be eligible for financing under the Project. It would also help Thai manufacturers identify production problems that do not require new research but can be solved by applying technical or managerial knowledge that is already available. A bi-product of this effort will be the rationalization and upgrading of the Thai consultancy industry. User charges should be structured to make the activity self supporting by the end of the Project's seventh year.

Background

Western manufacturing companies that encounter technical problems in their production process tend to seek help from professional consulting service companies (consulting engineers, management consultants, marketing consultants, etc.) to diagnose the problem and recommend an approach towards a solution. There is a tendency among Thai manufacturers to disparage the worth of indigenous consulting firms. They assume that competent solutions are available only from foreign sources. Resistance to employment of local consulting firms also stems from (a) uncertainty about these firm's "track record", (b) concern about their high daily fees and (c) a preoccupation with secrecy of company affairs.

A problem diagnosis and trouble shooting service by The Industrial Finance Company of Thailand (IFCT), Thailand's development bank was recently established. IFCT offers the service to its own industrial clients, and charges only out of pocket expenses, absorbing the consultants salary payments. Approximately 6 such consultancies were performed by IFCT in 1984. The 1985 budget provides for 40 consultancies.

TISTR has also provided consultancy services of this nature. From the year 1972 through 1984 TISTR's R&D services offered to private companies amounted to 140 contracts worth Baht 5.6 million - an average of Baht 40,000 per consulting/research contract.

These experiments, plus the existance of a fledgeling consultancy service industry in Bangkok (Engineering, management, accounting, etc.), indicate a growing awareness among Thai manufacturer's of the need for diagnostic and technical problem solving services. The attitute towards technical consulting services is gradually maturing.

And yet some action is needed to overcome the inertia/resistance toward this change in approach to problem solving. The recent "Buy-Thai" campaign to shift consumer demand away from imports and towards domestic products is experiencing difficulties because the public feels that Thai products do not meet internationally accepted quality. As the competence of Thai RD&E facilities is upgraded through other activities of this Project (e.g. designated research), it becomes important to inject that competence into the productive sector. Industrial consultancy services, drawing on the personnel of these upgraded facilities, should bring about quality improvement of Thai products.

Unlike the TIAC activity, it cannot be said that there is effective demand for the proposed service. Both IFCT and TISTR agree that a strong promotional effort and attractive incentives are needed to create an interest and awareness on the part of Thai producers that it is possible to achieve significant production cost savings and increased profitability from quality improvements, that would far outway the cost of the consulting services.

Purpose

This activity is intended to rationalize and speed up the development of the technical service industry in Thailand. It is also intended to identify important areas in which Thai industry requires research support, and to facilitate the preparation of well conceived research designs for financing under the research activities of this Project. It will build momentum for the enhancement of RD&E in Thailand by creating a relationship between the domestic consulting industry and Thai producers to achieve technological improvement. It is another important link between the suppliers of technology and those who demand it.

Operation of the diagnostic/research design service

Request Center

The service will be offered at a "Request Center" located where it is easily accessible to the Thai industry. It should not be physically located or organizationally attached to a government agency such as TISTR for numerous reasons but primarily because of the sensitivity of Thai companies towards disclosure of company information. Ideally it would be located in the same premises as the TIAC, in the headquarters of the Association of Thai

Industries. It will have its own budget, charge fees for its services and be responsible to the STDB, which will provide supplementary funds for its operation.

The "Request Center" will:

- Assist manufacturers, technologists and scientists in formulating requests for diagnostic or research design services. Initial consultation to develop the request for services shall be at no charge. Cost estimates shall be provided for follow on work.

- Maintain a register of consultants, technologists, scientists, and consulting firms whom it recognizes as having credentials and qualifications to offer service. This register shall be an open public record and shall identify each consultant, and all of his previous services to specific clients (by name). In light of Thai manufacturers' concerns regarding company internal information being passed on to their competitors, it is important for new clients of the Request Center to know the past client relationships of any consultant who might be proposed and selected to work on their requests.

- Publicise and market the services offered by it to industry, financial intermediaries and technologists.

- Set standard charges and fees for consultancy services offered by associated consultants.

- Establish a code of conduct for consultancy services.

- Conduct training programs to enhance the capabilities of Thai technical consultants to perform diagnostic work.

Sources of Consulting Talent

The request center shall not provide consulting services with its own staff. It shall act as a referral service, to bring together the demanders for services with suitable technical specialists to perform an efficient, low cost, short term analysis of the problem and design a methodology which has a reasonable expectation of solving the problem.

Sources of technical specialists shall include:

- Thai university faculty
- Thai engineering institutes
- Thai government laboratories, including TISTR
- Associated financial institutions such as IFCT
- Thai private consulting companies
- UN technical assistance agencies such as ESCAP, UNIDO,
- US bilateral assistance activities including IESC, activities financed under this Project, and

- any western bilateral assistance programs that are willing to participate in this activity.

Scope of services

The services to be offered may run the entire range of consulting disciplines (engineering, industrial engineering, business consulting, management, the scientific disciplines, data processing, etc.). It would not be limited to the priority areas identified for this Project (biotechnology, materials and electronics) but it would exclude military related research.

Relation to other services

As the diagnostic service becomes operational, which in the first instance will be concentrated in Bangkok, an effort will be made to link it to the various industrial extension activities of other RTG agencies such as Department of Industrial Promotion and the Department of Commerce Export Promotion A Efforts. Gradually, as the service becomes operational in the rural areas and the universities located outside Bangkok utilized to provide consulting services to their neighboring industries, every effort will be made to coordinate this activity with related activities contemplated under the USAID Thailand Rural Industrialization Project.

As Thailand's consulting service industry develops ATI may encourage and facilitate the formation of professional societies, and in other ways (seminars and training workshops) enhance the technical capabilities of its associated specialists.

Funding

The services provided under this activity are intended to be subsidized for the initial 7 years of the Project but they shall not be free. Out of pocket expenses (travel, hotel, perdiem, etc.) shall be paid by the company making the request. Overhead costs of operations estimated at $50,000 per year, including marketing costs shall be borne by the Project budget. Initial start up costs, including equipment purchases shall be borne by the Project budget ($50,000). Any foreign consultancy costs will be borne by the Project.

The direct fees payable to the Thai consultants, for services rendered shall be met as follows:

	User Fee	Project Contribution
1986	10%	90%
1987	25%	75%
1988	40%	60%
1989	50%	50%
1990	60%	40%
1991	75%	25%
1992	90%	10%

Assuming the average time required to complete one diagnostic/research design service is 2 person/weeks, the consultancy fee per service should be Baht 16,000 or $600 excluding costs of foreign consultants. We estimate the workload and Project costs will increase as follows:

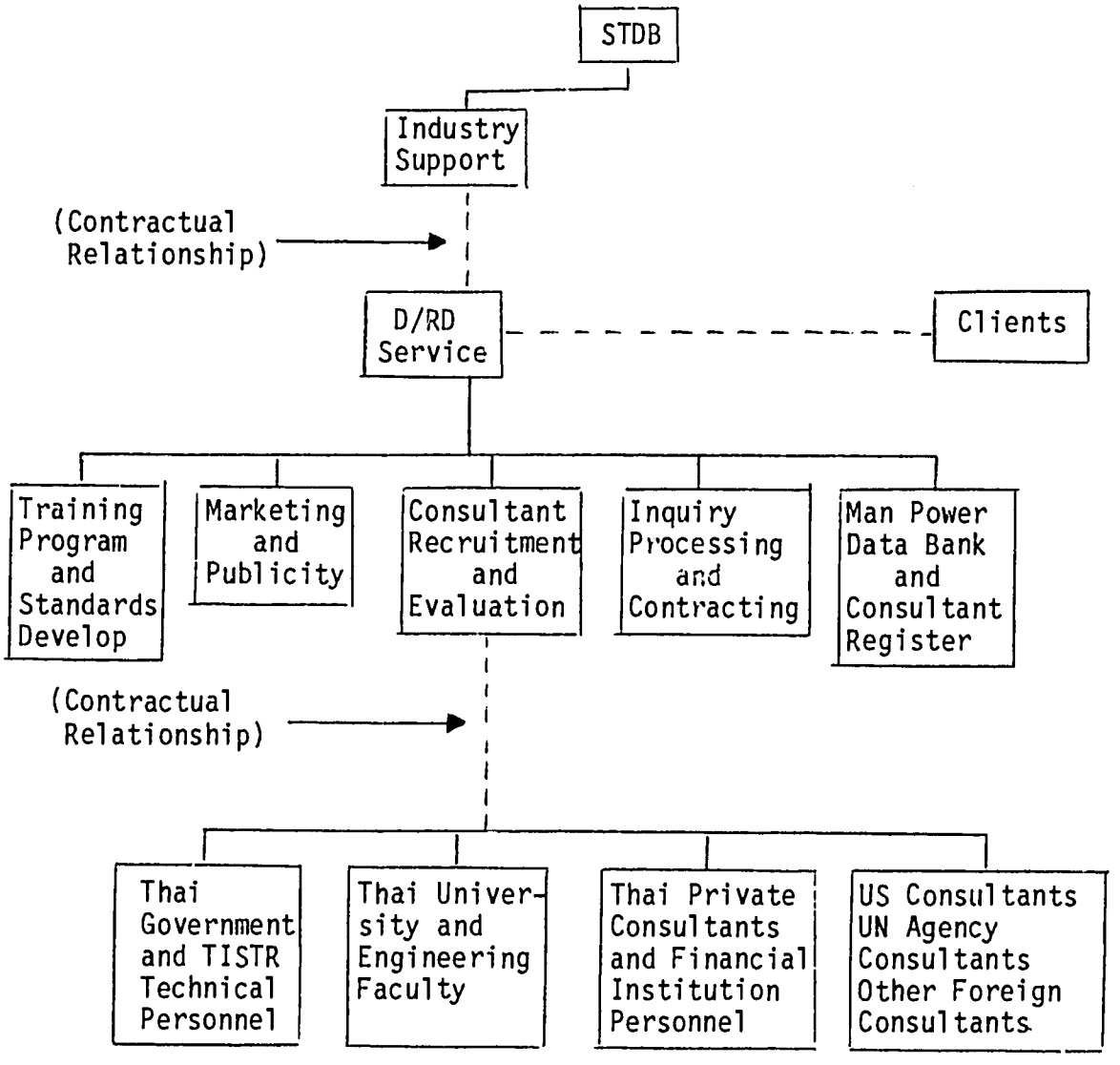
Year	Consultancies	Total Cost ($)	Project Cost ($)
1986	75	45,000	40,500
1987	200	120,000	90,000
1988	350	210,000	126,000
1989	500	300,000	150,000
1990	600	360,000	144,000
1991	650	390,000	97,500
1992	650	390,000	39,000
			$687,000

Project Management

The Association of Thai Industries (ATI) should manage the activity under the overall responsibility of STDB. STDB shall establish regulations to govern the operations of the DRD service in its contract with the implementing agent (ATI). It shall specify record keeping and periodic reporting requirements as well as the criteria for selection and employment of consultants. It shall approve payment of consultants. It shall approve payment schedules for consultants and consulting fees charged to clients. The organization and functions of this service are described in the following chart.

Figure 9 (M)

ORGANIZATION AND FUNCTION OF
DIAGNOSTIC/RESEARCH DESIGN SERVICE (D/RD)



STDB will have to arrange with universities and government laboratories to have their technical personnel released to ATI and to establish a fee schedule for their services. If possible it would be desireable to structure the organizational and management responsibilities in such a way that ATI would have an incentive to keep the operating cost of the service low, and to market the service widely. It is extremely important that this service is widely marketed. It should be pro active, not just reactive.

The service function, and the equipment could be vested in ATI on a "Permanent Loan" basis. STDB would review the desireability of continuing this arrangement with ATI periodically, say every 3 years. Fixed subsidy costs should be committed to the service by STDB. Profits from the operation should be retained by ATI. Fees charged by ATI for services should be approved by STDB in a similar manner that public utility rates are approved.

Implementation

After the Project Agreement is signed, conditions precedent have been met, and STDB has been established, the STDB will take the following actions.

a. Execute an agreement with ATI to establish this service. No additional EDP hardware, beyond that budgeted for TIAC, will be required. Some software and data base preparation will be needed. Significant advertising and promotional costs will be encountered.

b. Arrange with universities, engineering institutes and government laboratories to allow their technical staff to be available to ATI at a predetermined schedule of fees. This will require a change in the regulations which now prohibit university staff from engaging in extra curricular employment.

c. Approve a schedule of fees, drawn up by ATI, to be charged to clients.

d. Make arrangements with the STDB's designated implementing agent in the US (such as NAS), to accommodate specific requests for technical advisors required by ATI for their clients.

e. The ATI "Request Center" will

- Assist manufacturers, technologists and scientists in formulating requests for diagnostic or research design services.
- Maintain a register of consultants, technologists, scientists, and consulting firms whom it recognizes as having credentials and qualifications to offer services.
- Publicise and market the services offered by it to industry, financial intermediaries and technologists.
- Set standard charges and fees for consultancy services offered by associated consultants.
- Establish a code of conduct for consultancy services.
- Conduct training programs to enhance the capabilities of technical consultants to perform diagnostic work.

DETAILED FINANCIAL PLAN

ELEMENT

1. ESTABLISHMENT OF INSTITUTIONAL FRAMEWORK (STDB OPERATIONS)

	Person Month	USAID Loan	USAID Grant	Host Country RTG	Host Country DTEC	Host Country Other	Total
A. Technical Assistance:							
1) Long Term							
a) Team Leader	48		600				600
b) Project Monitor	48		300				300
Total	96		900				900
2) Long Term - US Home Office Assistance							
a) Project Director	48		400				400
b) Executive Assistance	48		200				200
Total	96		600				600
3) Short Term:							
Financial	12		24				24
Administrative	6		12				12
Publicity/Promotion/ Marketing	24		48				48
Management Improvement	9		136				136
Economic	24		336				336
Accounting Procedures	24		48				48
Contracting Procedures	6		12				12
Procurement Procedures	6		12				12
Office Management	6		12				12
Personnel	6		12				12
Others	24		48				48
Total	147		700				700
Total Technical Assistance			2,200				2,200

ELEMENT

1. ESTABLISHMENT OF INSTITUTIONAL FRAMEWORK (cont.)

	Person Month	USAID Loan	USAID Grant	Host Country RTG	Host Country DTEC	Host Country Other	Total
B. Operating Costs:							
1) Personnel*							
a) Thai Professional Staff			1,075				1,075
b) Local Support Staff 35 persons: Accountants, Secretaries, etc.					1,000		1,000
2) Facilities (Interior Design, Installation of Air Conditioning & Telephone)					100		100
3) Utilities (Water, Electricity, and Telephone)				60			60
4) Office Equipment (Xerox Machines, Typewritters, Air Conditioners & etc.)			70				70
5) Supplies				20			20
6) STDB Personnel Travel & Per diem (In-Country)					300		300
7) Vehicles (2 Vans & 5 Sedans)		100					100
8) Repair & Maintenance of Vehicles				45			45
9) In-Kind Office Space				295			295
Total Operating Costs		100	1,145	420	1,400		3,065
C. Board, Executive & Advisory Committee Meetings			200				200
D. Professional Exchanges			500				500
TOTAL ELEMENT NO. 1		100	4,045	420	1,400		5,965

* Beginning FY 1989, MOSTE will formulate plans for absorbing costs of this item.

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ELEMENT	Person Month	USAID Loan	USAID Grant	Host Country RTG	Host Country DTEC	Host Country Other	Total
2. S&T POLICY REVIEW							
A. Technical Assistance	36		300				300
B. Studies			500				500
C. Policy Dialogue (Study Tours/Mtgs.)			100				100
TOTAL ELEMENT NO. 2			900				900
3. RESEARCH DEVELOPMENT & ENGINEERING							
A. Projects:							
1) Designated 12 Projects @ $250,000 x 4 years		9,000		3,000			12,000
2) Competitive 15 Projects @ $150,000 x 4 years		6,750		2,250			9,000
3) Company Directed 18 Projects @ $500,000		2,250		2,250		4,500	9,000
Total RD&E Projects		18,000		7,500		4,500	30,000
B. Technical Support:							
1) Short Term (US)	62	864					864
2) Short term (Local)	144	286					286
Total Technical Support		1,150					1,150
C. RD&E Support:							
1) University Fellowships (In-Country)			1,000				1,000
2) Technology Transfer (Visits/Mtgs)			500				500
Total RD&E Support			1,500				1,500
TOTAL ELEMENT NO. 3.		19,150	1,500	7,500		4,500	32,650

ELEMENT	Person Month	USAID Loan	USAID Grant	Host Country PTG	Host Country DTEC	Host Country Other	Total
4. INDUSTRIAL DEVELOPMENT SUPPORT							
A. Standards Testing and Quality Control:							
1) T.A.							
a) Long Term							
- Quality Control	48	600					600
b) Short Term							
- Stds/Testing	32	450					450
- Quality Control	32	450					450
Total T.A.		1,500					1,500
2) Equipment (See Annex O)		1,500					1,500
3) Workshops and Training							
a) In-Country Workshops:							
- Stds. Testing		250					250
- Quatity Control		250					250
b) US Training			250				250
Total Workshops and Training		500	250				750
4) Publicity & Promotion		100					100
Total Standard Testing and Quality Control		3,600	250				3,850

ELEMENT	Person Month	USAID Loan	USAID Grant	Host Country RTG	Host Country DTEC	Host Country Other	Total
4. INDUSTRIAL DEVELOPMENT SUPPORT (cont.)							
B. Technical Information Access Center:							
1) Technical Assistance		350					350
2) Equipment		400					400
3) US Training			150				150
4) Other Costs:							
a) US ASEAN CFTE		1,000					1,000
b) Data Processing		625					625
c) Salaries (5 People)			125				125
Total Other Costs		1,625 1/	125				1,750
Total Technical Information Access Center		2,375	275				2,650
C. Diagnostic/Research Design Services:							
1) Technical Assistance		100					100
2) Equipment		50					50
3) Engineering Consultant Services		800 1/					800
Total Diagnostic Research Design Services		950					950
TOTAL ELEMENT NO. 4		6,925	525				7,450

NOTE: 1/ Net of Fees estimated to be earned by TIAC and Diagnostic Services.

ELEMENT	Person Month	USAID Loan	USAID Grant	Host Country RTG	Host Country DTEC	Host Country Other	Total
5. EVALUATION							
A. Base Line Data			25				25
B. Mid-Term (1988)			75				75
C. Final (1992)			115				115
D. Financial Auditing			85				85
TOTAL ELEMENT NO. 5			300				300
SUB-TOTAL PROJECT		26,175	7,270	7,920	1,400	4,500	47,265
CONTINGENCY 10% (Excludes Projects - Element #3)		825	730	180			1,735
TOTAL PROJECT		27,000	8,000	8,100	1,400	4,500	49,000

PROJECT COMMODITIES

Equipment	Costs
A. Project Support Equipment	
- Vehicles (7)	$100,000
- Air Conditioners (21)	16,000
- Typewriters (20)	21,000
- Copiers (2)	7,000
- Duplicating Machines (2)	4,000
- Office Equipment (Furniture, Calculators, etc.)	22,000
	$170,000
B. Standards, Testing and Quality Control	
- Temperature Calibration	$50,000
- Photometers and Monochrometers	40,000
- Testing (voltage, light & color)	75,000
- Analyzers	300,000
- Analytical Chemistry Equipment	200,000
- Ceramic and Metal Testing	300,000
- Electronic (Frequency Standardization)	300,000
- Hardness/Abrasion, etc. Testing	235,000
	$1,500,000
C. Technical Information Access Center	
- Microcomputers (10)	$200,000
- High Speed Printers (10)	10,000
- Letter Quality Printers (10)	20,000
- Optical Scanners (3)	60,000
- Facsimilie Communicators (10)	10,000
- Microfilm System	100,000
	$400,000
D. Diagnostic/Research Design Service	
- Microcomputer (1)	$20,000
- Printer & Misc. Hardware/Software	15,000
- Supplies	15,000
	$50,000

Notes:

1. Above represents broad categories of equipment that will be required to meet Project needs. This list will be finalized by STDB with the assistance of advisory/coordinating committee on standards, and testing, and specifications will be prepared, with the assistance of TA contractor, prior to proceeding with the actual procurement.

2. In addition to the above equipment requirements, needs specific to RD&E activities will become known only during the actual implementation of the Project.

ANNEX P

ACTION MEMORANDUM FOR THE ADMINISTRATOR

From: Robert Halligan, Director, USAID/Thailand

Thru: Charles W. Greenleaf, Jr., AA/ASIA

Subject: Non-Competitive Procurement of Technical Services from the National Academy of Sciences in Support of S&T for Development Project

1. Problem: Request for Waiver of Competition based on a Single Source Justification.

A.	Cooperating Country:	Thailand
B.	Authorizing Document:	Project Authorization
C.	Project:	S&T for Development (493-0340)
D.	Nature of Funding:	Grant/Loan
E.	Description of Services:	To provide technical assistance in support of S&T for Development Project under an overall TA contract
F.	Approximate Value:	$6,000,000. (This estimate comprises all known needs. RD&E specific TA needs will be in addition to this estimated amount.)
G.	Contracting Mode:	Host Country Contract
H.	Source:	National Academy of Sciences

2. Discussion and Justification

The National Academy of Sciences complex has predominant capability to provide and coordinate the technical assistance required in the Science and Technology for Development Project in Thailand. The National Academy complex consists of several related organizations including, the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The National Research Council is the operating agency of these institutions in the conduct of their congressionally-chartered mandate to advise government on important areas of science and technology.

Within the National Research Council, the Board on Science and Technology for International Development (BOSTID) is the unit concerned with the application of science and technology to the needs of developing countries. During the past 15 years, BOSTID has cooperated in projects in more than 50 different countries, including Thailand. In several countries, notably Brazil, Egypt, Indonesia, and Portugal, it has worked with diverse multiyear programs focused on building applied R&D capabilities in various areas, R&D management skills, and research marketing units that interact closely with end users. Two programs have included the provision of senior resident advisors, and all have used program committees and advisors that include outstanding scientists, engineers, and administrators from American research institutes, private companies, universities and government agencies. Recent BOSTID projects, for example, have involved three Nobel laureates.

BOSTID has the following predominant advantages in providing long-term technical assistance:

1) Access to the Entire S&T Community of the US

Because of the institutional structure of the National Research Council - National Academy of Sciences - National Academy of Engineering - Institute of Medicine complex, BOSTID regularly can involve the nation's outstanding scientists, engineers, and managers in its activities. Participants in BOSTID programs are drawn from corporations, universities, nonprofit organizations, and government agencies on the basis of their excellence and experience for a given activity. Because participation in Research Council activities is a recognized and prestigious form of public service, this gives BOSTID great range and flexibility in the provision of expertise. During the past decade and a half, BOSTID has used over 2,500 participants from over 200 leading universities and as many corporations, as well as every scientific agency of government. BOSTID can tap the full range of National Research Council activities, including the involvement of over 6,000 leading scientists and engineers annually who work on over 400 committees representing virtually the entire range of science and engineering. With respect to the Thai S&T Project, BOSTID can involve such Research Council organizations as the Board on Agriculture, the Board on International Health, the Board on Computer Sciences and Information, the National Materials Advisory Board, and many others.

2) BOSTID Experience in Priority Technical Areas

The target scientific areas of the Project are topics with which BOSTID has deep experience. In the biosciences, BOSTID produced a seminal report Priorities in Biotechnology Research for Developing Countries that has led to important activities by AID, as well as several developing countries and private sector organizations. The research grants program supports biotechnology-related work on acute respiratory infections and BOSTID is developing a new activity on the development and field testing of diagnostic kits for certain diseases. Other interesting BOSTID work has been done in biotechnology applications to food technology and development of improved varieties of crops and trees. BOSTID recently prepared for AID a directory of biotechnology training courses in the US open to LDC scientists. A current member of the BOSTID advisory board was editor for more than two decades of one of the leading journals in biotechnology.

Materials technology is an area with which BOSTID has worked in countries such as Taiwan (machine tools and microelectronics), Egypt (utilization and beneficiation of Bentonite clays), and Portugal (wood products). BOSTID studies have produced reports on low-cost housing materials and ferrocement. Moreover, the National Materials Advisory Board is an active part of the Academy complex which recently has produced an important report on the use of fine ceramics in industry. The chairman of the committee that produced the report is a member of the BOSTID Advisory Board and Vice President of one of America's leading corporations.

An extensive study of the implications of microcomputer technologies for developing countries is a current BOSTID project that is examining applications in agriculture, health, and energy. In addition, needs for software, training , and national regulations are being explored. Projects on innovation in the electronics industry have taken place in several countries. Advisory services on the use of computers in education and vocational training have been provided by BOSTID in Zimbabwe. The development of national information centers based on state-of-the-art computer and microelectronic technology has been part of BOSTID projects in Taiwan, Chile, Indonesia, and Egypt.

3) Experience in Managing Long Term S&T Technical Assistance Programs

In Egypt, BOSTID has been the US coordinating agency for the past seven years for a large AID project with the objective of improving the effectiveness of Egyptian S&T resources in applied reseach directed toward national development goals. Emphasis has been placed on improving RD&E management and building linkages with end-users. Through a $4 million contract BOSTID has maintained senior resident advisors in Cairo for six years supported by a local staff of four persons, plus Washington - based staff. The Project has included nine RD&E areas in which Egyptian institutions have worked with help from US advisors and consultants. In addition to its own staff inputs, BOSTID has provided over 800 days of consultation by outstanding industry, university and government agency specialists, has programmed training and orientation visits to the US and other countries for 119 Egyptians, and has arranged specialized formal training courses in the US for 43 Egyptians. In carrying out the project, BOSTID has had subcontracts for specific activities with the following organizations : Denver Research Institute, Consortium for the Development of Technology, International Fertilizer Development Centre, and Battelle-Northwest. (Subcontracts also can be made with private companies). Part of the project has involved procurement; BOSTID is responsible for identifying equipment needs in the various R&D projects, seeing that appropriate specifications are prepared, and conveying them to the ordering agency. In its overall project coordination responsibilities, BOSTID has worked with Georgia Tech in development of scientific information centers, with the U. of Wisconsin on equipment procurement and with the National Bureau of Standards on standards and quality control.

In Indonesia, Portugal, Ecuador, and Brazil, BOSTID has also managed complex long-range projects aimed at institution building in science and technology. The Indonesia effort (July'79 - April'84) included a series of technical workshops and symposia over a four-year period, plus training of Indonesians in the US and programming of Indonesian officials on visits to US scientific institutions. The Portugal project (Feb.'82 - present) was similar, but with longer term and larger numbers of trainees. A special aspect of the program was development of linkages between US and Portuguese intitutions. The Ecuador National S&T assessment (Aug.'83 - Jan.'85) has included a resident BOSTID advisor, and the seven-year Brazil chemistry project provided US postdoctoral chemists for 2-3 year teaching and research assignments at Brazilian universities in key fields of chemistry related to

national industrial development plans. An input of 40 person-years was provided by the BOSTID chemists in Brazil and 106 graduate degrees resulted in the target fields. BOSTID also operates the Overview Committee for the India-US Science and Technology Initiative (STI) with cooperative research between the two countries in agriculture, biomedical research, materials technology, and monsoon research. In the early 1970's, BOSTID worked closely with Korea's new Ministry of Science and Technology on Korean science policy and the role of specific research and educational institutions.

4) Experience in Operating RD&E Grants

BOSTID operates a large research grants program on a worldwide basis. LDC institutions compete for grants in areas identified and reviewed by BOSTID expert panels. The grants include extensive networking with US institutions and BOSTID support for provision of advisors, short-term training, and purchase of equipment, chemicals, and reagents. The program presently involves 66 grants worth about $7.5 million in over 25 countries and makes provision for US advisors to work periodically with grant recipients. In some cases, US companies or universities work with grantees in a specific research area.

5) Home Office Support

BOSTID has on its present home office staff senior professionals with long experience in providing the back-up and coodination essential for effective overseas programs. Moreover, senior BOSTID staff could be made available immediately for the start-up activities vital to the ultimate success of the Thailand Project. All necessary communication and information facilities are in place, including access to major scientific and technical data bases. Existing experienced staff are available to support functions such as the programming of training or travel for overseas participants in the US. or equipment purchases.

6) Linkages between LDC and US institutions

BOSTID has considerable experience in forging linkages between US and developing country institutions. This has been accomplished in a variety of ways. In Egypt, for example, each of the R&D activities of the S&T program has a small oversight committee of 2-3 Egyptians and 2-3 Americans, with US members from companies, universities, or government agencies with strong experience in the topic concerned. They generally serve on the committee for the lifetime of the project and visit Egypt several times a year. In turn, the Egyptian scientists usually have occasion to make visits to the US counterpart institution.

Industrial linkages have received emphasis in a BOSTID project in India on industrial energy efficiency, where Indian engineers and plant managers make study tours of US companies following joint seminars held in India. Egyptian scientists in a pharmaceutical project made visits arranged by BOSTID to about ten US drug companies to discuss acquisition of technologies for beginning the manufacture of certain pharmaceuticals previously imported.

7) Flexibility in Approach

BOSTID's ability to utilize the National Research Council's public service mechanisms and expert Committees, and its access to every segment of the US S&T community allow it to be extremely flexible in responding to changing situations and needs in its programs. This has been demonstrated in the planning process of this Project where BOSTID has provided, sometimes on extremely short notice, several dozen advisors including people as diverse as top executives of companies such as TRW Inc., DNA Plant Technology Corp., Kraft Inc., Burroughs Co. Ltd., Arthur D. Little, McLaren Machine Tool Industry Consultants, and ICI Americas Inc.; senior faculty from major universities such as Wisconsin, Florida, Auburn, Johns Hopkins, Purdue, Columbia, and Michigan State; and top government scientists from the Public Health Service, Bureau of Standards, and Department of Agriculture.

8) Prior Experience Related to RD&E in Thailand

Since an early 1970's workshop on national science planning with Thailand's National Research Council, BOSTID has had a number of activities and regular contact with the Thai scientific community. Thai institutions presently have more BOSTID research grants than any other country. And BOSTID has been deeply involved in the planning of the new S&T program in Thailand through the participation of advisors and staff.

9) Quick Response Time

Given its prior knowledge and role in the development of this Project, BOSTID could initiate the start-up phase in a time-frame that would be unreasonable for any other potential contractor. A timely beginning will be absolutely crucial to the eventual success of this complex activity.

10) Use of Scientific Volunteers

Many of BOSTID's advisors contribute their time without remuneration, and a substantial use of donated time could be expected in this Project. In BOSTID programs in Egypt, Portugal, and Indonesia, over 2,000 days of advisory time was donated by US scientists and engineers. Based on AID consulting rates this time was worth over $500,000, but many BOSTID participants normally would command much higher fees. Furthermore, many of these high level advisors, especially those from companies, would not be available for consulting except through public service for a prestigious national body such as the Academy complex.

11) Knowledge of S&T Development Worldwide

BOSTID has been involved in virtually every AID country where significant programs aimed at national S&T development have taken place. Moreover, through other activities of the Academy complex, BOSTID is familiar with scientific development in China, Japan, and E. Europe. This overview would be exceptionally valuable to this Project, and could also help establish useful linkages between Thai institutions and appropriate institutions in third countries.

Summary

In summary, the National Academy complex, through BOSTID, has compelling advantages as the main contractor for technical assistance in this Project. It has unmatched access to the whole spectrum of US scientists and engineers in corporations, universities, nonprofit organizations, and government as potential advisors to Thailand. It has substantive experience with the scientific areas on which this Project focusses, on the operation of RD&E grants, on improvement of standards and quality control, and on development of technical information centers. It has prior experience in the planning of this Project. It has experienced home office staff and facilities that could be focussed full time on implementation of the Project with relative ease. And it has a proven record of experience and accomplishment in managing a variety of similar projects in other developing countries, including experience in providing long-term resident advisors, procuring equipment, programming special training for local scientists in the US, linking local institutions to US counterparts, conducting scientific workshops and symposia, and developing closer relationships between scientific institutions and the end users of their work.

3. Recommendation:

That you waive the requirements of competition for the procurement of technical assistance services from the National Academy of Sciences in accordance with the provisions of Handbook 11, Section 2.4.2, Waiver Negotiation with A Single Source.

Approved: _____

Disapproved: _____

Date: _____

ACTION MEMORANDUM FOR THE ADMINISTRATOR

From: Robert Halligan, Director, USAID/Thailand

Thru: Charles W. Greenleaf, Jr., AA/ASIA

Subject: Non-Competitive Procurement of Services of a US Representative for Technical Information Access Center

1. Problem: Request for Waiver of Competition based on a Single Source Justification.

A.	Cooperating Country:	Thailand
B.	Authorizing Document:	Project Authorization
C.	Project:	S&T for Development (493-0340)
D.	Nature of Funding:	Loan
E.	Description of Services:	To provide services as the US representative of Thai Technical Information Access Center
F.	Approximate Value:	$1,000,000
G.	Contracting Mode:	Host Country Contract
H.	Source:	US/ASEAN Center for Technology Exchange in New York, N.Y.

2. Discussion

A Technology Information Access Center (TIAC) for Thailand will be established as an activity under the S&T for Development Project (#493-0340). The activity contemplates an elaborate networking of computerized S&T data sources within Thailand to link seven universities and other institutions in different cities of Thailand with the National Documentation Center in Bangkok. A new Technical Information Center to serve Thai industry's technical information needs will be established at the Association of Thai Industries (ATI) and will be a part of that network.

This network is to be linked with a TIAC representative in the US and with similar representatives in other ASEAN countries to allow Thai businessmen and Thai RD&E workers to gain access to S&T information available in the US through a high speed communications channel. The US representative must be in position to serve TIAC by being highly responsive to inquiries for S&T information made by TIAC network members. The TIAC's US representative must have a thorough familiarity with conditions in Thailand and other ASEAN countries and should have established relationships with at least some S&T users of such information.

The Project Paper describes the function of the US representative as follows:

1) A designated representative of the Thai TIAC would secure access to the multifold networks of data bases and S&T information sources in the US.

The designated representative would not create its own data base; rather it would build access to a network of information sources that would allow it to be responsive to requests from Thailand. Some of the sources will be automated, others will be human, and accessable via telephone.

2) The designated representative will act as "gatekeeper" for Thai inquiries. The gatekeeper will process all inquiries received from the TIAC in Thailand, utilizing in the first instance, automated data bases and then pursuing the appropriate channels of his network to produce a meaningful response for transmission to Thailand. Supporting the gatekeeper would be six part time consulting engineers with different specializations, kept on retainer to be available as needed to screen incoming requests, the proposed responses, and be in position to enhance the responses with information they can obtain through telephonic inquiries to the best sources of technical data available in the US, namely, the capital equipment manufacturers. Care will be taken to assure that the alternative technologies referred back to Thailand take into account factor costs in Thailand as they would effect labor or capital intensity.

The gatekeeper together with a small but well trained supporting staff would develop a sophistication to utilize, as appropriate, existing S&T information systems already available to those who know how to access them. He would also apprentice Thai personnel on a regular basis. These Thai personnel would return to staff the TIAC after completion of their training.

The US representative would also forward to TIAC, inquiries made by US companies about Thailand's technological capacities which might reflect opportunities for technological interchange or joint ventures.

It is proposed to contract on a sole source basis with the US/ASEAN Center for Technology Exchange, in N.Y.C., (CFTE) for them to serve as the US representative of TIAC.

3. Justification

The reasons for proceeding on a single source basis are:

1) US/ASEAN CFTE is a non-profit corporation established under the laws of N.Y. at the initiative of the ASEAN-US Business Council. The purpose of the Center is to advance small and medium enterprise development by:

- undertaking productivity-related training at the technical and managerial levels;
- establishing a search network in the US to respond to ASEAN requests for US technical assistance, particularly from small- and medium-sized companies;
- sponsoring industry-specific technology and training missions to the US for ASEAN corporate managers; and
- identifying the potential for on-the-job training of ASEAN managers and technicians within US companies.

2) The Center has now received funding from AID under the ASEAN Small and Medium Business Improvement Project to allow it to perform tasks that are closely related to several of the tasks that it will be asked to perform as the US representative of TIAC. For example, the Mission of the Center is "to provide a mechanism through which ASEAN companies can identify sources of equipment, technology, technical assistance and joint venture investment.... The Center's programs consist of ... technical information services, providing responses to specific requests for information on potential US suppliers of technology, equipment or technical assistance....."

3) The Center has established an office with a full time Program Administrator and a part time Country Director in each of the ASEAN countries (including one in Thailand) to provide it with a continuing presence. It can utilize this network of offices to search for technical and scientific information requested by TIAC

Briefly, overall AID interests would best be served by linking the two AID activities at the Center, thereby achieving significant cost economies to AID.

4. Recommendation

That you waive the requirements of competition for the procurement of subject services in accordance with the provisions of Handbook 11, Section 2.4.2, Waiver-Negotiation With A Single Source.

Approved : _____

Disapproved: _____

Date: _____

ACTION MEMORANDUM FOR THE ADMINISTRATOR

From: Robert Halligan, Director, USAID/Thailand

Thru: Charles W. Greenleaf, Jr., AA/ASIA

Subject: Request for Procurement Source/Origin Waiver for Motor Vehicles from AID Geographic Code 941 and Thailand to AID Geographic Code 935 (Selected Free World)

A.	Cooperating Country:	Thailand
B.	Authorizing Document:	Project Paper (493-0340)
C.	Project:	S&T for Development
D.	Nature of Funding:	Loan
E.	Description of Goods:	2 Passenger Vans 5 Passenger Sedans
F.	Approximate Value:	$100,000
G.	Probable Source:	Thailand
H.	Probable Origin:	Thailand/Japan
I.	Previous Source/Origin Waiver for Commodities under this Project Granted at USAID Level:	None

DISCUSSION AND JUSTIFICATION:

The vehicles listed above constitute an important element in the equipment required for the implementation of this Project. The vehicles must be of right-hand drive configuration in order to function in Thailand safely and effectively. US-manufactured vehicles of this type are available only in left-hand drive models and, as such, do not meet the needs of this Project.

HB 1B, Chapter 5, para 5B4b provides that the authorized source/origin of commodities including motor vehicles may be expanded when the commodity is not available from countries included in the authorized geographic code. Given the fact that the right-hand drive vehicles above are not manufactured in the United States, the test of HB 1B appears to have been met.

CERTIFICATION:

In this waiver request, you will be certifying that:

1. US made vehicles of the requisite specifications are not available from the US on a timely basis and that an alternative source of financing for the vehicles in question has been discussed with the host country agency concerned and are not available,

2. exclusion of procurement from free world countries other than the cooperating country and Code 941 countries would seriously impede attainment of US foreign policy objectives and objectives of the Foreign Assistance Program, and

3. sources of the vehicles will be considered in the following order of preference:

a) locally made or assembled vehicles using a substantial number of parts made in the US;

b) other locally made or assembled vehicles;

c) vehicles made or assembled in Code 941 countries using a substantial number of parts made in the US:

d) other vehicles made or assembled in Code 941 countries;

e) vehicles made in the region by a subsidiary of a US manufacturer; and

f) other free world sources.

RECOMMENDATION:

For the reasons cited above, I recommend that you approve this source/origin waiver to permit procurement of 2 vans and 5 sedans up to a value of $100,000.

APPROVED: _____

DISAPPROVED: _____

DATE: _____

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D.C. 20523

ANNEX Q

PROJECT AUTHORIZATION

KINGDOM OF THAILAND

Science and Technology
Project No. 493-0340
A.I.D. Loan No.

Pursuant to Sections 103, 104 and 106 of the Foreign Assistance Act (FAA) of 1961, as amended, I hereby authorize the Science and Technology for Development Project (the "Project") for the Kingdom of Thailand (the Cooperating Country), involving planned obligations of not to exceed Twenty-Six Million Five Hundred Thousand United States Dollars (U.S. $26,500,000) in loan funds and Eight Million Five Hundred Thousand United States Dollars (U.S. $8,500,000) in grant funds, over a seven year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing certain foreign exchange and local currency costs for the Project. The planned life of this Project is seven (7) years from the date of initial obligation.

2. The Project is designed to enhance the effectiveness and extent of public and private sector application of Science and Technology (S&T) to Thailand's development. In so doing, the Project will attempt to solve specific technology related problems in three broad technical areas: bioscience/biotechnology, material technology and applied electronic technology. Specific activities to be financed include: (1) establishment of a private and public sector Science and Technology Development Board (STDB) to forge linkages between private sector industry and public sector S&T institutions; (2) strengthening the analytical capacity of Thai public and private institutions in the S&T policy area; (3) research, development and engineering (RD&E) activities inclusive of designated RD&E (to build problem-focused institutional capacities), competitive RD&E (to enhance private and public sector collaboration in the process of solving problems), and company-directed RD&E (to encourage private sector RD&E capacity building and promote the use of RD&E in problem solving) and long and short term training in support of RD&E activities; (4) strengthening the capacity of and promoting coordination among key standards, testing

and quality control organizations in support of Cooperating Country efforts to improve the quality of Thai products; (5) establishment of a Technical Information Access Center to serve the business community and S&T institutions; and (6) establishment of a Diagnostic/Research Design Service to help private sector companies in the identification of problems and in the design of appropriate remedies.

3. 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 and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

4. a. Interest Rate and Terms of Repayment. The Cooperating Country shall repay the Loan to A.I.D. in United States Dollars within forty (40) years from the date of first disbursement of the Loan, including a grace period of not to exceed ten (10) years. The Cooperating Country shall pay to A.I.D. in United States Dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years, and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

b. Conditions Precedent to Initial Disbursement. Evidence that the STDB has been established by the Cooperating Country.

c. Source and Origin of Goods and Services. Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their source and origin in Thailand or in the United States for grant funds, and in Thailand or in countries included in A.I.D. Geographic Code 941 for loan funds except as A.I.D. may otherwise agree in writing.

Ocean shipping financed by A.I.D. under the Loan shall, except as A.I.D. may otherwise agree in writing, be financed only on vessels under flag registry of the United States, Thailand or countries included in Code 941 of the A.I.D. Geographic Code Book, and ocean shipping financed by A.I.D. under the Grant shall, except as A.I.D. may otherwise agree in writing, be financed only on vessels under flag registry of the United States.

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d. Waivers.

(1) Negotiation with a Single Source. In accordance with Handbook 11, Chapter 1, Section 2.4.2, I hereby waive the requirement of competition to permit the procurement of technical services from the National Academy of Sciences (NAS) based upon its unique capability by reason of special experience, facilities and specialized personnel, as more fully set forth in the request for waiver.

(2) Negotiation with a Single Source. In accordance with Handbook 11, Chapter 1, Section 2.4.2, I hereby waive the requirement of competition to permit the procurement of technical services from the U.S./ASEAN Center for Technology Exchange in New York based upon the determination that to do otherwise would impair foreign assistance objectives. This is also more fully set forth in the request for waiver.

(3) Motor Vehicle Procurement. In accordance with Handbook 1B, Chapter 4.C.2, I hereby waive the requirements of FAA Section 636(i) to permit the use of loan funds for the procurement of seven minibus/cars assembled in Thailand from the components manufactured in Japan and Thailand, in an amount not to exceed $100,000 on the basis of the justification set forth in the request for waiver. I hereby certify that exclusion of procurement of these items from free world countries other than the Cooperating Country and countries included in Code 941 would seriously impede attainment of U.S. foreign policy objectives and objectives of the foreign assistance program which this Project is intended to serve.

Signature
Mr. Peter McPherson
Administrator

6/14/85
Date

Clearances:	Date	Initial
Charles W. Greenleaf, AA/ANE		5/25/85
Richard A. Derham, AA/PPC	29 May 85	
Howard M. Fry, GC	6/5/85	

GC/Asia:HEMorris:hp:5/6/85

CONTRIBUTORS TO PROJECT PAPER

I. PROJECT DEVELOPMENT COMMITTEE

- U.S. Agency for International Development (USAID)

Name	
1) Mr. L. Twentyman	Deputy Director, USAID (Chairman)
2) Dr. B. Ali	Project Paper Coordinator, S&T
3) Dr. E. Briskey	Director, S&T
4) Mr. T. Fallon	Controller, FIN
5) Dr. R. Hopkins	Education Advisor, PROG
6) Mr. E. Ploch	Director, PROG

- Royal Thai Government (RTG)

1) Dr. Sanga Sabhasri	Permanent Secretary, MOSTE
2) Dr. Charoen Vashrangsi	Inspector General, MOSTE (Project Paper Coordinator)
3) Dr. Vichitvong Na Pombhejara	Advisor to MOSTE Minister & Chairman TISTR Board
4) Dr. Yenchai Laohavanich	Deputy Governor, TISTR
5) Dr. Kovit Posayanonda	Deputy Director General, Comptroller General's Department, MOF
6) Mr. Kittipan Kanchanapipatkul	Director, External Cooperation Division 1, DTEC
7) Mr. Visit Boonyakesanond	Director, Technology & Environment Planning Division, NESDB
8) Mr. Pahol Chindakul	Director, Economic Projects Division 2, BOB
9) Dr. Ackaratorn Chularat	Director, Law Drafting Division, OJC
10) Ms. Pornthip Jala	Director, Law and Petition Analysis Division, OJC
11) Dr. Anamai Singhabhandhu	Director, Technical and Foreign Relations Division, MOSTE
12) Ms. Wanasri Samanasana	Director, Translation and Foreign Relations Division, NRC
13) Lt. Hansa Kaewbandit	Chief, Branch 3, Economic Projects Division, BOB
14) Mr. Prasit Ujjin	Economist 7, Loan Policy and Management Division, Fiscal Policy Office, MOF
15) Ms. Narumol Dhammaraksa	Policy and Planning Analyst 7, NESDB
16) Ms. Kobkeao Akarakupt	Policy and Planning Analyst 7, MOSTE

17)	Mr. Chartdanai Chartpolrak	Engineer 7, NEA, MOSTE
18)	Ms. Siri-orn Wongchruawal	Economist 6, Fiscal Policy Office, MOF
19)	Ms. Ubolwan Usawattanagul	Economist 6, Fiscal Policy Office, MOF
20)	Mr. Somsak Chuvativad	Internal Auditor 6, MOSTE
21)	Mr. Patipan Vattana	Legal Officer 6, MOSTE
22)	Ms. Paranee Laotreepetch	Policy and Planning Analyst 5, MOSTE
23)	Ms. Choosri Keedumrongkool	Foreign Relations Officer 5, NRC
24)	Ms. Wasana Sinsatianporn	Economist 4, Fiscal Policy Office, MOF
25)	Ms. Petchara Sungkhaworn	Foreign Relations Officer 4, NRC

- AID/W

1)	Ms. Carol Peasley	Former Deputy Director, USAID/Thailand
2)	Mr. Robert Pratt	Deputy Director, ASIA/PD
3)	Mr. David Steinberg	PPC/E/PES

- USAID Secretarial Support

1) Mrs. Wannee Vardhanabhuti, Coordinator
2) Miss Busaba Tejagupta
3) Miss Sopit Chitravimol
4) Miss Jantana Luekajonsak

II. CONSULTANTS

1)	Mr. Richard Kalina	Project Implementation
2)	Dr. Robert Muscat	Economist
3)	Mr. Ludwig Rudel	Private Enterprise
4)	Mr. Charles Stockman	General

The other U.S. consultants who participated in the preparation of the Project Paper are listed in Appendix 3 to Annex G.

III. THAILAND SCIENCE & TECHNOLOGY PROGRAM ADVISORY COUNCIL (TSTPAC)

1) Dr. Sanga Sabhasri (Chairman)
   Permanent Secretary, MOSTE
2) Dr. Anat Abhabhirama, President
   Thailand Development Research Institute
3) Dr. Malee Suwana-adth, Director
   Center for Genetic Engineering & Biotechnology
4) Dr. Narongchai Akrasanee, Senior Vice President
   Industrial Finance Corporation of Thailand
5) Dr. Natth Bhamarapravati, Rector
   Mahidol University
6) Dr. Sippanonda Ketudat, President
   National Petrochemical Corp. Ltd.

IV. PROJECT REVIEW COMMITTEE

1)	Mr. R. Halligan	Director, USAID Mission
2)	Mr. J. Evans	Director, PERE
3)	Mr. J. Foti	Director, AGR
4)	Mr. P. Howley	Area Contracting Officer
5)	Mr. T. Tiffany	Director, HPN
6)	Mr. B. Viragh	Regional Commodity Management Officer
7)	Members	Project Development Committee