MID-TERM EVALUATION OF THE USAID/THAILAND SCIENCE AND TECHNOLOGY FOR DEVELOPMENT PROJECT

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INTERNATIONAL SCIENCE
AND TECHNOLOGY
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ACRONYMS

AUA	American University Alumni
A.I.D.	Agency for International Development
BOB	Bureau of the Budget
BOI	Board of Investment
BOSTID	Board on Science and Technology in Developing Countries
D/RDS	Diagnostic/Research Design Service
DTEC	Department of Technical and Economic Cooperation
FDA	Food and Drug Administration (U.S.)
GDP	Gross Domestic Product
GNP	Gross National Product
IDS	Industrial Development Support
IFCT	Industrial Finance Corporation/Thailand
MOF	Ministry of Finance
MOSTE	Ministry of Science, Technology and Energy
NAS	National Academy of Sciences
NESDB	National Economic and Social Development Board
NRCT	National Research Council/Thailand
OAG	Office of the Auditor General, RTG
PACD	Project Assistance Completion Date
PC	Personal Computer
PI	Principal Investigator
PIL	Project Implementation Letter
RA	Research Association (U.K.)
R&D	Research and Development
RD&E	Research, Development and Engineering
RFP	Request for Procurement
RTG	Royal Thai Government
S&T	Science and Technology
STAMP	Support for Technology Assessment and Mastery Program
STDB	Science and Technology Development Board
STP	Science and Technology Policy
STQC	Standards, Testing and Quality Control
TAC	Technical Advisory Committee
TDRI	Thailand Development Research Institute
TIAC	Technology Information Access Center
TISTR	Thailand Institute of Technology Research
TNO	Organization for Applied Scientific Research (Netherlands)
TRP	Technical Review Panel

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Science and Technology Development Project is an innovative seven-year cooperative initiative of the Royal Thai Government and the U.S. Agency for International Development/Thailand to develop Thai self-reliance in science and technology for industrial development. As one of A.I.D.'s most creative projects for institutional development, it involves the establishment of, and financial support to, a Science and Technology Development Board (STDB) which operates as a Project under the Thailand Institute for Scientific and Technological Research, within the Ministry for Science, Technology and Energy. Funding consists of $19.6 million of USAID loan funds and $15.8 million of grant funds, augmented by approximately $9.5 million from the Royal Thai Government and about $4.5 million from the private sector.

The Science and Technology Development Project is unique among A.I.D. programs in that it serves to strengthen university competence in science and technology, to provide technical support to industry, as well as to develop strong linkages between academia and industry. Unlike other university-industry collaborations, STDB does not (at present) itself conduct technical programs, but rather operates as a professional clearing house which identifies industry needs on one hand, appropriate technical resources on the other, and provides the planning and financial support for projects with which these resources can address the defined needs. Its focus is on small and medium scale industry in Thailand, rather than on large companies which usually have better access to suitable technical resources.

STDB operates in three major fields categorized broadly as genetic engineering/biotechnology, materials, and applied electronics/computers. Emphasis is placed on the use of science and technology (S&T) for improved competitiveness in export-oriented industry and on the improvement of product quality--especially for exported products. STDB has three main elements of activity:

- Research, development and engineering (RD&E) projects, established primarily at universities but also within private companies, in subjects potentially or specifically relevant to the needs of private industry. Most of the effort has gone to establishing designated RD&E projects to strengthen university competence (already world-class in certain fields), and to university-operated competitive RD&E projects designed to solve specific problems of industry.

- Industrial development support projects, including a program of standards, testing and quality control (STQC), a technical information access center to serve the RD&E and business communities, and a diagnostic/ research design service (D/RDS) to solve production problems in Thai industry and to develop the competence of the technical-service industry.

- A science and technology policy (STP) program to influence policies and practices in Thailand regarding the development and utilization of scientific and technological capabilities, and to upgrade the ability of Thai policy analysts.

Additionally, a program of fellowships provides support to students studying science and technology (S&T) in Thai universities, and a professional exchange program brings together industry professionals and academic researchers in workshops and conferences to review state of the art technology, identify industry problems and formulate approaches to solution of these problems. Finally, a recently conceived program for Support of Technology Assessment and Mastery (STAMP) is designed to assist companies in mastering technology and production processes relevant to their businesses.

In spite of a delayed start, STDB is established and operating effectively as a resource institution, identifying needs of users as well as relevant science/technology resources, and organizing/funding programs to address these needs. Originally planned to terminate its existence in fall 1992 after seven years of operation, STDB now appears to be established as a permanent institution. A current bill proposed to the Thai legislature provides for an expansion of the STDB with funding of 10 billion Baht (about $400 million) over a period of five years, starting perhaps in 1991 or 1992.

Because of the delayed start of STDB's programs, due to unanticipated complexities of establishing the STDB as a new institution and of attracting competent and experienced personnel, expenditures have lagged with respect to plan but are now building to the expected rate. In view of some remaining personnel shortages, STDB needs to maintain high vigor in its program activities if it is to meet its annual plan.

The Evaluation Team recommends an immediate three-year extension of the current Project Assistance Completion Date (PACD) to September, 1995, with continuing financial support thereafter by USAID, but contingent on passage of the proposed S&T bill by the Thai legislature. Such additional support will be needed around 1991 if the STDB programs are not to taper down. Positive action will improve the effectiveness of STDB by providing a long-term stable environment for attracting qualified personnel--especially personnel with private-sector industrial experience, including industrial, engineering and research and development (R&D) management.

Additional personnel are urgently needed to fill current openings, and to assist in developing more active linkages with private industry.

In retrospect, the Project Paper appears to have been somewhat optimistic in its expectations for STDB's development schedule. Major factors contributing to the delay in STDB's development include the unanticipated delay in establishing STDB as a new institution, the delay in providing technical assistance created by the bidding process for a technical-assistance contractor, the difficulty in attracting qualified senior personnel to an enterprise whose function was to terminate in 1992, and the complexities of operating within an administrative environment which includes oversight from three Thai government agencies as well as A.I.D.

Nevertheless, STDB has overcome these handicaps and is functioning relatively smoothly. At this point, the remaining personnel openings are being filled, and certain programs that have been delayed by staff shortages, especially industrial development support programs, are now being implemented.

In its review of STDB operations, the Team noted a number of opportunities for improvement. As highlighted in the Major Evaluation Findings, Conclusions and Recommendations, these included the need for additional personnel above and beyond the planned complement, a need for increased cohesiveness among senior management, and a requirement for tighter linkages between the RD&E coordinators (and their principal investigators) and the user private-sector companies. Such linkages should start before or during project planning and continue throughout each project. The need for improving these linkages results from the fact that STDB has been able more readily to attract personnel on assignment from the academic world than it has from industry.

The Team encountered an inadequate understanding of the STDB mission and operations, as well as a perception that STDB projects to date have insufficient relevance to industry needs. The Team does not fully agree with this perception; yet it assigns high priority to the need for STDB's coordinators to form tighter linkages with industry. Increased publicity addressed to appropriate government and user constituencies, including publication of suitable information materials, is advised. An associated strategy for marketing of STDB's services to private sector companies is also recommended.

In the past, considerable time and effort has been required of STDB personnel and its principal investigators to satisfy the project-approval procedures of the multiple oversight committees. With the increasing maturity of STDB, especially the increased experience in project planning, it is hoped these committees, including STDB's own Executive Committee, will delegate much of the approval process to STDB.

The Evaluation Team noted the need for increased participation by private-sector members of the Executive Committee to assist STDB with recruitment of staff having industrial experience and with issues of strategy and policy. It also noted that STDB can assist Thailand's Board of Investment with matters of technology policy and implementation, as well as the Industrial Finance Corporation of Thailand (IFCT) with product and process consulting support to IFCT portfolio companies. The Support for Technology Assessment and Mastery Program can be of special benefit to these agencies.

In regard to the industrial development support (IDS) programs, the Team strongly endorses the current "bottom-up" focused approach of the Standards, Testing and Quality Control Program to help specific companies or industries, such as to provide assistance to the latex glove industry to meet the quality specifications of the U.S. Federal Drug Administration. The Team noted that original plans to establish the Technical Information Access Center (TIAC) as an organization separate from STDB stemmed from the original anticipated shutdown of STDB in 1992. With the extension of the PACD and the expected permanent status of STDB, the Team recommends operating TIAC within STDB. Savings in personnel and administrative overhead can be achieved, thereby, because of the low utilization rate of existing on-line information facilities in Thailand, the term recommends an effort to identify new markets for information services, together with creative approaches to these markets.

Two long-range concerns for science and technology in Thailand are: (a) the need for private industry to undertake a greater role in research, development and engineering, and ultimately to relieve the Government of its current 90 percent involvement, and (b) the need for a larger production rate of scientists and engineers to support Thailand's growing program of industrialization. Through the expansion of its successful program of fellowships to include overseas universities, STDB can assist in increasing the rate of production. Another possibility is to extend the successful open university program to include science and engineering curricula--recognizing that laboratory experience on the university campus must be retained. Both issues are candidates for analysis in STDB's science and technology policy program and for the development of new, innovative policies.

STDB staff members are competent, enthusiastic and working hard to achieve STDB's goals. USAID/Thailand and the Royal Thai Government are to be commended for their vision and dedication in conceiving and inaugurating Thailand's Science and Technology Development Program.

INTRODUCTION

This document, written under Contract 493-0340-C-00-9072-00 with USAID/Thailand, is a mid-term (or interim) evaluation of the Science and Technology for Development Project being implemented by the Science and Technology Development Board in Bangkok, Thailand. The Work Statement for this evaluation is attached as Appendix A.

The evaluation was conducted in Bangkok, Thailand during the period from late May 1989 until early July. The evaluation team consisted of two U.S. individuals from the private sector and two Thai individuals, one a consultant from the academic community and the other a business-industry consultant. Curriculum vitae of the evaluation team members are provided in Appendix B.

The evaluation has been based on 1) interviews and discussions with many individuals, including members of STDB staff, its Executive Committee and its Board of Directors, and 2) a review of extensive numbers of planning papers, internal memoranda, project proposals and other relevant documents.

Appendix C lists the individuals with whom team members had helpful discussions, and Appendix D is a list of documents reviewed.

This report opens with a background discussion on the processes of industrial innovation and technology transfer whereby the fruits of research and development are translated into new or improved products and processes which contribute to economic growth. This discussion also provides a characterization of the industrial environment in Thailand that represents the market for the Science and Technology Development Board.

The team extends its appreciation to many individuals in Bangkok for their valuable assistance. The support of USAID staff, including Mr. Robert Barnes and Mr. Win McKrecken, has been most helpful. In particular, the cooperation of STDB staff has been highly significant, especially the Director, Dr. Thalerng Thamrong-Nawasawat; the Deputy Director, Dr. Wirojana Tantraporn; the Assistant STDB Director Prof. Dr. Montri Chulavatnatol; and Director of Planning, Program Development and Policy Review, Dr. Nit Chantramonklasri. Members of the Board of Directors and the Executive Committee were generous in allocating time for discussions and in sharing their insights.

Special thanks go to His Excellency Mr. Prachaub Chaiyasarn, Minister of Science, Technology and Energy, and Chairman of the STDB Executive Board, for the privilege of a meeting with him early during the study which provided guidance for the Team's further efforts.

Ms. Supatra Ngarmsa-ard, Administrative Assistant at STDB, provided effective assistance in arranging interviews and in administrative support.

CHAPTER I

BACKGROUND

Given the purpose of this Project: "to enhance the effectiveness and the extent of public and private sector application of science and technology to Thailand's development," it is useful as background to review the generally accepted evolutionary steps whereby the application of science and technology leads to economic development. Also helpful is a review of the process of technology transfer crucial to the commercial application of science and technology, and of the phases of industrialization typical in developing countries.

A. Stages of Industrial Innovation[1]

The stages listed below comprise the process of innovation, which is only complete after ultimate commercialization of the product process, including manufacturing, marketing, sales, service support, and the generation of profits. Necessary to the innovation process are many supporting actions without which research and technology developments cannot be translated into business success.

- Basic, or exploratory, research;
- Applied research;
- Technology (or engineering) development; applications development;
- Pilot production; pilot projects;
- Industrial production;
- Product and process improvement;
- Marketing, sales and service; and
- Product and process improvement.

The actions may occur in different sequence from that shown.

- Macro Analysis;
- Micro Analysis;
- Pre-feasibility Study;
- Feasibility Study;
- Technology Agreement (if necessary);
  - -- Marketing;
  - -- Evaluation;
  - -- Negotiation; and
  - -- Securing rights;

[1]Also called the "spectrum" of industrial innovation

- Industrial Engineering (including provisions for quality control); and
- Project Implementation.

In the innovation process, scientific advances occur in the conduct of basic and applied research. In technology development these advances are further carried to the stage where manufacturing or other economic activity is possible. Technological evolution does not always follow the simple sequence listed, but can be furthered by successive infusions of the results of continuing basic and applied research. For example, consider magnetic recording, which started with Poulson's invention (and patent) late in the nineteenth century for the recording of speech and music signals on a steel wire. The first innovation was the successful marketing of wire tape recorders. Continuing basic and applied research have yielded major developments in magnetic-steel alloys, mylar-based magnetic tapes, semiconductor devices and integrated circuits (including the original invention in the 1940s of the transistor), miniature electric motors, miniature magnetic reading and writing heads, etc.

Over many decades, these developments have provided successive innovations in paper-and mylar-tape audio recorders, as well as video recorders. Each of these innovations required supporting actions to determine whether a market existed or could be created, including economic and feasibility analyses, the negotiation of manufacturing and marketing rights, adequate product quality to sustain a world-wide market, and the implementation of a manufacturing, sales and service program. The first video recorder products were expensive, complex machines for broadcast-studio recording. To extend the technology to consumer markets required redesign of the product and manufacturing processes to achieve consumer cost levels and product acceptance, as well as the development of new consumer market networks to supplement the professional-market channels through which studio video recorders had been sold. Lest the impression be given that the innovation process is driven by science and technology developments, it should be emphasized that innovation is usually a result of perceived market demand or opportunity, with technical developments frequently occurring in response to the opportunity.

The purpose of the above discussion is to emphasize that scientific research and technological developments alone do not suffice for innovation success; complementary steps are needed along the way. Technical and commercial feasibility analyses are crucial to ensure that investment in technology development and pilot production, industrial production, etc. will reap a return. If the technology-transfer recipient (a licensee) does not possess these skills, they can be provided by local consulting organizations, or provided by the licensor as an integral part of the technology-transfer package. If the licensee does not develop such skills, he is handicapped in regard to business development and continues to be dependent on the licensor. Included in the skills needed for business self-sufficiency are technical and industrial management and the capability independently to procure (selectively purchase) raw materials, sub-systems, components, manufacturing and processing equipment, etc.

The innovation process can be continuously enhanced by the introduction of relatively minor improvements in product design and/or manufacturing process which result in reduced manufacturing cost and increased market share, by which the manufacturer can "progress down the learning curve." From a business perspective, product/process improvements--although less dramatic--often contribute more to profits than a totally new product design or new generation of products.

It should be clear that the innovation process is a complex one that needs to be managed. To do so, technology strategy, industrial engineering and engineering management--as well as science and technology--are needed skills, which in developing countries are usually in short supply.

B. The Process of Technology Transfer

The term technology transfer is typically used to denote the transfer of product designs and manufacturing processes from a licensor company in one country to a licensee organization in another country. The licensee may be an independent company, a joint venture with the licensor, or an organization wholly-owned by the licensor.

However, th. process of technology transfer is far more broad and pervasive; it occurs between university research groups and industry, between the central laboratories of an industrial organization and its manufacturing divisions and between the product design and manufacturing departments of a single manufacturing organization. **It also occurs between each of the successive stages of industrial innovation outlined above.** Technology transfer can occur between individuals or between organizations. The terms of technology transfer across a source-receiver interface may be highly informal--as between two close colleagues--or highly formalized--as between a licensor in one country and a licensee in another (when government regulations and protection of intellectual property rights may be factors). Usually a one-way channel, it can also be two-way.

Technology transfer can be discrete, as when transferring a "licensor package," or it can be continuous--as when an overseas and home-country plant share continuous improvements in manufacturing technology. Even within a manufacturing organization, this distinction occurs. Traditionally, a product engineer completed his design before handing it over (technology-transferring it) to the manufacturing-process engineer. Today, for example, in the automotive industry it is found that continuous technology transfer during the design process (mutual interaction between them) can reap major cost savings in optimized design for low-cost manufacturing, as well as significant time savings in the innovation schedule.

Technology transfer can occur under conditions of science (or technology) "push" or be stimulated by conditions of industrial or market demand (or "pull").

Usually, between the source and the recipient there is a difference in perspectives, in culture, or in value systems which affects attitudes toward the technology-transfer process. The university-industry interface is an illustrative example. Traditionally, academic researchers want to refine their developments. They consider cost factors less important, are less concerned about commercialization, and want to publish their findings as soon as significant results are available. The time schedule itself, however, is not urgent. Industry, on the other hand, is anxious to get the product to market and generate profits and is thus impatient with continuing refinements. Also, to protect proprietary rights, industry doesn't wish the developments publicized until patent applications, if appropriate, have been filed. For effective interaction between the university community and industry, these differences in attitude must be reconciled. Industrialized countries use a variety of bridging organizations to expedite the transfer of know-how from the university world to industry (see later discussion in Chapter IV).

For successful technology transfer, regardless of the source and recipient, the recipient must possess the "capacity to assimilate." This capacity embraces the following:

- An enthusiastic desire to absorb the technology in its entire scope;
- Building and equipment facilities for needed development and for manufacturing and quality control;
- Financial resources sufficient to implement the project; and
- Competent technical and managerial human resources, who either possess the required skills or will be provided the necessary training, and who will have adequate assigned time to the project.

If these factors are not satisfied, technology transfer is not likely to succeed, and business success will not be achieved.

In addition, business success is more likely if technology transfer is undertaken at a later stage of the innovation sequence than at an earlier one. Transfer of market-ready product designs and manufacturing methods has a higher probability of business success than transfer of knowledge at the applied-research or technology-development stage. In the case of the latter, many further steps are required prior to commercialization, with each step involving additional investment, different human skills, and possibility of failure--as well as time delay.

For effective technology transfer, it is helpful for the source and recipient to agree in advance on objectives, on criteria by which success is measured and on which party performs which tasks, and by when.

C. Stages of Industrialization in Developing Countries

In many developing countries, as in Thailand, the abundance of science or technology-trained university graduates is low. Each such individual is a national resource and should be "invested" in an activity which will yield maximum benefit to the country. Depending upon one's choice of criteria, this individual might be optimally used in an industrial capacity to contribute to economic growth through improvements in productivity, or through the design of new or improved products, by which to enhance import substitution or national exports.

Four phases of economic development can be identified. In phase one, particularly during development of a country's infrastructure, the country imports purchased technology by means of license agreements, with which to rapidly establish product manufacturing or processing. Typically, a product is first assembled from an imported kit. Later, component parts are fabricated locally, and the local added-value is increased to a level commensurate with local capability. More sophisticated components (for example, automotive engines) continue to be imported until facilities for their local fabrication are established. Through such progressive manufacturing a country develops its industrial base. The concepts of technology acquisition and technology adaptation (to meet local needs) apply to this phase, and require a certain minimum amount of technical talent. No major research is conducted; in fact licensor companies are expected to conduct research to keep the licensor's technology at optimum cost-effectiveness for the international marketplace; license fees paid to them are expected to fund such research.

The second phase is one in which a country's organizations utilize available technology for the improvement of existing products or the design of new ones. In this phase, dependence on foreign licensors is somewhat diminished, and the capacity to innovate begins to develop. The country's design and manufacturing skills now become more important, and a larger number of experienced scientists and engineers are needed.

In the third phase, the country's organizations develop new science and technology and apply it to the improvement of existing products and processes, as well as to the development of new ones. Innovation capability is significantly increased. A greater degree of technological self-sufficiency now exists, and a still larger number of engineers and scientists is needed.

Finally, in the fourth phase, a country performs basic, exploratory and applied research relevant to its domestic businesses, as well as to its national and human needs. Typical of priority national needs in tropical countries is research to support tropical agriculture and medicine, because such assistance is not available elsewhere. In fields where research results are available from other countries, it may be more appropriate not to devote scarce human resources to research in these fields, but to depend instead on outside sources.

Within any one country, industrial development will not be as distinctly structured as implied by the above model; there will be a distribution of maturity among various industries and companies. In an attempt to accelerate the process of industrializing, several of these stages may be undertaken simultaneously.

When constrained by limitations on availability of skilled human resources, a country may try to set priorities between short-term and long-term objectives. For shorter-term economic development, scientists and engineers are required to satisfy the technical needs of industry, whereas for long-term development a country may wish to establish a stronger base of research capability at universities and other national institutions. In fields where human resources are scarce, operation of the marketplace usually overrides such considerations, for private-sector industry can offer scientists and engineers economic incentives superior to universities and government institutions. This phenomenon exists in developed and developing countries alike.

D. The Environment for Thailand's Science and Technology Development Board (STDB)

Thailand's Science and Technology Development Board was established as a Project under a state enterprise Thailand Institute of Technological Research (TISTR), with the assistance of the USAID Science and Technology for Development Project. This Project had as its first major objective the establishment, staffing, and functioning of STDB, in accordance with the Project Paper (Thailand, 493-0340). In the initial conceptualization of STDB, it was envisioned that STDB would terminate its existence at the end of the Project. More recently, efforts have been initiated to institutionalize STDB as a permanent mechanism for stimulating the development and application of science and technology to stimulate industrial growth.

The constraints on science and technology development in Thailand of limited human resources, lack of experience in the R&D community in the support of industry as well as lack of expertise in management of technological programs are reasons we have heard cited for establishing STDB. While making progress in alleviating these constraints, STDB is itself facing some of them in building its own organization.

The discussions in the preceding sections describe the generic process of industrialization (and thus economic development) to which the various programs of STDB relate, and which is expected to be catalyzed by the results of these programs.

As an advanced developing country, Thailand is experiencing a rapid industrialization, stimulated by the growth of exports based on its indigenous raw materials and added-value industries, by the increased purchasing power of its domestic market, by a vigorous tourist industry, and by skyrocketing investments from countries whose strong currencies and high labor rates (relative to the Baht) make labor-intensive manufacturing and processing in Thailand highly attractive. These countries include Japan, Europe, Taiwan and the U.S., and their investments are intended to serve both domestic and export markets.

According to published information, the Royal Thai Government (RTG) wishes to maintain a balance between the agriculture, industrial and service (including tourism) sectors, and to improve the equity of wealth distribution among the population, about two-thirds of which is still devoted to agriculture.

The Project Plan has designated three sectors in which STDB shall concentrate its S&T efforts: bioscience/biotechnology; material technology; and applied electronics/computers. The suggested distribution of effort among the three is 50/25/25.

Consideration of the private-sector S&T markets to be served by STDB suggests that they can be characterized in several ways. One cut divides them into fields as follows: agriculture (including rubber), fisheries, food processing/packaging, mineral-resource extraction and associated industries, ceramic products including kaolin, pharmaceuticals and health care, automotive, consumer electronics, professional electronics, and others.

Another cut divides the Thai economy into agriculture (17 percent of GNP), manufacturing (24 percent), wholesale and retail trade (16 percent), services, including tourism and finance (14 percent), with the balance covering mining, construction and transportation. (These data are the latest available to the Team, and are based on early-1987 statistics). Note that the manufacturing sector's contribution to GNP is about 40 percent larger than that of agriculture, although it employs fewer workers.

Recognizing that bioscience/biotechnology has relevance to fisheries/food processing and pharmaceuticals/health care as well as agriculture, and that materials and electronics/computers relate essentially to all manufacturing, the planned distribution of STDB effort between these sectors appears to be appropriate. (The Team is concerned, however, that the RD&E effort in materials and electronics/computers appears to be lagging in comparison to the bioscience/biotechnology sector.)

A third cut divides the Thai agriculture and manufacturing industries into large-, medium-, and small-scale enterprises. For reasons of relative need as well as its ability to assist, STDB is focusing its efforts on the small- and medium-scale enterprises. The associated rationale also suggests that large-scale industry either already has adequate S&T capability, or has the financial resources to acquire the capability.

The latter case deserves further examination, for there may be opportunity to assist larger firms as well. Many large firms in Thailand are joint ventures with, or licensees of, foreign firms. Although there are notable exceptions, these organizations often are mere assembly houses, with little independent S&T capability. They depend largely upon the licensor company to satisfy their minimum technical needs. Such passive dependence does little to develop Thailand's technological competence. Criticism has been leveled at some licensor companies for this lack of technology transfer.

A nonintentional, but interesting example has been cited of the progressive manufacturing process in Thailand's automotive industry, which is occurring under RTG requirements of 65 percent local content. To quote a recent Time-magazine supplement: "Of the 1,500 people in Siam Motor's gleaming 19-story headquarters in Bangkok, Sakai and half a dozen assistants are the only Japanese. The company's Nissan-related business employs 4,000 people in all, including those at its 120 showrooms nationwide, which are all company-owned. Its slew of component joint ventures or simple technical tie-ups employs another 6,000, and reads like a **directory of Japanese parts makers: Nippon Denchi batteries, Hitachi electric components, Kayaba shock absorbers, Daikin brakes, Calsonic radiators, NGK spark plugs, Riken piston rings, Kiesel Kiki air conditioners and Tsuchiya oil filters.** These joint ventures, plus sourcing from other Japanese-local joint ventures, insure that the Cedrics, Bluebirds, Sunnys and one-ton pickup trucks assembled by Siam Motors contain up to 65 percent local components."

These local component suppliers provide significant employment and contribute to Thailand's economic growth, but their strong ties to the parent assembler on one hand, and to the Japanese component manufacturers on the other, suggest that little technology transfer takes place other than for the assembly process. For many components, the engineering design is relatively simple and readily accomplished in Thailand. The case for science and technology in Thailand would be benefitted if independent component manufacturers could innovate and develop these products locally. Alternatively, since the structuring of this automotive-component-assembly industry has reached some degree of maturity, these existing licensee companies could be assisted to develop an independent S&T capability and expand their product lines (or improve their manufacturing efficiency) without foreign assistance. The purpose of this example is to illustrate that STDB does have a market opportunity, directly or indirectly, to assist manufacturing enterprises in this larger-company category. However, since STDB's resources are limited, it is probably correct to concentrate initial efforts on small- and medium-size firms.

E. Linkages of STDB with the Private Sector

Given that the objective of STDB is to contribute to Thailand's economic development through S&T support to the private sector, it is appropriate to examine these interfaces.

First, it should be noted that STDB does not conduct actual S&T programs in-house. A possible reason is that by depending on external agencies such as university faculty and consulting organizations, it avoids developing a permanent internal technical staff that could become less relevant to industry needs as these needs change over the years. STDB's current role is thus one of a contracting organization, a brokerage role or clearing house that contracts for the most effective S&T services to meet a multiplicity of defined needs of the private sector. In contracting for these services, the effectiveness of its functions will be enhanced to the extent that there is a vigorous technical and economic competition among the agencies that compete to supply these services.

Note that the benefits of Designated and Competitive RD&E projects are likely to input the spectrum of industrial innovation at the applied research, technology development and pilot production stages; the Company-Directed projects at the technology or applications-development stage; and the industrial support programs primarily at the industrial production stages. In these activities it is probable that STDB will find many opportunities to assist Thai industry with product extension and product improvement, as well as manufacturing and process improvement, rather than with new product innovation.

The brokerage role for STDB results from the broad S&T scope that has been assigned to it. In this respect, its role differs from government-supported institutions in industrialized countries that provide more specialized S&T services to the private sector. (In Thailand, the Metal-Working Industries Development

Institute is such an organization.) In the U.K., the Netherlands and the Federal Republic of Germany, for example, there are networks of S&T organizations for defined sectors. They maintain working scientific staffs and laboratory facilities. In general they are partly supported by their governments and partly by memberships and/or specific contracts from private industry. In the U.K. this network is known as the Research Associations, and it includes the Rubber and Plastics R.A., the Motor Vehicle R.A., the Scientific Instrument R.A., etc. Member companies of each pay annual fees; the associations conduct generic research of benefit to all members, but apply their knowledge and experience to individual company problems under a contractual arrangement which provides for confidentiality and protection of proprietary rights. Some elements of these relationships are found in STDB's Diagnostic/Research Design Service (D/RDS) concept.

In the Netherlands, the Netherlands Organization for Applied Scientific Research (TNO) conducts similar programs for both Dutch and foreign companies in such fields as metal working, aerospace, energy systems, etc. The Dutch institutes are frequently located adjacent to a university and their staff sometimes hold faculty appointments. Staff members, however, have a mind-set that recognizes the needs and value systems of industry.

In the Federal Republic of Germany, there are two networks. One is the famous Max Planck network of stand-alone research institutes which conduct intensive and more basic research in such fields as biotechnology, astrophysics, nuclear structure, aerospace, etc. In addition, a network of Fraunhofer Institutes deals more in applied-science and technology for more direct support to industry. These institutes, located on or adjacent to technical universities, operate in a similar manner to the British Research Associations and the Dutch TNO institutes.

This contrast between the European institutes and STDB highlights the brokerage role of STDB. To implement its technology strategy responsibilities, STDB must have a broad overview of the state of science and technology in each of the three defined sectors. It must maintain a similar awareness of the state of technology and business in related Thai industries, and their respective needs for S&T support. It needs also to be aware of related business and technical developments in foreign industry if it is to implement its technology strategy effectively.

F. Roles Performed by STDB Staff

To understand how an organization can meet such a challenge, it is helpful to review some of the roles performed by individual S&T workers. The following analysis of S&T roles applies to university faculty and staff, to researchers in government institutes or private-sector laboratories, and to S&T staff in management organizations such as STDB. These roles are readily identified in structured organizations where staff members work cooperatively to achieve common goals. Note that any one individual need not be identified with a single role, but may fulfill a mix of roles--each with varying emphasis:

- **Idea generator**--This is the role of the creative thinker, or inventor, who develops new insights, ideas or product/process concepts, but may not necessarily himself be responsible for, or inclined to conduct the needed R&D to verify them or implement them in a practical embodiment.

- **Researcher**--This role is that of the individual who methodically conducts the R&D to carry new insights or theories to a further stage of refinement, or to a practical embodiment. As defined, this role does not include the generation of the original idea or insight.

- **Administrator**--This role is one of performing the necessary paperwork to make an R&D project possible. With the help of the researcher, the administrator formulates the required project plan and develops the budget, monitors to determine that identified milestones are met, and that project reports are written. He maintains records of staff time spent on each project. Though not a glamorous role, it is vital to the smooth functioning of a technical organization.

- **Champion**--In this role, an individual having techno-business understanding and a degree of vision recognizes the potential value of an R&D idea, development, or new product concept. On behalf of the idea generator or researcher, he campaigns to have an R&D project initiated or extended, locates needed human and financial resources, and campaigns with management for approval to conduct the work. He is usually an extrovert, knowledgeable about his organization and willing to spend political capital to promote a concept he believes in--which often is not his own. This role is the most entrepreneurial of the group.

- **Technical Gatekeeper**--This role is that of a human information node or data base. It requires an individual who is a natural communicator and keeps actively up-to-date with progress in his field by reading the professional literature, attending professional conferences, talking with colleagues, etc. It is a person who returns from a conference and conducts a seminar on the results or informs selected colleagues about new developments relevant to their work. He is probably a frequent user of bibliographic data bases, and is sought out by associates when they have technical questions. (Some technical organizations have institutionalized this role by publishing the names of identified gatekeepers and their fields of specialty, and by providing each gatekeeper with a stipend for journal subscriptions, new books and travel to conferences.)

- **Industry Gatekeeper**--The industry-gatekeeper, or business-gatekeeper, role is similar to that of the Technical Gatekeeper except that the focus is on information about new technology and new product developments in industry, both domestic and overseas. This person has a techno-business attitude. Frequently, he serves also as technical gatekeeper.

- **Manager**--The manager role is that of determining the priorities of needs to be addressed, defining the nature of each opportunity or problem, deciding upon a program for addressing the opportunity or solving the problem, identifying and allocating the human and nonhuman resources needed to accomplish the mission, and controlling the program to ensure that progress is commensurate with the schedule and the rate of expenditure or effort. In fulfilling these responsibilities, he is assisted by many staff members performing the various roles listed above, and, for defining technology strategy, he probably depends on his technical and industry gatekeepers. The manager should know the mix of roles performed effectively by each of his staff members; similarly, each staff member should understand his own effectiveness in performing these various roles.

Successful RD&E organizations are usually entrepreneurial in nature or are part of a larger entrepreneurial system. Entrepreneurial thinking involves the recognition of markets and business opportunities for new or improved products and processes, and the marshalling of resources with which to address these opportunities. Sometimes the technical ingredients of the entrepreneurial concept are based on simple combinations of features or developments--using existing technology. In other cases, they are based on new research or engineering results, as for example in genetic engineering for new drugs, industrial automation for improved quality control or in new applications of computers or new computer software. Associated with the entrepreneurial attitude is the ability to recognize where additional science or engineering effort can make a difference. It requires a knowledge of the business/industrial scene and the marketplace, and a certain willingness to undertake risks--sometimes financial risks.

The above discussion of roles is relevant to STDB; for effective service to the private sector it must perform most of these roles. For its brokerage function, the roles of technical and industry gatekeeper are especially important. The function of RD&E coordinators and program associates, in particular, involves the roles of technical and industry gatekeeper, as well as of champion to promote an especially valuable project, and of management to orchestrate and implement the portfolio of projects in his science/industry sector.

G. STDB, The Private Sector, and STDB's Market Environment

In discussions with senior members of the Thai S&T community, especially those in the private sector, the Team repeatedly heard comments that STDB was perceived as stimulating the quality of academic excellence in Thai universities, but that there was still insufficient direct support to the private sector. Indeed, the RD&E program is intended to provide long-term human resources for S&T in Thailand, as well as to directly support the private sector. With few projects older than one year, and the slow start of company-directed projects, it is premature to expect substantial output from this STDB program. Nevertheless, the conferences and seminars that have been held are believed to have created an awareness among small- and medium-scale industry of the need for stronger technical capability in their firms. At least some technical capability is required if project results are to be assimilated.

In addition, the industrial support programs: Standards, Testing and Quality Control (STQC), Diagnostic/Research Design Service (D/RDS), Technology Information Access Center (TIAC) and Support for Technology Assessment and Mastery Program (STAMP) have only just completed the planning phase and received approval to proceed; thus output from them cannot yet be expected.

As stated earlier, STDB's role as a broker or clearing house is to match private-sector needs for S&T assistance with resources capable of providing such assistance. These resources consist largely of university faculty, of consulting groups composed of university faculty, or services available from government institutions. Because of the low per-capita population of scientists and engineers, these resources are limited, but can be selectively augmented with help from the U.S. using the technical assistance available via the U.S. National Academy of Sciences contract.

The types of resources needed are related to the market needs. Thailand's industry is generally categorized as small-scale industry, medium-scale industry, and large-scale industry. The capacity of these companies to absorb technology inputs varies dramatically. Studies performed for STDB by the Thailand Development Research Institute (TDRI) subdivide technological capability into acquisitive, operative, adaptive and innovative, with most firms except the largest, having low operative capability, still lower adaptive capability, and negligible innovative capability.

In larger firms, especially foreign-connected, export-oriented firms, the situation is better, especially regarding operative capability. However, because of a tendency to depend on the foreign licensor for problem solving and product/process improvement, the adaptive and innovative capability are lower than desired. (It is usually in the financial interest of the licensor to encourage this dependency on the part of the license--payments by Thai companies to foreign licensors for technology fees in 1986 totalled about 2 billion Baht--and are undoubtedly now much higher.) The export-oriented institutions--particularly those favored with Board of Investment (BOI) promotion--are generally best qualified technically to strengthen their adaptive and innovative capability. Note that several large Thai firms, as well as one or more foreign joint ventures in Thailand, have excellent R&D capability, and have had outstanding success with the development in Thailand of new products for both domestic and export markets. Two examples are CP and Colgate Palmolive (Thailand) Company.

Recalling that STDB is currently focusing its attention on small- and medium-scale companies (having a short time horizon), several conclusions can be drawn:

- Although these firms are slow to recognize the benefits of technology assistance, success with STDB industrial-support services oriented to short-term problem solving, STQC, D/RDS, TIAC and STAMP will enhance these firms' awareness of the benefits of S&T inputs, as well as the longer-range Competitive, Designated and Company-Directed projects.

- The benefits of longer-range developments from two- or three-year RD&E projects to small- and medium-sized firms may be more elusive because of the disparity of time horizons and the low adaptive and innovative capability of these firms. The RD&E contribution may be in the ultimate supply of skilled manpower for the companies or to assist in providing industrial support services.

- In the large-company sector, STDB has an opportunity to assist the Thai economy through the catalyzing of increased technological capability in larger companies, particularly those where increased adaptive and innovative capability will permit greater technological self-sufficiency and ultimately reduce payments for foreign technology. A drawback is the natural skepticism that these firms have regarding STDB's capability to assist them. Certain technology-importing countries have deliberate S&T strategies for strengthening indigenous capability which are implemented by technology clauses in licensing agreements. The Team understands that Thailand has no such provisions in its regulations for foreign licenses, but that BOI has potential interest in assistance from STDB in developing and implementing an appropriate strategy that will stimulate the diffusion of technology. We believe this help will best be achieved through assistance to local firms in assessing, mastering and using technology. Such technology strategy assistance would constitute a major, long-term contribution, but may require the addition of suitable technical and management skills at STDB, including legal and technical consulting help.

CHAPTER II

MIDTERM EVALUATION OF SCIENCE AND TECHNOLOGY DEVELOPMENT PROJECT

The Evaluation Team finds the USAID/Thailand Project to establish Science and Technology Development Board with all of its concomitant functions to be the most innovative donor program for national science and technology support of which we are aware. The program is aimed at establishing an organization, Science and Technology Development Board (STDB), with the capability for taking a systems approach to the development and management of science and technology resources for the purpose of supporting industrial development. STDB's initiated or approved programs include: 1) developing S&T human resources through a fellowships program; 2) developing industrial research, development and engineering (RD&E) institutional capabilities by way of institution building grants; 3) solving specific industry problems or generating industry opportunities through grants to universities, public and private institutions, and private firms; 4) increasing the quality of the country's industrial output with a standards, testing, and quality control program that works through existing S&T institutions and agencies; 5) providing industry consulting support with consultants from universities, private firms or public institutions; 6) developing a national network of information centers with access to industrial, business, scientific and technological information; 7) initiating a support for program firms with their efforts to transfer and acquire technology; and 8) developing a program of policy studies directed at influencing policies and practices to stimulate the development and utilization of the country's scientific and technological capabilities.

Part of the Evaluation Team's responsibility is to assist STDB through the provision of constructive suggestions. The discussions that follow are structured in accordance with the questions posed in the **Evaluation Scope of Work.**

A. STDB Operations

The implementing organization envisioned by the **Project Paper** was to have had the following characteristics:

- "[A]n independent body . . . which receives **heavy managerial and technical inputs from the private sector** in all aspects of its operations";
- "[A]n organization . . . that acts with a large degree of **independence from standard Royal Thai Government (RTG) financial controls**";
- "[A] **legal entity** . . ."; and
- "[A]n organization which is run by professionals with both public and **private sector orientation and experience in technology development, financing, marketing and commercialization.**"[2]

For a number of reasons, none of the above conditions has yet been completely fulfilled. The Evaluation Team recognizes that they are desirable characteristics for the optimal operations of STDB. It follows that many of STDB's operational difficulties are less a result of managerial deficiencies than they are of difficulties in creating an organizational entity that possessed the desired characteristics. The inability, however, to create such an entity occasions no surprise at all to those with knowledge of RTG regulations or familiarity with public-private sector employment disparities in Thailand. The Team questions the reality-base of the analysis contained in the **Project Paper** regarding institutional feasibility.

The following section of the Report addresses five specific questions regarding STDB operations in the order in which they are raised in the **Scope of Work**:

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[2] Project Paper, Appendix J, emphasis added

1. Is the Organization Appropriately Staffed and Structured?

a. Staff

STDB's Thai staff consists of 16 professionals and 27 support staff. In addition, there are two Americans, the Deputy Director, who is Thai, and the Management Advisor, funded from technical assistance. Further technical assistance is provided by the National Academy of Sciences (NAS) team leader, who is in residence full-time, and by other short-term consultants. In terms of the staff needed over the anticipated seven-year project period, as suggested by the current staff manual, six professional and six support staff positions remain to be filled. At least one professional staff member is in the process of being hired. The selection/hiring process takes two to four months, on average.

At the present time, the following positions are vacant: Material Technology Coordinator (although a person is being processed for this position which will open up a Program Associate position), Industrial Services Coordinator, Economic/Commercial Development Coordinator, Automatic Data Processing Specialist, Director of Finance and Administration, and Chief of Administration. Positions that have been filled include: Director, Deputy Director, Assistant Director, Director of Planning and Program Development, Bioscience/Biotechnology Coordinator, Applied Electronics and Computer Technology Coordinator, STQC Coordinator, Company Directed Coordinator, Planning and Management Specialist, Chief of Finance, Information/Publicity Specialist, RD&E Finance Officer, Technical Information Access Center Director, and three Program Associates.

From the outset, STDB has faced a number of staff-related problems which have affected the performance of the organization. A central issue has been STDB's difficulty in recruiting and retaining qualified Thai professionals. Specifically, it has proved almost impossible to recruit professionals from the private (industrial) sector. It had always been the intention to keep STDB fairly small, with a professional staff of around 20 persons, but the current staffing level is less a result of this intent than it is a reflection of the fact that employment prospects, especially with respect to senior level positions, are not all that attractive within STDB. The lack of professional staff with management experience in the private (industrial) sector may have contributed to STDB's developing an orientation that, to too large an extent, resembles the operating modes of an RTG agency.

The reasons STDB has not been able to attract senior professionals are not difficult to understand. The very fact that STDB has only project status implies lack of long-term job security. Moreover, with the exception of the Deputy Director, who has been guaranteed a three-year term, all other professionals are hired on a one-year contract basis, which is not automatically renewable. Senior professionals in larger, more established organizations--both in the private and public sectors--are understandably reluctant to join an organization such as STDB, that is small, relatively unknown, and whose future is uncertain. Salary scales have not remained competitive with the private sector, nor have they been sufficient to induce university professors and other RTG officials to leave government service permanently. The prestige that attaches to government or university service, and the job security and fringe benefits that accrue to RTG officials, especially those that are more than halfway up their respective career ladders, are probably far more powerful factors affecting career decisions than was assumed by those responsible for drawing up the Project Paper.

The Team recognizes the difficulty STDB has had to date in attracting qualified personnel and commends STDB management on its achievements in a difficult environment. Nevertheless, to balance the preponderance of professional staff from the academic sector, STDB should continue to make special effort to attract additional private sector personnel. Assuming extension of the PACD, the Team believes that STDB at this point should attempt to devise creative incentive systems to attract private sector personnel as well as to retain academic staff. Especially desired are senior personnel with industrial experience in line management and RD&E management. The Team recommends that private sector members of STDB's Executive Committee again be asked to assist in this effort. Help from executive recruiting organizations may also be appropriate. In the effort to fill professional positions, it may be necessary to adapt the STDB organization structure to effectively utilize the qualifications of available individuals, rather than to attempt to match them precisely to pre-defined positions in the organization.

In addition to local solicitation, candidates could be sought among Thai professionals abroad and among individuals in industry who are approaching retirement. Further, effort should be made to recruit master's degree graduates from management schools who have completed an undergraduate degree in engineering or in science.

STDB can take a more active role in promoting beneficial results from RD&E projects to the private sector. The individuals at STDB positioned to perform the role of champion are the RD&E coordinators. The Team commends the coordinators for their accomplishments in establishing new RD&E projects and in the evaluation of existing ones. For the future, the professional development of STDB staff members and the recruitment of additional staff, as well as the strengthening of technical- and business-gatekeeper/entrepreneurial capabilities of the staff, should be emphasized. For development of these capabilities, consideration might be given to the use of internal workshops, with possible assistance from outside specialists.

STDB has suffered from a high turnover rate. On average, seven professional staff have been hired in each of the four years that STDB has been in existence. Each year an average of three professionals have left the organization. Of the 27 professionals hired to date, 11 have left. Current professional staff have been with STDB an average of 13.3 months. Staff who left had been with STDB an average of 14.8 months. If the present trend continues, one can expect professional staff to stay with the organization less than 1/2 years. Further details are provided below.

Table II-1

Year	No. New Appointments	No. Leaving	Net No.	Cumulative Appointments
1986	7	1	6	6
1987	8	3	5	11
1988	6	4	2	13
1989	6	3	3	16
Total	27	11	16	

Note: The above figures refer to professional staff only.

The high turnover rate can be explained by three factors. First, several of the individuals initially appointed to STDB positions turned out to be unsuited for the positions. Second, many professional staff are university professors on leave of absence from their respective institutions. Of the professors who have left, two did so in response to a request to return to their universities. Currently, about one-third of the professional staff are RTG officials on temporary leaves of absence. The third reason for a high turnover rate is because of offers of better employment with long-term job security elsewhere.

In brief, STDB has not been adequately staffed throughout its existence. The shortage of staff has been one of the factors hindering STDB's ability to fully undertake the responsibilities with which it has been charged.

In terms of qualifications, most of the professional staff possess requisite academic credentials, although some do not have as much work experience as the job descriptions contained in STDB's **Staff Manual** would require. As indicated above, particularly striking is the absence of professional staff with extensive management experience in the private (industrial) sector. Eleven of the 16 professionals have doctorates in appropriate fields, such as structural engineering, electrical engineering, solid state physics, agricultural economics, agricultural science, biochemistry, toxicology, plant pathology, and industrial and energy technology policy research and management planning. A majority obtained their doctorates only within the last five years or so.

Professional staff responsible for finance, although motivated and competent, require additional familiarity with "RTG organization, personnel, regulations, practices and customs".[3] Still, the Team takes note that the Chief of Finance had previously worked on a USAID energy project in an administrative/financial capacity which entailed dealing with Department of Technical and Economic Cooperation (DTEC). The R&D finance officer was an accountant with the Ministry of Industry for six years.

There are two administrative positions on the professional staff (Director of Administration and Finance, and Chief of Administration). Both positions are vacant. For the last three months, the Management Advisor has acted as Director of Administration and Finance. It would be better for STDB to appoint permanent administrators to fill its vacant positions, rather than have its advisor act as de facto manager for any length of time. Otherwise, a certain amount of confusion between managerial and advisory roles should be anticipated.

STDB's support staff possess the requisite qualifications. They also appear to be young, enthusiastic about their work, and eminently trainable. Among the support staff, the turnover rate has been much lower. Of the 35 staff hired to date, only eight have left. The usual reason for leaving is that better employment has been found elsewhere. Support staff morale and satisfaction with work conditions appears to be quite high, despite the fact that their salary scale is relatively much lower than the salary scale of the professional staff, and despite the fact that they lack employee benefits such as medical care, maternity leave, or pension plans.

b. Structure

Organizational structure usually denotes a number of dimensions. Here, we examine three: departmentation; decision-making; and communications.

STDB is governed by a Board of Directors, that meets once a year to set policy directions. Overall management is vested in an Executive Committee (a sub-set of the Board of Directors). Day-to-day operations are the responsibility of the STDB Director. For an organization as small as STDB, it is complex in terms of departmentation. Initially, STDB comprised six separate Offices and 16 identifiable sub-units within these Offices. As a result of a recent reorganization, however, there are now only four main Offices: IDS, headed by the Deputy Director; RD&E, headed by the Assistant Director; Planning, Program Development and Policy Review; and Administration and Finance. Sub-units include Standards Testing and Quality Control, Technical Information Access Center, and Diagnostic/Research Design Service under IDS; Bioscience/ Biotechnology, Material Technology, and Applied Electronics and Computer Technology under RD&E; Company Directed RD&E; Economic and Commercial Assessment; and a separate Information Publicity and Public Relations Unit. An organization chart appears in Appendix E.

The functional responsibilities of an organization should be reflected in the kinds of divisions it has. Currently, STDB does not yet have an active marketing activity. If one of STDB's objectives is to serve the private sector, and if the intention is to develop user services, then STDB should have a marketing arm, in addition to its technical divisions. The marketing of STDB services to the user community includes direct sales efforts to individual firms that can benefit from these services, and, in fact, STDB has a position for an Economic/Commercial Development Specialist (Coordinator), but this position has not been filled.

In the future, STDB may wish to consider expansion of the staff of the function of the Economic/Commercial Development Specialist (Coordinator) to allow more effort to be devoted to commercialization of RD&E and IDS products. An expanded group could stimulate, enlarge and strengthen the relationships between STDB and the RD&E coordinators and principal investigators on the one hand, and industry on the other. It would reduce the industry-interface logistic workload for the principal investigators (PIs), coordinators, and other STDB staff, yet stimulate linkages among the appropriate organizations and individuals.

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[3]STDB Staff Manual.

One of the functions that STDB senior management may have to perform in the future is to expand the search for donor support. In fact, if STDB is to become a multilaterally-funded organization as envisioned, its senior management may have to expend considerable effort on this task. It may be desirable for STDB to set up a separate development office for this function.

Organizational forms contain implicit assumptions about the functional relationships that exist. Divisionalized forms, of which STDB is an example, imply that each division operates more or less independently of the rest. Given the fact that there are only 16 professional staff at present, and that the number will certainly not exceed 24 in the foreseeable future, the question may be raised as to whether it is necessary to have such a system. To the extent that an organization's divisions are functionally interrelated and interdependent, the creation of unnecessary departmentation may prove dysfunctional to the performance of the organization as a whole.

Where functional interdependence exists, the greater the number of divisions, the greater the need for formal lateral communications linkages. STDB apparently does not hold regular staff meetings, which usually constitute one mechanism for lateral communications. What STDB possesses, however, are many in-house committees, subcommittees, working groups, and task forces. There are over ten such groups, each consisting of three to five members. A list of standing and ad hoc committees is provided in Appendix F. Dissemination of information about what is happening in the organization takes place through the mechanism of group meetings. We were unable to assess the quality of the information channels, much less the extent of communication generated, but what was quite evident was that the meetings consume an enormous amount of time.

In contrast to the many committees, subcommittees, etc. which serve as implementing groups, there are no regular staff meetings--as noted above. Staff meetings on a regular basis serve as one means for developing a common set of organizational goals and objectives, and for developing a uniform perception and acceptance of these goals and objectives. Moreover, staff meetings serve the additional purpose of assisting each individual to link his/her own work to the goals of the organization. Understanding one's contribution to the entire scheme of things helps also to prevent tunnel vision, a common organizational ailment.

STDB's decision-making structure appears to be characterized by rule by committee, hierarchical approvals, and a reluctance to delegate authority. Rule by committee is an obvious feature of the organization. In addition to the Executive Committee, referred to previously, important standing committees are the Technical Advisory Committee (for RD&E) and the Budget Committee (BC). The latter reviews and has to approve the budgets of all RD&E projects. STDB's Board appoints the Executive Committee, which in turn appoints the Technical Advisory Committee and Budget Committee. Membership on these three key committees consists of STDB senior management plus representation from the Ministry of University Affairs, Ministry of Science, Technology and Energy (MOSTE), Ministry of Finance (MOF), National Economic and Social Development Board (NESDB), DTEC, and the private sector in the case of the Executive Committee; MOSTE, National Academy of Science (NAS), and the private sector in the case of the Technical Advisory Committee (TAC); Bureau of the Budget (BOB), DTEC, MOF, and MOSTE in the case of the Budget Committee. A USAID representative has generally participated in the role of observer in all three committees.

The committee structure, which in the Thai bureaucratic context is generally employed as a device for facilitating inter-ministry and inter-departmental communications, has its advantages, but it also has its obvious drawbacks. Scheduling conflicts make it difficult to hold more than one meeting a month. Nine to ten meetings per year is closer to the norm. Meetings generally last no more than two to three hours. Decisions taken in one committee are more often than not part of a decision-making chain involving several committees.

Given the nature of this type of decision structure, agenda items (i.e., what to include and what to exclude) and intervention rules (i.e., level of detail considered appropriate) become of paramount importance. Some individuals think there has been a tendency to focus too much on minor details in these committee meetings. While serving a useful purpose in protecting the organization from error, too close scrutiny is time-consuming, and decision processes can become unduly protracted. Representatives of other agencies who sit

on STDB committees have pointed out, however, that, had agenda items been properly prepared in the first place, corrections would not have had to be made at the committee level.

Oversight and control by MOF, BOB, DTEC, and USAID are dealt with in a later section. It appears, however, that STDB's credibility in managing its own affairs was eroded at the beginning through its inexperience with RTG regulations, the reported submission of a proposed project that had already been undertaken elsewhere, questionable hiring practices, and internal management disputes. The outcome is that the various committees have thought it necessary to exercise their powers of oversight to the full. This has resulted in possibly too much attention to details, to the neglect of the more macro issues with which the committees should be concerned.

Recommendations

- STDB should consider holding staff meetings on a regular basis.
- STDB should hire a Commercial Development Coordinator or Specialist who will serve both the RD&E and IDS groups, including the marketing function.
- STDB should appoint a Director of Administration and Finance and a Chief of Administration.
- STDB should make special effort to attract private sector personnel.

2. Are Administrative and Financial Controls Systems Within STDB Adequate and Efficient?

The Management Advisor, as directed by the STDB Director, and in conjunction with the Director of Planning and Chief of Finance, has produced a series of flowcharts depicting administrative and financial procedures to be followed internally. Some of the flowcharts have been prepared to provide guidance on RTG/USAID requirements for commitment of funds, as well as to provide examples of various documentation involved. Others may have been assembled as a result of the document by relating to STDB Ernst & Whinney.[4] These flowcharts are assembled in loose-leaf form in the STDB Handbook, **Commitment Flow and Miscellaneous Flow Charts.** We reviewed 15 such charts, covering administrative and financial procedures for: travel authorizations (three examples); preparation of vouchers for Technical Review Panel (TRP) and A/CC meetings; authorizations for the use and disbursement of funds to cover telexes, FAX services, long distance calls, and overseas courier service (three examples); preparation of vouchers for honoraria paid to non-STDB committee members for attending meetings. Additional flowcharts cover, for example: commodity procurement operations, contracting--local technical assistance, annual implementation plan and financial plan, request for technical assistance services from NAS; response for technical assistance services from NAS. An example of a typical flowchart is provided in Appendix G.

While the flowcharts are commendably explicit, and result largely from the requirement for compliance with a myriad of regulations from five different organizations to which STDB is accountable, they also unmistakably reflect the degree to which STDB has bureaucratized itself. Typically, authorizations require signatures from the O/Administration, the O/Finance, the Management Advisor, and the Director. For example, travel authorizations for professional exchange events involve 15 separate steps (including 7 signatures and 4 clearances) from the time a memorandum is prepared by the appropriate Coordinator, to the time an advance travel voucher is received. During this process, signatures are required from the Director on three separate occasions (signing the memorandum to approve preparation of travel authorization, signing the travel authorization, and signing the travel voucher); clearance from the Management Advisor on two separate occasions (clearance for the memorandum before it reaches the Director's desk and clearance for the travel authorization after it is signed by the O/Finance, before passing it on to the Director).

Ernst & Whinney. Report on the Study and Evaluation of the System of Internal Control of Office of Science and Technology.

The Director's signature is required for the most routine matters. For example, requests for honoraria for non-STDB committee members for attending meetings, the sending of telexes, and the use of overseas courier services all have to be approved by the Director. The procedure is for the Coordinator/sender to prepare a memorandum which goes to O/Administration for clearance; then to the O/Finance for clearance; then to the Management Advisor for clearance; finally, to the Director for his signature; then back to the O/Administration and O/Finance for implementation. We note incidentally that in RTG agencies, the Director of General Administration would normally be authorized to sign approvals regarding purely administrative matters on behalf of the head of agency.

Standardization of procedures and guidelines is generally desirable for effective administration and financial control. For an organization the size of STDB, however, some of the internal controls may be excessive. Our impression is shared by some of the STDB professional staff, in particular, staff coming from the private sector. When asked to compare STDB's internal procedures with the private sector, one interviewee replied, "It's like night and day." Another commented, "We are like a government bureaucracy."

We do not know to what extent the development of the present system of internal management controls was influenced by the Ernst & Whinney 1986 Report, which stated that, "It is our impression that STDB's system of internal control is not sufficiently strong to withstand improper and programmatic pressures. Consequently, projects managed by USAID Science[5] and Technology Office would be at a risk . . ." Nevertheless, excessive control can have negative effects on the overall performance of the organization. A review by Price Waterhouse of STDB's financial reporting systems concluded that "internal controls appear to be adequate".[6]

In spite of the complicated and numerous procedures STDB has evolved for itself, however, authorizations appear to be produced in a fairly timely manner. Professional staff may complain, but on the whole they appear to have adjusted to STDB's procedures--which is not surprising since most of the professionals are from the RTG bureaucracy themselves.

Left to their devices, over time organizations tend to evolve their own preferred modes for handling internal operations. These are referred to as the standard operating procedures of the organization. STDB provides a case in point. The question organization analysts usually raise in this connection is, "To what extent are the organization's standard operating procedures functional or dysfunctional for the organization?" Our assessment is that on the whole, the present system is to be favorably compared with other public sector organizations and state enterprises.

Recommendation

STDB should review its internal administrative and financial controls to see if it is possible to reduce the number of steps presently required to obtain clearances and authorizations.

3. Are Linkages and Relationships with Other Organizations (Public and Private) Appropriate?

As described in the Project Paper, STDB was expected to encourage linkages and opportunities for interaction between industry and the producers of research, RD&E. It was expected to act as a coordinating unit "to give direction to the network of public and private institutions comprising the Science and Technology (S&T) community in Thailand in order to enhance the efficient allocation and utilization of research and development (R&D) capabilities."[7]

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[5] Ibid., p.3

[6] Price Waterhouse. Report. June, 1988. III-8, III-12.

[7] Project Paper, Annex J.

STDB's linkages with private and public sector organizations have been established primarily through the mechanism of the standing committee, where there is representation from both public and private sectors. STDB's, for example, is chaired by the Deputy Prime Minister and consists of 38 members. Represented on the Board are: MOSTE (5 members); TISTR; the Ministries of Defence, Agriculture and Cooperatives, Finance, Public Health, Industry, and University Affairs; NESDB; BOI; National Research Council/Thailand (NRCT); BOB; DTEC; the University Rectors' Council; the Council of the Scientific and Technological Association of Thailand (2 members); the Board of Trade; the Thai Bankers Association; the Federation of Thai Industries (3 members); IFCT; and ten well-known scientists and researchers.

STDB's Board of Directors has been assigned the responsibility, among other tasks, to set policies and establish priorities for STDB, as well as to identify RD&E needs and to encourage the private sector to participate in such activities. It meets once a year.

It is actually the Executive Committee, which is appointed by the STDB Board from among its membership, that performs the functions of the Board itself. The Executive Committee consists of: the Minister of Science, Technology and Energy (Chairperson); the Permanent Secretary of MOSTE; the Governor of TISTR; representatives from MOF, NESDB, DTEC, Ministry of Defence; a representative from the Federation of Thai Industries; three representatives from the private sector; and two expert individuals. The Director of STDB serves as Secretary to the Committee.

In accordance with by-laws, the public sector has seven representatives on the Executive Committee, while the private sector has six. Unfortunately, some representatives have not always been able to attend meetings, since meetings are not scheduled on a regular basis, but are held, rather, at the convenience of the Minister. Thus, the Executive Committee has not always served as effectively as possible as a forum for exchange between the public and private sectors. The Team recommends that meetings be scheduled well ahead of time, preferably on a fixed day-of-the-month basis.

The support and commitment of the STDB Board and Executive Committee are important for assisting STDB to achieve its goals. The public sector organizations represented on the Board and STDB Executive Committee are part of STDB's task environment, i.e., STDB must seek to establish good working relationships with these organizations if it is to perform effectively its catalytic role. The private (industrial) sector is not as well represented; nevertheless STDB would do well to create effective linkages here. Based on our interviews, the Team concludes that relationships and linkages could be improved.

Rather than rely on the formal mechanism of the Board, STDB could strengthen its linkages directly with the industrial sector through more active relationships with relevant private firms, and through increased interaction with relevant industry-related, quasi-governmental institutions, such as, for example, BOI and IFCT.

Moreover, STDB should consider pursuing multiple strategies for establishing meaningful linkages with other public and private organizations which fall within its task domain.

Recommendations

- STDB should strengthen its linkages and improve the quality of its relationships with the public and private sector organizations that are represented on its Board of Directors and on the Executive Committee.
- STDB should strengthen its direct linkages with the industrial sector. It should increase the number of purposeful factory visits and should increase its interaction with BOI and IFCT.
- STDB's Executive Committee should schedule meetings on a regular basis, preferably on a fixed day-of-the- month basis.

4. Are Administrative and Financial Controls/Supports from USAID, BOB, MOF and DTEC Appropriate and Efficient?

STDB was established in 1985 as a Project under TISTR as an outcome of an Agreement between the United States Government and RTG. STDB was initially funded through a Project Loan Agreement for U.S. $26.5 million and Grant Agreement for U.S. $8.5 million. In addition, RTG funding amounted to U.S. $9.5 million, and it was expected that the private sector would contribute U.S. $4.5 million. Recently, U.S. $6.9 million of the Loan funds have been transferred to Grant funds.

STDB expenditures must comply with the regulations governing each category of funding, i.e., MOF regulations regarding the use of loan funds; BOB regulations regarding the use of RTG funds; DTEC regulations regarding the use of counterpart funds; and USAID regulations covering the disbursement of Project Loan and Grant funds. The relationship of these four agencies to STDB has been largely regulatory in character. A certain amount of confusion prevailed in the beginning, owing to some staff members attempting to find short cuts through the regulations that STDB is subject to. Midway into the Project, STDB is now managing more effectively.

The Team notes the considerable administrative and bureaucratic burdens under which STDB operates. In spite of the intent to provide STDB with reasonable operating flexibility by establishing it as a Project under a state enterprise, it is subject to a myriad of regulations, reporting requirements and approvals due to the diverse sources of funding. The multiple reporting requirements of USAID, BOB, MOF, and DTEC have made heavy demands on STDB's financial administration staff. DTEC requires reports by source of funding on a monthly basis, and it also requires an annual report. Trimester financial reports have to be submitted to both MOSTE and BOB. USAID requires an annual plan. A Balance Sheet of receipts and expenditures has to be kept for the Office of the Auditor-General, RTG. Internal reporting procedures of STDB also require that quarterly, semi-annual, and annual reports be filed. Reporting formats vary considerably from agency to agency. All calculations are performed manually, since STDB has not computerized its financial system.

The Evaluation Team recommends that STDB computerize its financial system. It would be better to proceed with a partially computerized system now, rather than to wait for the installation of new equipment or the arrival of new staff to design a fully computerized system. One or two hard-disk personal computers should be sufficient.

A frequently mentioned problem concerns the different time frames involved in the preparation of financial plans and budget requests. RTG and USAID budget cycles operate on different time frames. RTG procedures require that STDB prepare its budget requests almost two years ahead of time, whereas USAID financial plans and approvals are made on a yearly basis. The problem is that in making its requests for RTG budgetary allocations, STDB has to rely on guesswork as to what activities will be authorized in the financial plan submitted to USAID. An incorrect guess could well result in mismatched budgets, resulting in oversized (or undersized) budgets.

An even greater burden is placed on the financial staff's time by the many audits to which STDB has been subject. Thus far, STDB has been audited by the Office of the Auditor-General (in June 1988, the Office of the Auditor General (OAG), RTG conducted a three-week, 100 percent audit of the loan, grant, counterpart and RTG funds expended by STDB since its inception); DTEC, which carries out a monthly audit; and by a private firm (Price Waterhouse) hired by USAID.

The Team wishes to emphasize that, to function effectively, STDB will need a fast turnaround time on many matters such as approvals for new projects, necessary travel, help from domestic and foreign experts, etc. Response times more customary to the private sector rather than government are necessary if the mission of STDB is to succeed. With the gradual maturation of STDB, the Team hopes that funding agencies will increase their confidence in the operations of this organization, and will permit a relaxation of requirements.

a. USAID

In addition to seeing that disbursements of the loan and grant funds comply with U.S. government regulations, USAID also: 1) approves annual financial plans; 2) concurs with plans for major programs; and 3) screens RD&E project proposals and the hiring of staff. A negative vote on the part of USAID is tantamount to a veto. In fact, in Project Implementation Letter (PIL) No. 38 of July 1988, USAID formally de-committed all funds previously committed for STDB Professional Staff salaries which, to that date, had not yet been further sub-obligated by contracts. As stated in the PIL, "These funds remain earmarked for STDB Professional Staff salaries, and may be committed following **DTEC and USAID review and approval of any proposed contract drawing upon those funds**" (emphasis added). A Joint Consultative Committee has been set up to review the hiring of professional staff. The committee consists of the Director of USAID, the Director of STDB, and the Director General of DTEC. According to DTEC, USAID has never before formally reserved the right to approve the hiring of professional staff in any of the projects it has funded. The Team hopes that this unusual practice, while perhaps necessary in the past, will not be needed in the future.

Because of the inexperience of the early STDB staff in their new tasks, the delay in fielding technical assistance, and the magnitude, experimental nature and visibility of the A.I.D. Thailand Science and Technology Development Project, Agency for International Development has understandably involved itself to a much greater degree of detail in STDB operations than in other A.I.D. projects known to Team members. The involvement is reported by RTG agencies to be greater than that of other foreign government donor programs operating in Thailand. While A.I.D.'s involvement in past years appears to have been appropriate, in view of the developing strength of the STDB organization and operations, the Team recommends that the A.I.D. Mission review the detail of its involvement and determine how much is appropriate at this time.

One indicator of STDB's maturity will be its ability to prepare and then execute annual financial/programmatic plans. The Team has learned from USAID that there are some problems in this area. Of particular note is a current problem USAID, and hence STDB, is facing in connection with the funding pipeline. USAID, apparently, has made funding arrangements and commitments based upon STDB's stated plans for program operations. The slower than planned pace with which STDB has initiated new projects and programs has resulted in USAID's losing some operational flexibility vis a vis its Washington Headquarters. Continuation and/or exacerbation of the problem apparently could result in a reduction of funds available for the STDB program.

b. BOB

Although it is a member of the Budget Committee, BOB has almost no interaction with STDB apart from its direct obligation to process budget requests that draw upon the regular the RTG budget. The general feeling is that BOB has not been provided with a **total** perspective on STDB, that the picture it has is rather fragmentary--which is not surprising, given that BOB is allowed to see only its portion of the budget. Officials we interviewed said that they were unable to provide adequate explanations about what STDB really did when called upon to provide information to their superiors. Since BOB has to defend agency budgets (including STDB) before Parliament, development of a closer working relationship between STDB and BOB might well be worth the investment of time and energy.

BOB pointed to the same problem as did USAID concerning an apparent STDB difficulty in preparing and then executing its financial/programmatic annual plans. STDB budget requests have tended to be much larger than its ability to spend funds that are allocated. As a result, each year large amounts of earmarked funds remain unused. BOB feels that the funds might have been put to better use elsewhere.

c. MOF

MOF is responsible for monitoring the Loan Fund and for seeing to it that STDB complies with RTG regulations governing the use of loan funds. The Loan Agreement was negotiated at MOF before STDB came into existence. MOF feels that the quality of STDB financial staff has improved, and that there are now fewer problems in dealing with STDB. In comparison with other state enterprises, however, STDB still receives a low rating regarding its understanding of RTG regulations and procedures. MOF feels that STDB still does not draw up realistic or attainable annual implementation plans.

STDB was created with the belief that it would be granted more flexibility than regular RTG agencies. The major flexibility that has been extended to STDB by MOF is that in the case of awards made to universities procurement can be carried out according to state university regulations (that comply, of course, with normal MOF procedures), rather than having to apply loan regulations. It appears that the flexibility extended to STDB has fallen short of the implicit promise contained in the Project Paper. STDB is allowed 15 percent flexibility between elements in any given annual financial plan. RD&E recipients are allowed flexibility between line items only with Budget Committee concurrence.

d. DTEC

DTEC's function is to administer grant funds that are made available to RTG. In this function it implements USAID regulations. DTEC notes that STDB has lacked credibility with respect to administrative skills. Agenda for meetings are sometimes drawn up at the last moment, and there is inadequate preparation of items to be discussed on the agenda. The hiring of personnel who did not possess the requisite qualifications is also cited by both DTEC and USAID as the reason for these agencies' intervention in the hiring of personnel.

The flexibility granted by DTEC to STDB, while greater than that generally afforded implementation agencies, is limited. STDB is permitted to administer its fellowship program and professional exchange programs without having to go through DTEC. Within any given program, STDB may adjust and even combine line items. Finally, DTEC claims that it will grant more flexibility to TIAC: "we are going to review and supervise from a distance, provided they follow USAID regulations", but has not indicated what form the new flexibility will take.

Recommendations

- STDB might consider ways to disseminate information about its objectives and activities to foster greater understanding on the part of RTG agencies which exercise financial control and oversight. Circulating newsletters and annual reports to these agencies might be one means for generating greater support. More importantly, efforts should be made by STDB staff to develop closer personal relationships with relevant officials in the various agencies.

- USAID and DTEC should review the detail of current involvement with STDB in their requirements/approvals procedures, and should determine how much is appropriate at this time.

5. Is Foreign Technical Assistance Soundly Used?

Most technical assistance is provided to STDB in the form of a contract executed between DTEC and the NAS. NAS, through the Board on International Science and Technology in Development (BOSTID), provides technical assistance to STDB for program implementation and management. A four-year contract in the amount of U.S. $3.3 million (grant funds) was signed with DTEC to cover the period March 1988-March 1992. In addition, a companion four-year contract in the amount of U.S. $1.9 million (loan funds) was signed with the MOF. This second contract provides funding for BOSTID to support four specific STDB tasks, namely: RD&E project design, IDS and STQC, D/DRDS, and TIAC.

The Board on Science and Technology in Developing Countries (BOSTID) Team Leader is in full-time residence at STDB. Other technical assistance is supplied by short-term consultants.

The Team Leader has been helpful in clearing up the backlog of RD&E preproposals, assisting STDB in the preparation of full research proposals, and ensuring rapid turnaround time of peer reviews conducted in the United States. More than 50 proposals and 23 preproposals have been reviewed through NAS/BOSTID auspices. Ninety-five U.S. experts have participated in the review process. The Evaluation Team notes the quick-response contribution to proposal peer reviews by NAS-organized scientists. It recommends continuation of this effective practice.

In the first quarter of 1989, five consultants visited Thailand to participate in conferences organized by STDB or other scientific groups and also to assist Thai scientists with proposal design (NAS Task D: Conferences and Studies). Each visit lasted between one and two weeks. A sixth consultant spent a month visiting Thailand to review existing research activities of the Department of Agriculture and the leading universities on plant breeding and tissue culture (NAS Task AA: RD&E Project Design).

The Team notes and endorses the effective technical assistance from NAS in the planning and organizing of these conferences.

Many of the consultants visit private companies that have potential association with STDB programs. The team endorses this practice; these visits stimulate additional private sector interfaces by Principal Investigators PIs and STDB staff. With strategic planning (by the project coordinator), benefit from such visits can be maximized.

The choice of U.S. private-sector experts should be helpful for assisting in the interface with Thai industry. The duration of their visits should be sufficient to allow for follow-on discussions and further planning. Information, both technical and business, gained from purposeful visits can be used for subsequent project planning, as well as for decisions on project selection and funding.

B. Science and Technology Policy

The STP Program was initiated with several ad hoc studies in 1987, but the Plan as outlined below was developed subsequently and approved in December 1988.

The principal objectives of the STP Program, as stated in the Plan, is ". . . (a) to influence policies and practices in Thailand so as to stimulate the development and utilization of scientific and technological capabilities in the country, and (b) to upgrade the ability of Thai policy analysts in this field." To accomplish this objective, it is recognized that the conclusions and recommendations of the studies will not only need to be disseminated in the usual form of publications, seminars and conferences but will require more active promotion through interaction with relevant policy and decision makers who need to make use of and be influenced by the studies' conclusions and recommendations.

The STDB Plan outlines several proposed areas for analysis and study. These are:

- Basic problems in industrial and technological development in Thailand;
- Human resources development and institutional innovation in the current phase of national economic development and global technological advance;
- Implications of radical technological changes and strategic responses to new technological challenges; and
- National strategies in major economic development projects.

1. Are STDB's Plan and Approach Appropriate in this Area?

The areas for studies and analyses seem highly relevant. The Team is particularly appreciative of the Plan's recognition that studies and analyses must be actively sold to policy and decision makers. It is our experience that this phase can easily require as much or more effort than the original study and analysis. Surprisingly, many policy efforts elsewhere do not encompass provisions for selling the resultant recommendations. We commend the STP Plan for doing so. One criterion that we were informed that STDB uses is that the results will affect actions. The Team believes this criterion to be an appropriate one.

2. Have Studies Carried Out Thus Far and Follow-Up Actions Been Appropriate?

Up to present, the following studies have been conducted under the STP Program:

- The Commercialization of RD&E Results in Thailand;
- The S&T Manpower Situation in Thailand: An Analysis of Supply and Demand; and
- Government Policies Affecting the Acquisition and/or Utilization of Science and Technology in the Small Scale Businesses

Reportedly, the first policy studies were commissioned by STDB, and then, on completion, DTEC would pay for the effort and a seminar would be held to introduce the results to interested parties. These apparently led to confrontations on occasion. To better control this situation, STDB began routinely to review interactively with the vendor each study prior to final submission of the product and approval of payment by DTEC. STDB believes this practice has increased the quality of the studies and reduced controversy. It has also resulted in a learning process by the S&T policy-analysis community.

More recently, STDB has initiated a policy that it will use its own staff to manage these studies. This will be beneficial to STDB, provided it can recruit competent persons for such tasks. Initial indications are that it can. The first of these new STP Program managed studies will be carried out in support of the STDB STQC Program. Others in areas such as agro-biotechnology, human resources development and S&T infrastructure are planned. STDB will be in a much stronger position to promote policy recommendations if its own staff have been involved in the analyses that led to them. It will also provide opportunities for STDB to improve its linkages with Government organizations and industry.

The studies conducted so far have, among other things, provided STDB ideas for future STDB programs. For example, the study on the Commercialization of RD&E described a Korean activity aimed at the commercialization of technology which some at STDB think, at a later date, could be appropriate as a model for an STDB program. The same study raised questions concerning internal operations of STDB which led to significant internal discussion and reflection.

Critical to this Program, and indeed all of STDB's Programs, is passage of legislation currently being proposed to convert STDB from the status of a TISTR project to a state enterprise. We endorse STDB's plan for having a portion of the STP Program's activities directed toward providing a rationale and plan in support of the legislation. The Evaluation Team believes that the basic assumptions, rationale and thrust of STDB is right for Thailand at this particular point in history. It is more likely that the proposed legislation will be passed, assuring a future for STDB, if supporting analysis is provided by STDB.

3. What Steps Might Be Taken to Enhance Activities in this Area?

Having sufficient personnel involved in each policy study will require additional staff, which in the current situation in Thailand are in short supply. One short-term solution for alleviating this shortage would be to use internships of graduate students from one or more universities having recognized programs in S&T policy analysis such as Harvard University's Kennedy School, M.I.T., and Sussex University.

A longer term solution would be to train Thai S&T policy analysts. While it seems the Professional Exchange Activity would be a good vehicle for such training, we have been informed that it does not permit payment of tuition fees of the magnitude associated with such programs. We suggest that the policy on nonpayment of tuition fees associated with the Professional Exchange Activity be reconsidered. An alternate approach would be to bring recognized experts in S&T policy analysis to Thailand for a series of short courses.

We have heard it said that some believe if you are a professional, you should not need additional training. The Team strongly disagrees with this concept. Continuing education, including formal training, should be a lifelong process for a professional.

C. Designated and Competitive Research, Development and Engineering

Under the Designated RD&E Program, funding support is awarded to specific institutions to enable these institutions to develop their capabilities to work towards the resolution or amelioration of designated high priority industrial problem areas, or on areas of opportunity while simultaneously building the institution's capacity to assist industry in the area. The Competitive RD&E is directed toward solving a specific private sector problem or toward assisting a firm in taking advantage of an opportunity. Competitive RD&E should result in a new or improved process or product, or improved state-of-the-art technology in Thai industry, and have relevance to development growth.

In the Project Paper, it was believed that, in the Competitive RD&E, the STDB staff would work with industrial firms to identify problems or opportunities and then issue requests for proposals from the S&T community. For at least two reasons this procedure was rejected. First, some of the STDB staff viewed themselves as too inexperienced to be able to identify urgent problems for their often more senior members of the S&T community. Second, the culture and smallness of the S&T community in any one area do not lend themselves to such open competition. Therefore, in both the Competitive and Designated RD&E areas, STDB has, by and large, invited the S&T community to submit proposals which they believe appropriate. STDB may then decide that a proposal should be switched from the category applied for to another, if the fit seems better. The Evaluation Team concurs in this decision.

The Team believes that on the whole the RD&E activity, under these two program elements, is going well. STDB is now well-known among Thai universities and RD&E organizations. There is some knowledge within industry of STDB projects, but perhaps less of STDB.

STDB coordinators have been successful in soliciting proposals of which there have been more than 130. Forty-five projects were approved in 1987, 1988, and through May 1989, of which 23 were in bioscience or technology, 16 in material science and technology, and 6 in applied electronics and computer technology. Of these, 29 are classified as designated and 21 as competitive. For a list of the projects see Appendix H. The Evaluation Team has examined a number of these and in all examined have found a relationship to an industry problem or opportunity. The scientific or engineering progress seems reasonable in all these with possibly one exception. The Team has been impressed with what we have seen.

Because of the slow start in getting the overall project off the ground and the problems with staff turnover described in the earlier part of this report, the RD&E effort is behind schedule. The current staff and management, however, are progressing at the rate anticipated.

1. Are the Guidelines, Criteria, and Implementation Procedures Clear and Appropriate?

The Evaluation Team found the following guidelines, instructions, criteria, and implementation procedures:

- Designated
  - -- Guidelines for the program;
  - -- Criteria for project selection;

- -- Instructions for proposal preparation; and
- -- Procedures for proposal submission and project selection.

- Competitive
  - -- Guidelines for pre-proposal preparation;
  - -- Guidelines for full proposal preparation;

- All RD&E
  - -- Instructions for preparing the semi-annual report;
  - -- Instructions for preparing the report on the review of the semi-annual report;
  - -- Guidelines for making site visits including instructions for preparing the report on the visit;
  - -- Instructions on setting up project review task forces for projects, including the duties of these task forces; and
  - -- Guidelines for the final project evaluations.

The Team was impressed with the number, thoroughness, and clarity of these documents. It is unusual to find this degree of procedure in an organization as small and as young as STDB. We understand that many of the STDB staff are relatively inexperienced in these activities and there is also the need for accountability for the administration of public funds.

This body of documentation should be helpful to RD&E proposal writers as well as the STDB staff in carrying out its work, and to this extent the documentation is certainly appropriate. We are not as sanguine about the project selection criteria. As desirable characteristics, they are undoubtedly useful for PIs and proposal reviewers to consider. However, as rigid criteria they seem too complicated and idealistic. For example, the Designated RD&E projects ". . . must satisfy **all** of the following criteria:"

- Fall into one of the three designated areas of RD&E;
- Clearly be important for Thailand's development;
- Result in a permanently enhanced capability on the part of the submitting institution to be of significant service to a particular industry;
- Result in significant benefits being gained by the productive sector;
- Show clear evidence that proposers are aware of actual concerns and problems of private sector (or other) ultimate end-users;
- Show evidence of strong institutional capability and strong institutional support; and
- Show evidence that the proposers are familiar with the state-of-the-art of the problem area their project will address, and that the project makes sense from a cost/benefit perspective.

Additional criteria stated by STDB as being desirable are:

- Interaction and collaboration on the project with foreign institutions with indications that long-term institutional relationships are being established;
- Creation of a significant number of (net) new jobs;
- Centered around individuals with evidenced outstanding abilities; and
- Project activities will be continued using the institutions own funds or that the project activities themselves will generate sufficient funds to allow eventual self sufficiency.

If these criteria had been rigidly applied, none of the projects the Team reviewed would have been approved. We suspect that indeed there might not be a single STDB project in existence if the criteria had been rigidly applied.

We have given some thought to the adequacy of STDB's focus on the areas of bioscience and technology, applied electronics and computer application, and materials sciences and technology. We certainly agree that they are all important to Thailand's industrial development. Furthermore, they are so broad that there is little that one can think of, that has relevance to Thai industry, that could not be contrived to fit these categories. The Team wonders whether it might be better to simplify the criteria and just make relevance to Thai industry and good RD&E the only two criteria. The current criteria could be provided as characteristics which are considered desirable.

Specifically for the Competitive RD&E projects, the Team would like to emphasize an evaluation of the probability of achieving both technical and market success. For this purpose, the words of Dr. le Pair are relevant: "What should determine the choice (of project) is whether in a certain area researchers are good and early connections have been established between S&T and the prospective user. With perhaps some exaggeration one could say that the advocacy of a certain technology is suspect unless there are indications of good R&D user contacts or signs that timely steps are being taken to help find or create active user involvement." He continues: "The best way is to pursue S&T in relation to existing strong points in the economy."

At present, the Evaluation Team understands, 25 percent of the cost of these projects are paid for out of Thai Government funds and 75 percent come from a mix of USAID loan and grant funds. Further, it is our understanding, because of certain restrictions, that some desired projects are not eligible for support with U.S. funds. For these, the Tean suggests that STDB change the mix of funding for projects such that some may be entirely funded with RTG funds, obtaining Cabinet approval if necessary. To the extent that it is possible, funding projects from only one source of funds should reduce the number of RTG and USAID regulations that STDB would have to accommodate.

Recommendations

- Reduce the number of RD&E project selection criteria to two, namely that they (1) have industrial and commercial relevance and (2) that they have a good probability of success with all factors being taken into account.
- Explore the possibility of eliminating the mixing of funds from various sources on projects where this can be done, thus simplifying the administrative procedures and allowing the use of solely RTG funds on projects where this will provide desired flexibility.

2. Is the Proposal Review Process Efficient and Objective?

The formal steps in the proposal review process are the following:

- Receive a pre-proposal;

- Screen the pre-proposal internally at STDB;
- Request for full proposal;
- Screen the proposal internally at STDB;
- Review of the proposal by the TRP;
- Review of the proposal by the TAC;
- Review of the proposal by the Executive Committee; and
- Review of the proposal by the Budget Committee.

The Technical Review Panel consists of technical experts from Thailand and the United States in the field encompassed by the RD&E proposal being reviewed. The U.S. expert reviews are arranged by the NAS under its technical assistance contract with STDB. As individuals, the experts review the proposals and respond rapidly with written critiques and advice on the proposed project. The quality of these reviews is reportedly quite high.

The Technical Advisory Committee, described earlier, reviews all aspects of the proposal in light of the Designated and Competitive RD&E criteria.

The Budget Committee and the Executive Committee were also described earlier. The former reviews the proposal to ensure that all USAID, Ministry of Finance, Department of Technical and Economic Assistance, and other RTG regulations and norms have been met in preparing the proposed project's budget. The Executive Committee provides a final overall assessment.

In addition to the above steps, PIs are often invited to STDB so that the STDB technical and financial staff can work with the PI to make any revisions required in the technical or financial portions of a proposal to help it get through the TRP and the Advisory, Executive and Budget Committees. Working with a Pre-Budget Committee has now become a formalized procedure. We find this practice of providing internal quality control commendable. STDB is receiving valued technical assistance from the resident NAS Advisor in the proposal generation and development process.

In addition to the above formal and informal steps, USAID approval for conducting a project is also required.

We are told that the average time for a successful proposal to get through the review process is six months. This is, reportedly, a considerable reduction from the average time required a year ago. As STDB's internal screening and proposal preparation assistance continues to strengthen, we would expect to see the average processing time reduce even further. At some point, this capability Panel consists of technical experts from Thailand and the United States in the field encompassed by the RD&E proposal being reviewed. The U.S. expert reviews are arranged by the NAS under its technical assistance contract with STDB. As individuals, the experts review the proposals and respond rapidly with written critiques and advice on the proposed project. The quality of these reviews is reportedly quite high.

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As far as the Team has been able to determine, the proposal review process is objective.

Recommendation

STDB should continue to strengthen its internal screening processes so that less involvement is needed at higher levels--by the TAC, Executive Committee, DTEC and the Budget Committee.

3. Have Funded Projects Generally Met Criteria?

In broad terms, for example if one accepted the two simple criteria which we have proposed, the projects which we have reviewed did meet these more simple criteria. At the same time, we should point out that virtually none of the Board Members or Executive Committee Members that we talked with believe a majority of the projects meet the industrial relevance criteria. The Executive Committee Members from industry, with whom we spoke, expressed the belief that a greater presence on the Committee of industry representatives would begin to correct their perceived concerns. Whether this perception is right or wrong, the fact that it exists, should be of grave concern to STDB.

The Evaluation Team wonders if part of the criticism of STDB's projects stem from a lack of understanding of the purpose of the projects as a result of the titles of the funding categories. Almost everyone with whom we spoke who is on the Board appeared to believe that the results of all of STDB's projects should be directly applicable to a problem or opportunity within an industrial firm. The development of institutional capability to assist a segment of industry in its future growth does not appear to be thought of as a significant part of STDB's goal. It is, however, an important one. Perhaps if the Designated projects were relabeled under the title "Development of Industrial RD&E Institutional Capacity," it would help clarify the primary purpose of these projects. Likewise, it could be useful to relabel the Competitive category as Industry Support. We believe this would also help potential PIs in focusing the objectives of their proposals.

The Team believes that having more industry members present at the Executive Committee meeting would help in correcting the impression that not enough projects meet the criteria of industrial relevance if that perception is wrong. If it is right, the greater number of industry representatives should help to correct the situation.

A few of the Board or Committee members with whom we met noted that some projects duplicated work that had already been done. Our perception is, however, that this is not a serious problem. No one raised questions about the quality of the work being carried out by STDB sponsored researchers. Our review of the project titles suggest to us that they all fall into one or other of the STDB priority areas.

Recommendation

Although the activities of STDB are well known in the research community by virtue of its research support, STDB's goals and activities are not well known nor understood in many relevant private sector and government circles. The Team received a number of negative comments on the value to the private sector from STDB's RD&E Program, which the team believes were not fully justified. This leads the Team to recommend that STDB consider how to increase the effectiveness of its industry directed public relations activities.

4. Additional Observations

The RD&E Program coordinators (including the program associates working in this program area) have a big responsibility with, for the most part, little experience in managing an RD&E grants program and perhaps even less with industry who is supposed to be the ultimate benefactor of the RD&E Program they are managing. The Evaluation Team is impressed with what the coordinators have achieved under the circumstances. The increased interaction with potential PIs in helping them prepare proposals that will pass an unusually extensive battery of reviews and committees, we have previously acknowledged as commendable. We believe now, however, the coordinators greatest need is to begin to acquire rather fundamental understandings of the industries their projects are serving. We know of no other way to gain this understanding than to spend a very significant amount of their time visiting and interacting with these industries, discussing possible project areas identified in these meetings with potential PIs, bringing PIs and interested industry personnel together, and discussing and marketing the results of projects completed and in progress with interested industry personnel. The coordinators should attempt as a part of this process to involve the targeted firm, in Competitive projects, or one or more industry representatives from the targeted industry, on Designated projects, in the semi-annual research evaluations.

Our concern is that coordinators, under pressure to initiate more and more projects, will not think they have time for these industry interactions. The Team believes, however, that for the sake of the RD&E Program, this must be done. In the long run, the only way the RD&E Program will be able to eliminate the perception that it is making little contribution to industry or its future needs is for the Program coordinators to develop the type of relationships with industry that we are here urging.

The Team acknowledges that finding the time to achieve this critical industry relationship is going to be difficult. STDB provides USAID and RTG annual budgets and there is pressure to initiate the targeted number of new projects. As new projects are initiated, they have to be monitored; a practice which we are concerned is not being adequately pursued at present. For example, we met one Principal Investigator (PI) who did not even know who the STDB coordinator was for his project. Other PIs noted they had never been visited by their coordinator. The current 45 projects will increase to around 80 and will stay at that level if funding for STDB is maintained at its projected level.

The RD&E Program is going to need additional personnel. Uncertainty over STDB's future may make this difficult. However, USAID's current actions to extend the PACD will help. Even more important would be passage of the current legislation to convert STDB's status from that of a project under TISTR to that of state enterprise.

As STDB obtains additional staff and as they become more experienced, we believe the RD&E Program could undertake pro-actively to develop strategies and synthesize the allocation of research funds, using multiple synergistic research efforts to achieve a specific, well-defined objective. Cross disciplinary elements can perhaps be incorporated, e.g., improved rubber tree yield (bioscience) coupled with improved rubber quality (materials). In such cases, liaison should be maintained among the multiple PIs, STDB staff, and working-level representation from the participating firms. Progress reviews which include all parties serve to reinforce the concept of the ultimate goal, rather than the individual objectives of each separate research task.

The Team heard of one problem that may become more serious in the future. Some PIs are having to use part of their honorarium to supplement the allowable pay provided research assistants under an STDB

project. Because of the tight job market for engineers in the electronics and materials technology areas, the pay which STDB allows for research assistants is reportedly inadequate.

A final observation on the Designated and Competitive RD&E Program focuses on the use of the NAS technical assistance contract. The Assistant Director of STDB has expressed to the Team his appreciation of the contribution that short-term technical assistance has made to projects under this program. We have been informed, however, that this form of assistance has not been used to the extent originally envisioned. It is not our impression that support from this source has been written into many of the RD&E projects. Reportedly, coordinators and PIs have until recently not been aware of the extent of assistance available. It also occurs to the Team that being so far removed from the United States, the PIs and program coordinators may not be as familiar as they would like to be with U.S. researchers in their field and how the U.S. researchers could contribute to proposed RD&E through personal participation or how they, the Thai researchers, might make use of facilities and equipment available in U.S. laboratories. Therefore, the Team recommends that when the NAS sends out the STDB RD&E proposals for peer review (part of the TRP process) that it instruct the reviewers to include in their comments thoughts, if any, on how they or other U.S. researchers or U.S. facilities might contribute to the project. Likewise, in the planning phase of, particularly Designated, RD&E projects, the NAS permanent advisor may be able to assist STDB in finding planning support under the Academy contract.

Recommendations

We understand that USAID is planning to extend PACD and is considering funding a second phase of STDB's development. We recommend that PACD be immediately extended to 1995. This will eliminate some of the feeling of nonpermanence at STDB and the uncertainty associated with planning for the expenditure of funds that exist as a result of the slower than expected establishment and making operational STDB. Passage of the currently proposed Government legislation, to change STDB's status from a project under TISTR to a state enterprise in its own right with an initial proposed five-year budget, will make an even greater contribution to the stability of STDB. Stability is important for maintaining STDB's current staff and providing a basis for attracting additional quality personnel, especially some with private sector experience. We believe USAID's funding of a second phase of its STDB program, following the extension of the current PACD, should be contingent upon passage of the before mentioned legislation. Indeed, we believe a contingent offer of intent should be made soon to encourage passage of the legislation.

Program coordinators should begin to take a more active role in interacting with Designated and Competitive RD&E targeted firms and industries. This should include visits to get to know the firms and industries, begin to learn their problems, and work with them to enunciate potential projects. The coordinators should visit firms and industries with PIs to market their RD&E both while it is in progress and when completed and to identify new projects. They should attempt to involve firm and industry representatives in the semi-annual reviews.

Because of the lack of industrial experience among the program coordinators, we recommend expanding and enhancing STDB's industrial outreach capabilities by entering into indefinite quantity-type contracts with two or three local business- consulting firms that have broad perspectives of Thai industry. These firms would assist STDB coordinators and their associated principal investigators to identify potential industrial users of specific RD&E results, to facilitate the establishment of linkages among them, and where appropriate to assist in related market and economic assessments. Implementation of this outreach activity will require more coordinator staff.

Ask the NAS, and its peer reviewers, to take a more active role in making suggestions as to how U.S. scientists, engineers, and facilities could contribute to STDB's RD&E Program.

D. Company Directed Research, Development and Engineering

The company directed RD&E is aimed at stimulating the establishment of R&D capabilities within small- and medium-sized Thai firms. Originally, the program offered companies loans for up to 50 percent of their costs on approved RD&E projects. The funds for the loans came from a pool of money supplied by STDB,

RTG, and one of three financial institutions which participated in the Program. The financial institutions administer the fund. Loans are offered at an attractive rate but the financial institutions require collateral from the borrower. Although fifteen companies or so have been interested in this Program, only two have qualified for loan funds so far.

To increase participation, STDB is in the process of adding a grant-based component to this Program. This should substantially increase its attractiveness to companies. The Program is directed toward small and medium sized firms--those employing fewer than 500 people.

At present, the staff position for managing this Program has just been filled. This should stimulate the Program. There are funds available for approximately six more loan funded projects. Approximately nineteen grant funded projects are projected for the next two years with nothing available afterwards unless STDB obtains additional funding.

1. **Are the Guidelines, Criteria, and Implementation Procedures Clear and Appropriate?**

The criteria for this Program are:

- The supported project should ". . . focus on an effort to development a new product(s), the development of which entails the establishment and utilization of a significant in-house research and development (R&D) capability which can be lasting or growing";
- The proposed project should be in one of STDB's priority areas; and
- The project ". . . must clearly be important to Thailand's technological and economic development."

These criteria are certainly more simple than those for the Designated and Competitive RD&E. While the wording leaves room for interpretation, the Team suggests expanding the first criterion to include " . . . new or improved products or processes, the development of which entails the establishment and utilization of a significant RD&E capability . . ."

Companies will apply for grants on a form provided by STDB, the draft of which is short and simple. If the Company Directed RD&E Program officer believes a proposal should be funded, he submits his recommendation to a Company Directed RD&E Program Committee. This Committee--composed of the STDB Director; the STDB Deputy Director; the Director of Planning, Program Development and Policy Review; the Assistant Director for RD&E; STDB's Management Advisor; the Team Leader of the NAS Technical Assistance team and a DTEC representative with a USAID observer--makes the decision to approve or disapprove the application. Signed agreements with companies are to be reported to the Executive Committee for acknowledgement. The Evaluation Team finds the simplicity of these procedures refreshing.

The Program implementation guidelines envision that "Continuing efforts will be made to make the industrial community aware of the existence of the Program . . . . These efforts will include the placement of occasional notices in appropriate newspapers, trade journals, etc., talks to industrial groups, trade associations, etc. Particular efforts such as firm-level visits will be made to make 'BOI-privileged' firms aware of the Program." Hopefully, this Program will contribute to eliminating the negative image that some from industry seem to have of STDB. We believe the public relations component of this Program should receive particular attention. We also applaud the interaction with BOI-privileged companies and encourage close interaction with BOI and IFCT in promoting the Program as well as in identifying potential participating companies.

Information on the U.S. Small Business Innovation Research Program initiated by the National Science Foundation may provide helpful ideas to STDB's Company Directed Program.

Recommendation

- Involve BOI and the Industrial Finance Corporation of Thailand in this Program. RD&E grants could, for example, be part of the privilege provided a promoted company under a BOI project. IFCT, in its efforts to develop industry, will be able to assist STDB in identifying potential clients for the Company Directed Program.

2. Is the Proposal Review Process Efficient and Objective?

The efficiency of the review process is commendable. The process, as described in the implementation guidelines, sounds objective.

3. Have Funded Projects Generally Met the Criteria?

STDB noted that a major worry of companies who were interested in this Program was confidentiality. As a result, STDB is concerned, and we believe rightly so, that if they bring a stream of visitors around to see these projects, STDB's reputation with respect to its ability to maintain confidentiality will be damaged. As a result, we did not visit either of the two funded Company Directed RD&E projects. From the description of the projects, however, we believe they have satisfied the program criteria. One of the projects is aimed at developing a rubber sheet for lining reservoirs and an inflatable rubber dam for damming small streams. The other is focusing on the development of diagnostic reagents for hospital usage.

E. Fellowship Program

The Graduate Fellowship Program is regarded by STDB as an RD&E support program and aims to increase the number of highly trained professionals within the three priority technological areas. The program originally planned to grant 105 fellowships for graduate studies at the master and doctorate degree levels in leading universities in Thailand. The Program has already exceeded its goal, granting its 129th fellowship earlier this year. Of these, 81 are in the area of bioscience and biotechnology, 23 in the area of material technology, and 25 in the area of applied electronics and computer technology. A Program target is to have 50 percent of the fellowships in the bioscience and biotechnology area, and 25 percent in each of the other two priority areas.

1. Are Program Guidelines and Procedures Appropriate and Adequate?

Within the past year, the Program has shifted from attempting to identify priority fields of study in specific universities which then receive the benefit of the STDB Fellowship Program, to more broadly opening the opportunity to essentially all Thai university programs offering master or doctoral degrees in STDB's three major priority areas. We think this appropriate. It is better to let the market place and student response shape the Program than for STDB to attempt to forecast future RD&E manpower needs within very narrow fields of study and limit the fellowships to these as was done previously. The new approach, as would be expected, is increasing the quality level of students with STDB fellowships.
Also in the past, preference was given to students who applied for fellowships that would associate them with an on-going STDB RD&E project. As the projects are already funded at a level that is believed adequate, as one member of STDB management put it, this practice "was like putting icing on the cake." This change seems reasonable to the Team.

Students are nominated by university faculties who have graduate programs in the STDB priority areas. STDB then considers the following factors in selecting its fellows:

- Quality of previous academic record or work experience;
- The applicant's own statement of study and research interest;
- Letters of recommendation concerning the applicant's research potential; and

- Relevance of the proposed graduate work to announced STDB priority subject areas for fellowship support.

As there is a national shortage of engineers in materials technology, and applied electronics and computer applications, STDB might wish to consider making financial need a factor for consideration in these areas. We understand that STDB already gives priority to these two areas by accepting students in these areas with academic records of lessor quality than those required in the bioscience and biotechnology area.

2. Additional Observations

One original goal that has not been met was to obtain industry contributions to the Program. As STDB now has a track record and experience with administering the Fellowship Program, we believe it is time to actively seek such support. Likewise, funding support should be sought from other development assistance donors. STDB has a further goal of diversifying its donor support. It seems to the Evaluation Team that this would be a promising place to start.

To increase the number of professionals, it is necessary to have trained teachers. Thus an emphasis of the Fellowship Program should be to train science and engineering teachers. To train teachers, we believe that one should aim more at quality than quantity. If additional funding is forthcoming through efforts such as those suggested in the previous paragraph, we propose that some of the Fellowship Program's new funds be devoted to training faculty who will teach for a number of years as an obligation of the award. To obtain interest as well as to promote quality, we propose sending these scholars to international centers of excellence where they are more likely to have better laboratories and equipment, where textbooks and technical information are more readily available and the knowledge of science and technology is likely to be more advanced. To respond to the market demand for graduates in the material sciences and applied electronics areas, we suggest that the proposed foreign fellowship program provide preferential treatment to graduates in these two areas.

As a further effort to increase the highly-trained professional manpower in the applied electronics and material sciences, we suggest that STDB consider providing scholarships for bachelor's or engineering degrees that include research for specially qualified students--possibly tied to institution building (Designated) RD&E projects.

In our review of RD&E proposals and projects as well as through discussions with leading industrialists and bankers, we believe that a lack of management skills is a detriment to STDB being able to achieve its overall goal. Therefore, if additional funding support becomes available for this Program, we suggest the establishment of a Fellowship Program element to provide established scientists and engineers a master's in management or business administration.

Recommendation

- Use this Program and the experience, structure, and mechanism that STDB has achieved in managing it to launch an effort to expand STDB's donor support. A good starting place would be with major Thai industrial firms. Attention should also be given to donor assistance organizations, in additional to USAID, as sources of funding.

F. Standards, Testing and Quality Control Program

The STQC Program aims to raise the quality standards of Thai products, particularly those which are exported. The USAID Project Paper came right to the point when it stated that, "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." In the STDB plan for this area, prepared with technical assistance provided through the NAS contract, it was stated that the Program objective was to attain high-quality products as required by the international market.

To achieve the STQC Program objective, the STDB plan states that the Program will assist standards, testing and quality control organizations to raise their capabilities. This is to be done, according to the plan, by upgrading both the equipment and personnel in a number of governmental laboratories (support of core STQC organizations), and then let them train, upgrade and certify lower grade public and private laboratories so that the latter can perform at a level called for. The upgrading will involve primarily training of personnel by the trained personnel in the major governmental laboratories (national STQC training program).

There are three other elements to the STQC Program, namely:

- Review and modification of Government policy affecting national STQC capability;
- Strengthening and enhancing coordination among the different organizations which comprise the national STQC system; and
- General STQC strengthening which will involve efforts to bring about infra-structural developments including better instrumentation capability, testing technology and some RD&E for improving quality of specific products.

These later Program elements are to be funded as a part of other STDB Programs. As noted earlier, the STP Program already has plans to conduct a study and analysis of the Thai standards institutional structure and related Government policy.

The STQC Program plan was approved by the STDB Executive Committee in early June 1989 and the Program is now officially under way.

1. What are the Reasonableness and Feasibility of STDB's plans for the STQC Program?

For the STQC Program to be effective and achieve its stated objective of raising the quality standards of Thai products, there must be constant interaction between it and all the other programs which are designed to assist in solving the technical problems of firms. In its efforts to help a manufacturer whose product quality falls short of the accepted standard, the STQC coordinator may have to work with TIAC to obtain necessary or useful information which may help to identify (or even solve) problems. The Program may utilize the consulting services under D/RDS, or it may in suitable cases coordinate with the RD&E office to get an appropriate RD&E project underway. The solution to a problem of quality may also lie in providing proper training to the personnel of the firm. In such cases STQC should be prepared to organize training courses, workshops, seminars, etc. We believe a very significant need will be for STQC to sponsor a comprehensive publicity program promoting concepts of quality in production processes. STDB will need to market quality. One of the industrialists on STDB's Executive Committee noted that STDB will need to market all of its industry directed programs with as much vigor as he markets the products of his group's firms.

Increasing the quality of primary standards testing capabilities and quality control standards in themselves do not improve product quality. Testing can only reveal the relationship of the quality of some product to a standard. If this is found to fall short of the standard, more work will have to be done to improve the quality of the product. The road from discovering a quality flaw to producing a high-quality product of accepted standards is not a short one. The problem or problems will first have to be identified; consulting and RD&E work may be needed to find answers. The next stage is to apply the answers.

The STQC plan describes a process of strengthening Government laboratories having a role in primary and product standards and then helping these organizations to provide assistance to product testing, certification, and quality control laboratories of both the private and public sectors "primarily through training." The third Program element is described as focusing on the national legal system, laws, policies, and plans as they relate to national standards. The fourth Program element will focus on bringing ". . . about more effective and efficient functioning of each of the major STQC organizations by facilitating a process wherein each of the organizations may obtain a greater awareness of the capabilities and responsibilities of the other organizations. The principal mechanism for doing this will be the institution and conduct of a series of

regular meetings among the organizations (hosted by STDB) at which discussions on matters of common interest can be held." Under the final Program element it is envisioned that there ". . . may be provided for a number of efforts and activities, to be carried out by a range of organizations or individuals, which could result in significant strengthening and deepening of national STQC capabilities."

What is described in the STQC plan is a top down approach. The Evaluation Team wishes to propose a simultaneous bottom up approach. We suggest including surveys of major Thai industries to identify the product quality problems that are currently and in the immediate future most likely to adversely affect Thai exports. Based on the results, we believe the subsequent steps to be taken under the STQC Program can be more effectively targeted. Without industry background studies, it is difficult to assess the significance of the projects described in the STQC plan. Intuitively, some appear quite reasonable.

As a further reason for considering a bottom up approach, the Japanese Government has committed to providing over $20 million in equipment and facilities to support the nation's central standards organizations. This is almost ten times the amount which STDB has allocated for support of its entire STQC Program of which it currently plans to spend $2.6 million on 14 core organizations. We recommend that the funding priorities be changed back to what the Project Paper and the Plan referred to as the country's most critical problem and the Program objective, namely improving product quality.

2. **How reasonable is STDB's approach to the Implementation of the STQC Program?**

The initial activities under the STQC Program have been:

- To assist the latex glove manufacturing industry with a significant problem it is having in meeting new U.S. Food and Drug Administration (FDA) specifications for latex examination gloves by, among other things, bringing an expert in this industry to Thailand for consultations;

- To arrange a visit of an FDA team to consult with the food processing industry on problems associated with low acid canned food; and

- To co-sponsor a seminar on "Materials for the 21st Century: Measurements and Testing for Quality."

This support, based on industry requirements, is the type that we believe will allow STQC to have the largest impact on Thailand's efforts to increase its export of quality products. In its first activities, the STQC Program is developing in a sound direction.

As an example of what we have in mind by a bottom-up approach, consider the business of latex glove manufacturing, with which the STQC Program is already working. As Thailand produces its own latex, if small and medium sized companies can compete from anywhere, it should be here.

Over the past 11 months, the price of latex gloves has plummeted. Small scale manufacturers have closed down in mass in Taiwan. The Evaluation Team is aware that well over half the production capacity there is no longer operational--possibly, an even larger capacity has closed.

On top of this, the world's largest market for these gloves, the United States, in April started requiring that any latex examination gloves that are involved in interstate commerce must meet U.S. FDA standards.

During the period that glove prices were soaring, the large scale manufacturers were also constructing huge facilities in places as far away as the United States and as near as Malaysia. We heard talk of a major multinational firm putting up a big plant in Thailand.

In light of the above, as a first step, the Team suggests that STDB request an expert in latex glove business analysis through the NAS technical assistance contract. Determine whether there is a possibility that small or medium scale producers have a chance of survival in the current international market. If this turns out positive, the consultant already brought here through the NAS has proposed a total quality control program for the company he visited. This is likely to be needed by all of the latex glove manufacturers in Thailand if they are to meet the new U.S. standards. We understand that STDB has already been instrumental in establishing an association of latex glove manufacturers. STDB could provide the Rubber Research Institute, or some other appropriate institution, a Designated RD&E grant to work through the association to implement a total quality control program at its members' facilities. To obtain assistance in preparing this project proposal as well as providing the association the needed total quality control assistance, STDB could again make use of its NAS contract. If more directed assistance is required by some firms, this could be provided under the D/RDS Program. Based on information that would be generated in such an approach, it might be determined that certain of the nation's primary or secondary standards organizations need assistance. This type of targeted assistance is where the Evaluation Team believes the STQC Program can be most effective.

To implement an approach of the type we have described is going to require additional professional and administrative staff. During our stay at STDB, we noted that this Program already has need of additional administrative staff.

Recommendation

Continue the Program's current emphasis on improving the quality of Thai industrial products, particularly those aimed at an export market. As it is determined that a specific product or category of products require unavailable support from primary and secondary standards organizations, provide the standards organizations the assistance, equipment, training, and resources needed to support the product quality of concern. We suggest support to core standards organizations be tied to a specific STQC project for supporting product quality in an industry. To conduct the STQC Program in the manner currently being pursued is going to require a larger STQC professional and support staff.

G. Technical Information Access Center Program

NOTE: In this section, the Team makes a number of observations and recommendations that are controversial. The Team also recognizes that none of us are information specialists. Therefore, we and STDB have taken the unusual step of having the technical assistance advisor who assisted STDB in the development of the TIAC Plan comment on the draft of this section. To present a full and fair appreciation of the issues we surface, the Team is including his comments in their entirety at the appropriate place in the text of this report.

The July 1988 Plan for the TIAC Program notes "Improving access by the scientific and industrial communities to local and global communication channels and information resources is . . . a prerequisite for S&T to affect more positively and in a self-sustaining way both science and the economic development of a country. This is the principal goal of the Technical Information Access Center program of STDB." In the preparation of this plan, STDB received technical assistance under its NAS contract.

According to the Plan, the Program goal will be attained by way of the following steps:

- Appointment of a high-level Advocacy Committee and a Users Advisory Committee;
- Establishment of a TIAC at STDB to serve scientific and industrial users;
- Organization of a network of existing information service organizations from the private sector, government organizations, and academic R&D institutions into a Consortium which will cooperatively work to service the S&T information needs of their constituencies;
- Development of public S&T databases in Thailand; and

- Evolvement of TIAC into an on-line vendor of Thai databases.

The TIAC Program seemed to be getting off to a faster start than other IDS Programs with a plan completed in July 1988; although this was two years behind the original schedule in the USAID Project Paper. The Program was further delayed because of difficulties encountered in hiring a Program Director. This hurdle was overcome when the TIAC Director was hired in February 1989. The Program is now moving forward with a current planned start-up date for TIAC services of January 1, 1990.

1. What are the Reasonableness and Feasibility of STDB's plans for the TIAC Program?

Business, technical and scientific information are critical for the further development of Thai industry and the S&T community's ability to provide RD&E and consulting services to enhance this process. The TIAC Program's objective is to facilitate the availability and access of valuable information to industry, government and higher education. Within itself, the 1988 Plan seems reasonable. The original concerns of the Evaluation Team were similar to those expressed in the Plan. Two potential problem areas it noted were:

- The pricing strategy for TIAC's services; and
- The willingness of Thai database-producing organizations to lease their products to TIAC to enable TIAC to become a database vendor.

The 1988 Plan notes, "It is the expectation of free, or nearly-free, service that is likely to be the major psychological impediment to the popularity of electronic information services . . . and to the commercialization of these services." This expectation, and current practice of most existing Thai information services, has led most of the potential market for TIAC services, with whom the Evaluation Team has discussed this issue, to express skepticism about TIAC's ability to sell services at anywhere near their costs. The 1988 Plan recommends charging users about 35 percent of the cost for foreign database searches with a lower rate for students. It also suggests discounts for first-time users and for large volume users.

The Evaluation Team thinks that TIAC should put initial emphasis on the development of its market size and, as it proves its value to the user community, then to gradually move in the direction of cost recovery. Therefore, we recommend that TIAC provide its products free of charge to begin with. After a substantial user volume develops, then begin to gradually introduce charges and increases in their levels. In discussions the Team had with one of the industrialists on STDB's Executive Committee, he recommended this approach noting that when his firms introduced new products into the market, it was common practice to give them away in the beginning.

> TECHNICAL ADVISOR'S COMMENT: "The almost universally accepted maxim in the information service industry is not to offer any information services or products gratis. The main reason for this has to do with the desire of inculcating in the minds of people that information is a resource whose value renders it a commodity; and current marketing trend is to charge some nominal fee for valued commodities--say samples of a new toothpaste.
>
> TIAC's selective survey of on-line search services in Thailand earlier this year established that only one such service, American University Alumnni, charged no user fee; the meager budget for this service dictated that the number of users who could be served had to be severely restricted--thus achieving the opposite of its purpose (which is to provide service to the largest possible clientele), and in fact having to turn away individuals able and prepared to pay for the service.
>
> What TIAC is attempting to do is to arrive at a uniform pricing policy of the on-line service sector in Thailand. For TIAC to offer completely free service would undercut organizations that already offer the service for a fee; drawing away their clientele to TIAC would very likely destroy the Consortium. The tentative pricing schedule developed by TIAC this spring was commented upon favorably at the first meeting of the prospective TIAC Consortium

organizations. The proposed schedule allows each Consortium member to subsidize any portion of the user cost (from zero to 100 percent), but it establishes a common price platform for services rendered by one Consortium organization to another. Incidentally, this platform is generously subsidized by TIAC for public-sector users.

To attract new users, the Consortium will offer initially reduced service fees, a range of incentives, and it will mount a Consortium-wide marketing campaign. The Evaluating Team is perceptive, however, in estimating that the information service sector of Thailand is unlikely to be financially self-supporting in the near future."

The Evaluation Team is also concerned about what appears to us to be a significant misconception in the Plan, i.e., that on-line access to international databases is not available in Thailand. Indeed, the Plan envisions TIAC introducing this service and as other information centers in the country see its value, they will gradually begin to access these databases directly. The fact is that many information centers in Thailand already directly access international databases. We will return to this point later.

TECHNICAL ADVISOR'S COMMENT: "There is no misconception in the TIAC plan on this point: it refers to existing electronic information services (which encompasses on-line access to remote databases).[6] In June 1988, when the document was written, these services accessed one U.S. vendor, and the rate of usage was very sporadic. It is precisely for this reason that the STDB information program was formulated as a means of strengthening existing Thai information services. In this program, the TIAC organizational entity is principally a mechanism for stimulating the growth of a robust information service sector; for formulating, in a participatory manner, joint standards and conventions aimed at maximal ease of access and use; for achieving high quality of service through provision of professional training; for obtaining highest economies for accessing foreign databases by centralizing (and subsidizing) subscriptions; for stimulating user markets by means of marketing assistance, and so on.

The decision to have TIAC also operate an information service was made to provide a temporary backstop for those members of the Consortium who might not be initially in a position (for personnel, technological or other reasons) to operate on-line search service, and to serve users who at present are not members of the user communities of any of the Consortium members. One such largely "unattached" community are business users, and TIAC intends to address this community.

Having said this, it is nevertheless natural to expect some degree of competitiveness, and perhaps other frictions, to exist in the Consortium. These need to be treated with highest sensitivity, sincerity and even humility on the part of TIAC. Decisions regarding the Consortium must be made entirely in the open and in full participation of those concerned. I am convinced that the TIAC Director is very sensitive of this need and able to handle it."

Problems which the database vendor element of the TIAC Program may face were also pointed up in the 1988 Plan. There may be a reluctance on the part of database producing organizations to give TIAC access to their products. The price for access to their products may be greater than TIAC can afford. A concern with regard to the potential for database piracy, i.e., users down-loading a complete database for internal manipulation or sale, may dampen the interest of some database producers in cooperating with TIAC.

2. How reasonable is STDB's approach to the Implementation of the TIAC Program?

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[6]The plan reads, "The existence of public, electronic information services is, however, an exception, to be found in a few clinics that subscribe to a medical database on optical media; a few agencies that occasionally access a foreign database vendor; and in a small number of governmental agencies which are connected on-line to the National Statistical Office." (page 9) and "So far, however, Thailand possesses only sporadic modern S&T information services--those mediating access to and provision of information in electronic form" (page 11).

2. How reasonable is STDB's approach to the Implementation of the TIAC Program?

Implementation of the TIAC Program has only recently begun. Appendix I provides a schedule which our Team was given on its arrival. There already is slippage in this schedule because of the lack of necessary approvals which STDB needs from Government organizations such as the National Computer Committee for the purchase of computer equipment, the Department of Technical and Economic Cooperation for hiring additional staff, and the Ministry of Finance for leasing office space. The latter task has recently been further complicated by the Ministry of Science, Technology and Energy offering space within the Ministry for the TIAC. As far as the Team can ascertain, everyone is only trying to do their job or be helpful; still it is clear that "helpful" guidance can be an impediment to STDB being able to emulate the performance expected from an independent organization and that which was anticipated in the USAID Project Paper.

As noted earlier, STDB had difficulty in finding a qualified Director for TIAC. While they need approval from the DTEC before hiring additional staff, STDB has advertised the positions and is attempting to identify possible candidates for 4 of the 11 TIAC positions. So far, possible candidates have reportedly been identified for the positions of the Administrative Specialist, the Database Management Specialist, the Computer Systems Specialist, and the Senior Information Specialist. Despite this early encouragement, we believe that finding staff with qualifications as identified in the 1988 Plan is going to be a challenge.

While the 1988 Plan notes, "Worldwide estimates indicate that 90 percent of searches are for business data . . . ," the Plan further estimates that only 25 percent of TIAC's requests for searches will come from the industrial sector and 75 percent will come from the public-sector research community. The Plan did not provide a list of recommended database services to which TIAC should subscribe; but since evidence suggests that by far the majority of the data searches world-wide are for business data and that the Plan envisioned the research community initiating most of TIAC's search requests, the Evaluation Team wonders if the Plan envisioned TIAC subscribing primarily to databases of interest mainly to the academic community.

Subsequently, we have been informed by the Director of TIAC that it will subscribe to two data services, namely Dialog and BRS. Dialog contains databases in the following categories:

- Agriculture and nutrition;
- Bibliography--books and monographs;
- Business;
- Chemistry;
- Computer science;
- Current affairs;
- Directories;
- Education,
- Energy and environment;
- Foundations and grants;
- Law and government;
- Materials sciences;
- Medicine and biosciences;
- Multi-disciplinary;

- On-line training and practice;
- Patents and trademarks;
- Science and Technology; and
- Social Sciences and Humanities.

We are informed that BRS contains similar databases.

The Team understands the present TIAC approach to be to set up its electronic network of Thai information centers and provide them, as well as individual clients who approach TIAC directly, with service based on the two on-line information systems to which TIAC will subscribe. TIAC plans to offer this service to students, teachers, civil servants and state enterprise employees at 500 baht per query and this price will include up to 10 pages of "hard copy." For everyone else, the price will be 990 baht for this service.

It is envisioned that after a year of operation, TIAC will consider preparing an index of Thai databases to offer in the form of a directory to interested parties; and subsequently to consider becoming a vender of Thai databases.

There are at least seven information centers in Thailand that already subscribe to Dialog, namely Chulalongkorn University, Mahidol University, Khonkaen University, Sukhothai University, the Asian Institute of Technology, the American University Alumni, and the Ministry of Science, Technology and Energy. We talked with management associated with three of these. At Chulalongkorn University we were informed that on the average they receive requests to conduct searches of Dialog databases five or six times a month. Its service is offered to the business as well as the university community. At both Mahidol University and the Ministry of Science, Technology and Energy, we were informed that the usage level was similar to that at Chulalongkorn. It is our understanding that at these three locations the full cost of the service must be paid for by users but at AUA the service is free.

Through the NAS contract, STDB provides access to an information analysis service which, among other resources, accesses Dialog to locate needed information. At present, this service is provided free of charge to anyone from the RD&E community who comes to STDB with a question or problem. NAS in Washington are carried out primarily by facsimile. At present, STDB receives about the same number of queries per month as do the previous services cited.

The information manager at Chulalongkorn was unaware that TIAC was being planned. While management associated with all the centers seemed, in principle, to be willing to cooperate with TIAC, none indicated a willingness to give up their own direct access to international databases and rely on TIAC for this purpose. Indeed, if they did, it would be a step backward from what is envisioned in the Plan for TIAC. Yet in our discussions with the TIAC Director, he said he expected this to happen, i.e., for the other information services in Thailand to discontinue their direct on-line services.

> **TECHNICAL ADVISOR'S COMMENT:** "I expect some miscommunication has occurred on this point. TIAC has no intention to limit or deprive Consortium members of direct access to foreign database vendors; indeed, some members may open a private subscription to a particular vendor's service, if others in the Consortium have no interest in that vendor. TIAC does, however, have concern that direct database searching be conducted in a cost-effective manner (because TIAC will partially subsidize Consortium members financially). It is for this reason that some members may defer access until their staff has had appropriate training.

Other situations may also affect the volume of direct access by individual Consortium members. TIAC intends to promote prudent use of optical-disc databases in Thailand; while these can be accessed in an on-line manner from remote sites, such use is suboptimal, and one Consortium node may pass the search request to another node that possesses the optical disc. TIAC also may want to promote the concept of subject specialization by certain nodes (including the TIAC node itself). It is conceivable, and desirable, that when a node receives a request outside its area of subject competence, it redirects the query to an appropriate specialized node. This routing or referral of queries is one of the added services of a network, and is made feasible and attractive by the Consortium's communications network."

In our discussions with the business and academic communities, we were widely advised that the academic community would be reluctant to pay for information services. However, the business community would be willing to pay if the information was appropriate. Assuming the impressions we have are correct, we believe it would be to TIAC's advantage to subscribe to databases that are of interest to both the business and academic community. Databases that are of particular interest to industry include those which provide information on designs; patents; standards and norms; product manufacturers, specifications and prices; markets; regulations; etc. Some of these are included in Dialog. The absence of significant usage, at places such as Chulalongkorn where they are offered to the business community, should be of concern to STDB's management.

The Evaluation Team thinks TIAC needs something beyond direct access to two electronic data services to attract clients. One potential information product is a database of much of the world's industrial output in terms of technology, equipment, parts and products; and their specifications and prices. There is at least one and perhaps other such databases available on microfiche. In an earlier USAID world-wide project, which one of the Evaluation Team members managed, a service was offered to information centers located in R&D organizations in support of industry oriented queries. A majority of these queries concerned this type of information. Such a database would be of importance to STAMP and would also be needed by BOI if it implements a proposed program to assist promoted companies in assessing alternative sources of technology and equipment.

In addition, TIAC should begin as soon as possible to develop its directory of the contents of Thai databases. This is a product that should be of value to both industry and the RD&E community. It may wish to speed up its consideration of becoming a vender of Thai databases if some of the high value to industrial and RD&E communities is discovered in compiling the TIAC Thai database directory.

The other STDB Programs offer TIAC a good potential captured market. All of the projects of the RD&E Programs--Designated, Competitive, and Company Directed--could have line items in their budgets for TIAC services. Many of the consulting assignments under the D/RDS Program could potentially use TIAC services. Additionally, the STDB Policy and Planning Division, the Standards, Testing and Quality Control Program, and STAMP should have significant demand for TIAC services--if it offers the right products. To ensure that the desired interaction occurs will require a conscious and concerted TIAC effort, particularly since TIAC will be located away from STDB. As the D/RDS Program contractor will be an organization separate from as well as located away from STDB, particular TIAC attention will be needed here.

The 1988 Plan noted several possible ways that TIAC could evolve in the future. These are:

- TIAC may evolve into a Thai database vendor, providing on-line access to Thai data- bases leased from their producing organizations.

- TIAC's organizational, training and technical expertise may qualify it to become the focus of a Thai information service industry association, expanding the membership of the initial consortium and attracting more members, especially from the private sector. The expanded association would be funded by member subscriptions, consulting activities, and from income generated by services and products.

- TIAC may merge with another STDB program, the D/RDS, to form a consulting company.
- TIAC could be adopted by an existing large organization or agency such as the Federation of Thai Industries, the MOSTE, or a bank, to carry on its information services.

At present, the Evaluation Team believes that all of the above options should be left open.

The Team is a little surprised that such effort has been made to separate TIAC physically and organizationally from the rest of STDB. Not only has this required considerable extra effort to create procedures and agreements, e.g., a Staff Manual, a Financial Management Manual, an Administrative Management Manual, and a Memorandum of Agreement Manual, but the staff and effort to administer an effort parallel to the STDB structure will be considerable. All of the skills and relationships and understandings developed with other Thai agencies will presumably have to be duplicated by TIAC. In addition, relations and interactions with the other STDB Programs and functions will be more difficult to achieve.

In light of what we have learned in examining this Program and somewhat similar services offered at other institutions in Thailand, the Team can not help but wonder if this high cost facility that is being created will not prove an embarrassment to the management of STDB. The service could initially be provided in-house at the current STDB facilities, with a lot of thought given to what future data services should include--perhaps with the assistance of a professional market analysis.

Recommendations

- Reconsider the initial establishment of TIAC as a separate entity from STDB. To the Team, it makes more sense to start it off in-house at STDB's current facility.

TECHNICAL ADVISOR'S COMMENT: "I interpret (from discussion preceding this quote) that the recommendation questions the physical, not organizational, separation of TIAC from STDB. The need for physical separation has been given primarily by 1) the lack of space in present-day STDB premises for the TIAC operation, 2) the unsuitable location of STDB for the purposes of TIAC, and 3) the desire to develop TIAC as rapidly as possible into a self-sufficient, dynamic, commercially organization.

1) TIAC requires office space to accommodate a minimum of 12 persons, training and laboratory premises for 20 persons; user interview room(s); a conference/presentation facility for 12 persons; a library housing a reference collection and extensive database search manuals; an ample mail room to receive, store and distribute database search printouts; and a storage room to house spare equipment, parts and supplies. In terms of space, these requirements are tantamount to one complete floor of the Jaran Insurance Building. The latter did not have such space available, to my knowledge.

2) The Jaran Insurance Building location and facilities are extremely inconvenient for TIAC's purposes. The building has no easily accessible client parking space; its telecommunications facilities leave much to desire (for example, I have been unable to use the STDB telephone for sending electronic mail); and the electrical system on the floors I am familiar with is not up-to-date to support the range and quantity of information processing and communications devices required by TIAC. A nontrivial percentage of users, particularly those with complex information needs, will wish to visit TIAC in person; so will a stream of Consortium personnel; yet the trip to the Jaran Insurance Building is a major enterprise, and return to the business section in the afternoon is plainly exasperating. In contrast, the Central Plaza facilities have none of these drawbacks, although I suspect the premises there will be fully saturated within one year. A future move to Chulalongkorn University should not be ruled out, if offered.

3) Unquestionably, TIAC must and does intend to support other STDB programs, as the Evaluation Committee observed. Recommendations to that effect have been made by TIAC, including the provision of a budget line item for information services in each STDB grant and contract, and database search services temporarily executed by the NAS. From TIAC's viewpoint STDB, its staff, and its contractors/grantees are another organizational user of the TIAC and Consortium services, and there is no intrinsic requirement or need for TIAC to be physically adjacent to STDB. Since TIAC desires and is expected to become an independent organizational entity upon the termination of the STDB program (or earlier, if possible), its management and administration will benefit from having to face the ramifications of such an entity early. Physical distance does not preclude continuous, strong administrative support of TIAC by STDB; it makes it imperative, however, for STDB and TIAC to be equipped with appropriate information and communications technology, and to build compatible information systems. From this standpoint, the development of TIAC manuals has not been an "extra effort" but an inevitable and, frankly, unusually anticipatory one, for TIAC's commercial endeavors will require departures from the administrative mold of STDB.

A final note regarding the Evaluation Team's wondering whether TIAC will not prove an embarrassment to the management of STDB. This is, of course, a possibility. But in my opinion it may occur not because of the high-cost facility that is being created for TIAC but because of extraneous obstacles that neither TIAC nor STDB seem able to deal with, such as the non-action by the National Computer Committee. The embarrassment will exist whether TIAC is located within or outside of the STDB premises, but the reasons for it should not be attributable to either TIAC or STDB."

Recommendations Based on Technical Advisor's Comment

- Have engineering firms determine if the electrical and telephone systems in the Jaran Insurance Building are adequate to accommodate the TIAC equipment specifications, and if not how much it would cost to provide the necessary upgraded systems to accommodate the TIAC equipment.

Recommendations

- Initiate TIAC services free of charge and build a market. Afterward, begin to consider the introduction of cost recovery approaches gradually.

- Provide services at TIAC that are not so widely available at other information centers in Thailand. They should be products that will serve as an attraction to industry. As a first approach to identifying such products, we recommend that the Director of TIAC conduct an informal survey of industrialists, starting with those on the Executive Committee and the Board. Discuss with them what information bases and services are available and determine their thoughts on other markets.

H. Diagnostic/Research Design Service Program

The D/RDS Program is aimed at stimulating ". . . the development of technical consulting services in Thailand and to promote more efficient utilization of these services by Thai industrial manufactures." The planned mechanism for achieving the goals of this Program is a contract with an outside firm to act as a broker of consulting services to industry. The consulting services are to come from local contract consulting organizations and universities with an emphasis on the use of university faculty.

The premise of the Program is that companies have technical problems which could be solved by expertise existing in universities and consulting firms, but the companies do not know how to tap this expertise. At the same time, contract consulting for the manufacturing industry is a relatively new activity in Thailand and it is believed that an organization acting as a broker could assist in linking technical expertise with company need.

As with other industrial support programs, this one is getting off to a slow start because of the delay in the establishment of STDB and the delay in obtaining a technical assistance contract that would assist with the design of the Program. Changes in management and staff designated to carry out this Program are additional factors. At present, a Program plan has been developed and approved. A request for procurements from contractors was advertised; and six proposals were received by the June 15, 1989 deadline. These are currently being evaluated and a contractor is expected to be selected by September to initiate the D/RDS Program.

1. What are the Reasonableness and Feasibility of STDB's Plans for the D/RDS Program?

There is clearly a need to better link consultants and potential consultants with Thai industry. We believe the use of an experienced contract research and consulting service organization to act as a driving force to broker existing and potential consulting services to industry to be an innovative approach that has a reasonable chance of success. We do, however, have a few caveats and concerns about some aspects of the plan. These include:

- The inexperience of some potential consultants and STDB-D/RDS legal liability;
- The confidentiality of client operations;
- Potential D/RDS conflicts of interest;
- The magnitude of Program targets; and
- The role of STDB in Program monitoring.

The plan describes a brokerage role for D/RDS whereby D/RDS will identify a problem, propose an approach, bring in the best consultant to carry out the job, negotiate and sign one contract between the client and D/RDS and another one between the consulting organization and D/RDS, and then confine itself to minimally monitoring the project and assuring, at project's end, that the consulting organization had carried out its contractual obligations. Thus D/RDS and possibly STDB are legally liable for the consultants' performance as contracted for. As noted, a basic premise of the project is that these are consultants and potential consultants who are relatively inexperienced in providing technical consultant services. Thus D/RDS will be basically in the role of a prime contractor with presumably an inexperienced subcontractor much of the time but as envisioned in the plan, D/RDS will not provide the normal management and oversight that is expected from a prime contractor. We believe that D/RDS is going to need to provide this oversight and supervision to make the Program a success.

The question of client confidentiality is another one that concerns the Evaluation Team. While this issue was raised in the D/RDS, we are not sure the potential seriousness of the issue is recognized. In the United States, if a contract research or consultant organization performs work for a client in a given industry, e.g., the automobile industry, it will not perform work for another firm in the automobile industry, that is a competitor, without first obtaining the consent, probably in writing, from the first firm indicating that it has no objections to the work being performed for the second firm. In fact, work for competitors is hardly ever done. There are industry supported research organizations that conduct generic research and provide general consulting assistance to an industry as a whole but not under contract to any one organization. Although, reportedly, this is done in Great Britain. We are uncertain how Thai manufacturing firms will react to D/RDS providing contract consulting services to competing firms in the same manufacturing industry, but are concerned that it may possibly become a problem.

Another type of conflict of interest that D/RDS and STDB may encounter would be D/RDS using its own staff to conduct consulting services under contract. If such a practice were carried out, we assume other competing Thai contract consulting organizations would raise questions that could possibly be bothersome.

The magnitude of some of the Program's targets such as the number of consulting contracts that should be concluded seems quite ambitious, i.e., 25 in the first year and 100 in the fourth year. We do not believe a very experienced consulting contract service organization working in an environment where contract services are the norm could obtain this level of contract activity, even on a subsidized basis, with the size staff that is implied in the Program and for which STDB has budgeted. We believe more realistic levels would be five to ten contracts in the first year and 25 to 35 in the fourth year. See Appendix J for a brief analysis of the time required to obtain 100 contracts.

2. How Reasonable is STDB's Approach to the Implementation of the D/RDS Program?

This is a Program of fundamental importance in reaching STDB's objective of linking industry with the scientific and technological community of Thailand. There will be pervasive opportunities to link this program with other of STDB's program elements. For example, the designated RD&E Program can help create centers of manufacturing consulting expertise and resources to assist selected industries. Problems identified in consulting assignments can provide the basis for competitive or company directed RD&E projects. TIAC should be a major resource for D/RDS consulting organizations in carrying out their assignments. As noted in the previous section, one future option would be to combine D/RDS and TIAC into a contract research and consulting firm. The STQC Program will undoubtedly identify many opportunities for consulting support from the D/RDS Program. Likewise, D/RDS should be able to identify training and other needs that could be met by the STQC Program. It is likely the D/RDS Program will identify policy issues which affect the rate of technological advance of segments of Thai industry that the Policy and Planning Division of STDB could profitably examine. In short, this Program has the potential of serving as an integrative driving force for much of STDB's overall mandate. For this to happen, however, STDB is going to need internally considerable depth in its monitoring and analysis capability for this program element. We recommend that STDB explicitly examine the opportunity that this Program offers and develop and structure the capability and mechanisms for taking advantage of this.

In most of STDB's other programs, STDB is developing an in-house operational management capability. To maximize its future options, STDB may wish to supplement the staff of the firm which obtains the D/RDS contract with STDB staff. The experienced contract consulting firm which wins the D/RDS contract can serve as a mentor for the less experienced STDB staff thus transferring a contract consulting capability to STDB. This will particularly increase STDB options with regard to combining D/RDS and TIAC functions at some future date. Also, the firm managing this Program is going to need all of the assistance it can obtain for the D/RDS Program to achieve anywhere close to its targeted number of consulting contracts.

We assume that the reason that STDB is not conducting this Program in-house--considering the linkages such a program provides to industry and the university communities, as well as other STDB programs--is first, that STDB was not originally viewed as being a permanent organization; and second, that, as a consequence, STDB has never obtained the in-house staff to carry out such a program. As STDB does now envision being institutionalized through proposed legislation, this change may be another reason for acquiring in-house capabilities.

The Evaluation Team, however, has a reservation in suggesting the options in the preceding paragraphs. The firm winning the D/RDS contract is going to need a great deal of flexibility and ability to react rapidly in order to successfully provide the envisioned industrial consulting services. In attempting to increase Program interaction or to learn the contract consulting business, STDB should be careful not to restrict or inhibit the winning D/RDS firm from getting on with its principal business.

I. STAMP

STAMP is a recently formulated STDB Program experiment, designed by the Director of Planning, Program Development and Policy Review together with the A.I.D. S&T Office ". . . . to facilitate, expedite, and encourage the process by which Thai firms gain increasingly greater expertise and experience in the acquisition and assimilation of technologies important for the continued success and growth of the firms." The activities which STAMP will support out of STDB's Office of Planning, Program Development and

Policy Review are 1) the analysis and assessment of technological options and 2) the mastery of technology embodied in new capital equipment.

The first of the two STAMP activities ". . . encompasses systematic efforts to acquire and generate technical information needed by senior managers of firms to arrive at appropriate investment decisions, regarding 1) whether to make a major new capital investment, 2) whether to purchase, lease or to develop locally a production technology or certain components of a production technology, and 3) the nature and source of technology and related technical services to be procured and the terms on which these technical elements should be procured. The second major STAMP activity encompasses ". . . efforts aimed at assimilating a technology recently acquired or to be acquired by a firm, including efforts to seek and absorb knowledge and expertise for securing efficient production operation and for effecting technical changes and improvements in products, production procedures, processes and systems."

STAMP has been approved by the STDB Executive Committee. The officer under the Office of Planning, Program Development and Policy Review who is assigned to specifically take charge of the Program is "on board" and currently preparing detailed procedures as well as making visits to a number of industrial firms which are potential clients of the Program. It is anticipated that the Program will be initiated within one or two months after the shift from loan to grant funding of certain STDB activities is made.

1. What are the Reasonableness and Feasibility of STDB's Plans for the STAMP?

As noted, STAMP is to be an experiment aimed at demonstrating to industrial firms and related development promotion institutions the need for appropriate technology and how investments in capability development can secure efficient operation and improvement in the technology's processes and products. The Evaluation Team endorses this experiment. In addition to the objective and approach of the Program being solid, it should provide opportunities for integrating other STDB Programs into its activities. It will require consulting support which could be arranged through the D/RDS Program. Information on sources of technology, equipment, specifications, costs, etc. will be required which hopefully can be supplied by the TIAC. It is conceivable that RD&E facilities and capabilities may be required for the companies involved in STAMP to provide them the ability to continually upgrade the technologies' processes and products. This could lead to Company Directed RD&E Projects.

2. How Reasonable is STDB's Approach to the Implementation of STAMP?

While implementation of this program is not under way, the Team has a recommendation about its implementation.

Recommendation

This Program is directly related to the programs of two major development promotion institutions in Thailand, namely IFCT and BOI. We believe that STDB in general, and especially STAMP, should work closely with these two agencies. One of the Program's first implementation activities should be to develop protocols and procedures for working closely with IFCT and BOI. We believe a designated STDB office at each location would be appropriate with an STDB staff member working out of each approximately half time, the other half of their time working out of STDB. STAMP could be the center piece of this effort to tie STDB to BOI and IFCT; however, all of the other industrial support services as well as the Company Directed RD&E should be represented.

At BOI, STDB Programs could be made available to a promoted enterprise as a part of its promotional privileges. Since one objective of BOI is to increase licensees' utilization of Thai technical resources in lieu of technical dependence on the foreign licensor, STDB (and BOI) can assist in identifying and involving small and medium scale Thai technical resources. STDB may be able to help new licensees and joint ventures assess, purchase and achieve optimum use of production equipment with the help of STAMP and TIAC, and enhance company in-house capability in S&T through use of the Company Directed RD&E Program.

The IFCT portfolio contains many small and medium sized companies. IFCT's program of support to these companies with management and marketing assistance (through its Industrial Management Company, Limited subsidiary) can be expanded to include technical assistance with testing, quality control, manufacturing methods, product extension and trouble shooting. IFCT's seminars for its portfolio companies provide and excellent interface at which STDB can publicize its capabilities and identify specific opportunities to assist.

J. Professional Exchange Activities

The professional exchange activities are described in the USAID Project Paper as being supportive of fostering private and public sector linkages in the transfer of technology. It notes, "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." In terms of the funded volume of activity, this Program element is approximately on schedule.

Under the Program STDB has organized conferences, seminars and meetings on subjects such as:

- Aquaculture Research and Development Needs for Thailand;
- Linkages between Science and Technology Development Plans and Other Development Plans;
- Development of Electronic Ceramics in Thailand;
- Research and Development in the Software Industry;
- Scientific and Technological Research to Support the Green E-Sarn Project;
- Research and Development of Biotechnology for Improvement of Thai Agricultural Products; and
- Direction for Enhancing the Effective Utilization of Minerals and Metals in Industry.

The purpose of these seminars has been to bring together specialists to share knowledge, to exchange information and to try to find solutions to problems of common concern. The meetings seem to generate a fair amount of interest and to be well attended. Industry representatives have been in attendance. The conclusion of many of the seminars has been that a study should be undertaken or that another seminar should be organized on the subject. The meetings are useful in the following ways:

- They provide a needed forum for specialists and experts on the same subject to meet and to exchange ideas and information which should stimulate further work on the subject;
- They help to identify areas that needed further RD&E. They should help both potential PIs and STDB;
- They help to stimulate awareness of the importance of S&T in agricultural and industrial development; and
- They help to promote linkages between Government, RD&E institutions, STDB and private firms which will facilitate future cooperation.

The Team would like to suggest one approach that STDB may wish to utilize at one of its seminars. As is often done at present, schedule a seminar/workshop for two days with appropriate representation from the RD&E community, industry and government. On the first day have presentations and exchange of information on the subject of interest as is currently done. On the second day, however, break the participants up into small working groups and have them design RD&E projects, address specific issues, or perform other tasks as may be appropriate in light of the subject and objective of the seminar/workshop.

CHAPTER III

THE FUTURE OF STDB

A. The Post-Project Environment for Science and Technology

The future, post-PACD environment of STDB in Thailand is expected to be a continuing process of industrialization. It is assumed that key currencies will maintain their appreciated level against the Baht, which has stimulated tourism and a dramatic rate of investment from Japan, Europe, the U.S. and Taiwan. Under this assumption, foreign investment will continue, but Gross National Product (GNP) growth rates will be less than the recent level of 10 to 11 percent. Lower growth rates are anticipated because of infrastructure bottlenecks in the Thai economy, an increase in labor costs and because of competition in export markets from other ASEAN nations (e.g., Philippines, Malaysia, Indonesia).

This continued industrial growth is expected to be characterized by:

- Increasing strength of large domestic industries as well as of foreign joint ventures, to serve both domestic and export markets. Both will have requirements for science, technology and engineering manpower, which will be in short supply. Some joint ventures that continue to be technically dependent on the foreign parent will wish to develop their own innovation capability.

- Increasing recognition by small- and medium-sized domestic industries, especially those based on indigenous raw materials--ceramics, rubber, agriculture, food processing--of the value of S&T inputs for the expansion and modernization of their businesses. As the size and markets of companies increase, their use of S&T will grow. The following trends will be evident:

  -- Accelerating growth of the extractive industries, especially oil and gas, with development of associated support and processing industry;

  -- A shortage of S&T manpower, with universities struggling to keep up with industrial demand, and to maintain faculty size and quality in spite of losses to industry. Availability of S&T manpower is a function of price (salary); and

  -- Pressure of competition will force improvement of product quality and productivity.

B. National Actions to Further Develop the S&T Infrastructure

National actions by RTG to stimulate the role of S&T are expected to continue. Success of STDB in attaining its objectives will have a positive effect. With continuing economic growth, the ability of RTG to finance such action should not be a problem. Political and institutional factors will play a role.

As Thailand has moved from infrastructure development through import substitution to export orientation, political awareness of the need for increased capability in S&T has grown. A recognition is developing that Thailand cannot rely only on imported technology but must adapt it to its own needs and develop its own products. With increasing agriculture exports, international market pressures will necessitate higher productivity, especially in the agricultural sector. According to one qualified observer, Thailand now needs an emphasis on applied research.

There is thus government interest in strengthening public-sector S&T institutions, and consolidating activities where there is duplication of objectives and efforts. Primary responsibility for S&T in the government is vested in MOSTE.

Current evidence of this interest includes the submission to the Cabinet and the Parliament of a bill to support the country's S&T. It proposes a state enterprise to benefit national science and technological development. This initiative would represent an RTG investment of ten billion Baht (about $400 million) over a period of five years. The contents of the bill have been tentatively endorsed by a number of related public-sector institutions (e.g., NESDB, BOI, BOB AND MOSTE). It calls for a new, enlarged S&T Development Board, which will absorb the current STDB. The bill also anticipates consolidation of the three National Centers for Genetic Engineering/Biotechnology, Materials, and Electronics/Computers into the new organization, thereby eliminating some duplication of function and adding competent staff to STDB. In addition to high-level government executives, the Board of Directors would include the President of the Federation of Thai Industries and nine additional qualified representatives from the private sector.

The Board of Investment is now offering incentives in the form of exemption from import duties for investment in R&D. MOSTE is considering promulgation of a special "Law for the Promotion of Technology Development for the Private Sector." Another law concerning official recognition of private laboratories is being written.

Also under consideration are:

- The establishment of industrial parks which can have S&T linkages with university faculties;
- Incubation centers at which designated university developments can be nurtured to industrial fruition; and
- A registration and approval system for imported technology.

In regard to the supply of professional S&T manpower, plans are being laid for a scholarship program for up to 800 Thai students to study science and engineering at overseas universities, as well as another 400, supported by the Ministry for University Affairs, to study overseas in all key fields. It appears, in the case of S&T university faculties, that the 2 percent limitation on faculty growth is being relaxed. (However, there is concern about being able to fill additional faculty vacancies.)

A program is underway to attract Thai S&T personnel working in the academic and private sectors in other countries back to Thailand.

In addition to assistance from USAID, RTG is accepting assistance from the Japan International Cooperation Agency for equipment and facilities to strengthen national capability in industrial standards, as well as for environmental studies. Further, discussions are underway with the World Bank and with Canada for assistance to Thailand in its program of support to STDB.
The above intentions represent a growing perception of the value of S&T in industrial development.

C. Output of S&T Training Institutions

Information available to the Evaluation Team regarding the output of science and engineering graduates from Thai educational institutions provides mixed impressions, but on the whole is positive. For example:

- One report was heard that the total number of students studying physics, chemistry and mathematics was diminishing.
- In engineering fields, the total annual admission rate at Thai universities is currently reported to be about 2,700 to 3,000. This rate is about half the estimated annual requirement of 6,000.
- Thai universities can increase their S&T throughput by increasing class size (and student-faculty ratio) without increase in faculty--but with a possible concern for quality.

- There are good engineering programs at such universities as Chulalongkorn, King Mongkut and Chiangmai. Mahidol University is expanding its engineering offerings. The Asian Institute of Technology, with graduate education only, is a major engineering-education resource.

- Of the engineering graduates continuing for graduate study, a significant fraction selects business administration for further studies. A disadvantage is that these individuals are lost as "bench engineers and scientists"; the advantage is that they represent a pool of engineering-oriented managers needed for industrial development.

- Other institutional arrangements are developing to meet the private-sector demand. They include university-degree evening programs (with high tuition fees and commensurate reimbursement for evening faculty) as well as special courses organized by local universities and offered by industrial firms for their employees. Companies are sponsoring one- or two-month in-house courses to upgrade the capabilities of their technicians. In addition, a few private universities are offering S&T curricula--a trend which could continue.

- Increasing job mobility among experienced professionals in the private sector may have a diffusive effect upon the S&T capability of Thailand's private-industry sector.

- Regarding the supply of young engineering faculty, some of the 800 students expected to go abroad for S&T education will return to faculty posts, and will compensate for the reported loss of existing faculty to industry.

- It is still not assured that the national S&T institutions will suffice to meet the demand; also, there are still too many social-science graduates compared to science and engineering. However through special educational initiatives such as the above, by both the public and private sectors, the disparity will be significantly reduced.

D. RTG and Private Investment in S&T Infrastructure

The Team has few statistics to measure the level of investment in S&T infrastructure, by either the private or public sector. In regard to the public sector, however, RTG is considering the new S&T bill and its associated financial commitment of 10 billion Baht over a period of five years, as described in Section B.

Should overseas scholarships for 1,200 students be approved, the annual expense for tuition, travel and subsistence would average somewhat under $10,000 each, for an annual total of around $10 million, or about 0.25 billion Baht. In addition, RTG would experience a certain loss in tax revenue due to the R&D tax incentives and reduced import duty on R&D equipment. (However, in accordance with supply-side economics, the increased level of R&D activity and resultant economic growth will more than compensate for this loss).

In regard to the private sector, the increasing foreign investment will result in more S&T facilities. According to the BOI approvals for foreign investment in Thailand increased from 34.6 billion Baht in 1986 to 67.8 billion in 1987 and 210 billion in 1988, representing an approximate six-fold increase over two years to a level of about US$8 billion. Whether the investment is for labor-intensive industry such as ceramics, semiconductor or telephone manufacturing, or for capital-intensive industry related to oil and gas or pulp and paper, a certain but unknown fraction must be devoted to S&T, including in-house RD&E and training. In addition, existing industries are using increasing amounts of computers. This usage, with the associated computer sales, service and education industries, is an additional S&T component and a shift away from blue-collar or clerical work to white collar and S&T. (The 1987 demand for computers and peripherals was $ 219 million, with anticipated annual growth of nearly 40 percent.)

BOI is keen to attract high-technology ventures, but not at the expense of an imbalance between the agricultural, industrial and service sectors. According to BOI secretary-general Chira Panupong, "BOI aims to expand investment in agricultural products and industrial services, to improve the production efficiency of

existing industries, and to help Thailand become more self-sufficient in raw materials and the development of high technology." It may also be commented here that fiscal incentives can be used to accelerate growth of RD&E capability of firms; for example, by offering tax deductibility of twice the amount put into RD&E.

According to Minister Prachuab Chaiyasan, Minister of Science, Technology and Energy, the Science Ministry during the sixth Five-Year Plan (1987-1991) is trying to increase the governmental expenditure on S&T from 0.3 percent of GNP to 1 percent. At the same time, it is hoping to adjust the proportion of government and private sector expenditure on S&T from 90/10 to 70/30. (In 1984 the ratio in South Korea was 40/60.)

E. Should the STDB Continue Beyond the PACD?

As stated previously, the Team recommends that PACD be immediately extended by a period of three years, from September 1992 to September 1995. (We understand that action to extend PACD has been initiated and can be approved by the USAID-Thailand Mission Director.) Such action will help create a feeling of permanence at STDB and diminish the uncertainty associated with planning for the expenditure of accumulated funds that exist as a result of the slower than expected establishment and the making operational of STDB. It will provide a more stable environment for attracting quality personnel, including private-sector personnel, and will encourage key staff members to remain at STDB. The Team urges expeditious approval of this extension. No additional A.I.D. loan or grant funds will be required for this PACD extension.

Additionally, passage of the currently proposed Government legislation to change STDB's status from a project under TISTR to a state enterprise in its own right with an initial proposed five year budget will make an even greater contribution to the stability of STDB. The sooner this bill can be passed the better. We understand that USAID is considering funding a second phase of STDB's development. The Team recommends such continuation. We believe, however, that funding a second phase of the STDB program following extension of the current PACD should be made contingent upon passage of the RTG S&T Development bill and appropriation of funds for STDB at an appropriate rate. In this manner, each source of funds will gain leverage from the other. We believe a contingent offer of intent should be made soon to encourage passage of the legislation.

It is not known when the S&T bill will be passed, but A.I.D. will need to inject funds into the Program by around the beginning of 1992 in order to maintain the anticipated level of activity. The Team suggests that plans for such funding be made, with the possibility of reconsidering should the S&T bill not be passed by that time.

F. The Future Form of STDB

With regard to the future form of STDB, there are four possibilities. Which of these possibilities is most appropriate depends in part on implementation of the proposed S&T bill, on the availability of stable financing, and on the need for flexibility of operations. This includes maintenance of a capability to respond rapidly and with high performance to needs of the private sector.

In addition to RTG financing, loan and grant support can come from USAID, the World Bank, the Asian Development Bank, and from bilateral relationships with other countries such as Japan and Australia. Because of the Ministry of Finance's understandable reluctance to exceed a specified national debt-service ratio, a ceiling is imposed on potential loan support.

The four possibilities are:

- **A foundation.** A foundation provides maximum flexibility of operation. As a foundation, STDB could receive funds from a variety of sources, private, public and international. However, as a foundation, STDB may not be able to rely on a consistent annual budget from RTG and would have to depend on other sources of funding. For stable operations, it would need guaranteed multi-year, non-loan support from outside sources (including

contract revenue), or investment income from a sizeable endowment fund. In addition, a foundation is not allowed to conduct business for profit. A foundation structure is thus not believed in the present circumstances to be the ideal option. However, as it is by no means certain that the proposed legislation to set up STDB as a State Enterprise will be passed by Parliament, this option should not be ruled out.

- **A private company.** STDB could be converted to a private corporation, but would then need equity funding, and should be able to operate profitably on a commercial basis. At this point, this option does not appear to be a viable one.

- **Continue as a project under a state enterprise (TISTR).** In this form, STDB can continue to receive RTG direct funding as well as loans and grants from international sources. However, without assurance of continued support from non-Thai sources, this option is not considered to be practical in the long term. STDB is able to operate fairly independently of TISTR at the moment only because it makes no demands on the TISTR budget. If STDB has to use an allocation from the TISTR budget, TISTR will undoubtedly have to bring STDB under its rules and regulations (e.g., for staff salaries), and will want to exert more direct control over it.

- **A state enterprise.** This option is the form proposed in the pending legislation. This form would be more attractive for the recruitment of additional personnel than the present form if the existing salary structure can be maintained.

Pending passage of the legislation, the Evaluation Team believes that the current status of STDB is the optimum one. However, efforts to increase flexibility of operation should continue. One method is further improvement in quality of management and operations within STDB so that approval committees perceive less need for oversight.

In connection with the proposed legislation (and the political process for gaining its approval), the Evaluation Team recommends that STDB and MOSTE insure the availability of detailed and credible plans for STDB's proposed expansion of operations. If not yet available, they should be developed in the near term, using foreign assistance if required (for example, via A.I.D. or NAS).

The Evaluation Team observed that the current version of the proposed legislation does not contain essential provisions such as: 1) that the organization is specifically authorized to own property, lend and borrow money, issue bonds, etc. and 2) that it is authorized to establish companies, foundations, institutes, make investments and participate in joint ventures (in addition to the existing provision permitting it to set up state enterprises) with which to further its objectives. (See, for example, the provisions in the Thailand Institute of Scientific and Technological Research Act, BE 2522 (1979), Sections 6-8, as documented in the Project Paper, Appendix J-2, pp 2-3.)

Further, in spite of what the Team has heard, the bill does not provide for needed exemptions from various Government regulations, including salary scales for new employees. If possible, it is preferable to incorporate needed exemptions in the legislation rather than to have them provided by Cabinet resolution which can be readily changed by subsequent cabinets.

Note that it is not clear how rapidly the above legislation will be approved, or whether it will be approved at all. As of this writing, it has been submitted to the Cabinet and is under legal review by the Juridical Council. If not submitted to Parliament before adjournment in July, implementation is unlikely to occur before the beginning of 1991.

If the legislation is approved, STDB's status will soon be that of a state enterprise--hopefully with special features which provide for operational flexibility not currently found in such organizations. Beyond this time, STDB may wish to consider other arrangements for itself or some of its programs. For example, if the TIAC and D/RDS Programs prove to be commercial successes, they could be privatized, either separately or merged, with STDB maintaining an equity position in them. For greater flexibility, it may someday be appropriate to convert one or more of its institutes (under the proposed legislation) into foundations. As it is difficult at this time to foresee all of the problems and opportunities that STDB will face, STDB should maintain open options regarding its future.

CHAPTER IV

MAJOR EVALUATION FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The STDB Project

The Evaluation Team finds the USAID Thailand project to establish STDB with all of its concomitant functions to be the most innovative donor program for national science and technology support of which we are aware. There were, however, some misconceptions in the Project Paper about the independence that STDB would have under the administrative arrangement proposed or the attractiveness of employment in the proposed structure. The tragic death of the then Minister of Science, Technology and Energy delayed project initiation. USAID Thailand must be complimented for a herculean effort in assisting STDB to get on its feet. Much of the work originally envisioned to be conducted by a technical assistance contractor was actually provided by the USAID staff, as delays were incurred in bringing the contractor into the project. There has been some criticism of the extent of USAID's involvement in the program's initiation. In our view, however, the program would not be poised for making the major contributions that we see on the horizon if it had not been for USAID's heavy initial involvement. After a shaky and delayed start, the program is advancing as intended. The Evaluation Team is impressed with STDB's accomplishments and plans.

The USAID S&T support program that USAID officials most often point to with deserved pride is the establishment of the Korea Institute of Science and Technology. This institute was established just as the Korean economy was moving into an aggressive export promotion mode. This is just the point where the Thai economy is today. Before this point in economic development, there is rarely an industrial demand for S&T. One can see this demand beginning to develop in Thailand. If STDB management and staff continue to support this growing industrial need for S&T with its well conceived programs, we believe that some day USAID officials will point back to the establishment of STDB as another of its big contributions to economic development.

Personnel

One of our greatest concerns is with STDB's need for additional personnel. The assumptions in the Project Paper concerning STDB's ability to attract staff with significant industrial and RD&E experience have turned out to be unrealistic. For the most part the staff is enthusiastic, hard working, intelligent, but was, at least originally, inexperienced in the jobs to be performed. By and large, the original staff did not consist of the people that the Project Paper envisioned. Even if those people had been obtainable with the incentives offered, the Project Paper underestimated the difficulty in conducting business in the type of institutionalized structure in which STDB is embedded. In our view, the fact that the current staff has accomplished what it has is a testament to the intelligence, devotion and hard work of some extraordinary people associated with the project.

In any regard, STDB has been given a large assignment and does not yet have sufficient people to carry it out. In many cases, the original positions were perhaps defined with an inadequate view of what is required to make technological advances in an industrializing country such as Thailand. There needs to be a reassessment of staff needs in light of STDB's mission, the environment in which it is working, and targeted achievements. Virtually every STDB program needs additional professional and support staff, in particular the STQC and RD&E Programs if our subsequent recommendations for these Programs are accepted. Especially needed for working with industry are professionals with industrial- and engineering-management experience. DTEC and USAID should approve new positions based on realistic needs assessments.

Management

We believe there needs to be a greater degree of senior management attention to strategy, agreement on goals, and cooperation in reaching them. Perhaps weekly senior management meetings to share information and to review STDB's progress and problems would be appropriate.

Senior management needs to see that middle management continues to improve internal quality control on projects and activities so that the Executive Committee does not feel it necessary to dwell on these matters and can devote its attention to helping STDB's top management determine wise policies and strategies. This attention will also affect positively the progress of RD&E project approvals through various committees. Eventually, if high quality is maintained, it may be possible that RD&E project processing will gradually be delegated to STDB.

There needs to be established a regular date for Executive Committee meetings so that its members can arrange their schedules. It is particularly important for STDB's future that industrial Executive Committee Members actively participate in these meetings because of their perspective on industry needs for RD&E and associated services, and because STDB needs them as advocates. The occasional unavailability of one or more key executives should not be a reason for a change in schedule.

Program Planning

We have noted some non-uniformity in the effectiveness of the program planning at STDB. Most programs, but not all, had their origins in the Project Paper, the development of which did not include STDB. All program plans have subsequently evolved or been further developed. In some cases STDB does not appear to have been sufficiently involved in the formulation and/or reformulation of these plans. The Team recommends active STDB involvement by both the Planning Office and the program's management in the development of all program plans.

Technical Information Access Center

Communication and information technology will be critical to Thailand's industrial, technological, and scientific development. It is the Team's belief that this technology will be an essential component of the revolutionary advances that are beginning to take place as a result of the exponential growth of science and technology. If legislation is enacted bringing the National Electronics and Computer Technology Center (NECTC) under the umbrella of STDB, STDB will have access to communication and software technology through TIAC that will be produced by NECTC as well as others. This may be a significant advantage to Thailand in its efforts to catch up with the industrialized countries.

There are, however, some short term concerns that the Team has with respect to the way in which the TIAC Program is being implemented. We have these concerns because of what we believe to be an incorrect original assessment of the Thai environment with respect to industrial and S&T information. Thus resulting in a plan based on this incorrect assessment, an apparent strong desire in the plan to separate TIAC from STDB, and STDB's acceptance of the plan without a sufficiently critical examination.

The Team recommends that STDB reconsider the establishment of TIAC as a separate entity from STDB. To the Team, it makes more sense to start TIAC in-house at STDB's current facility. We also suggest initiating TIAC's services free of charge in order to develop a market. Thereafter, consideration can be given to approaches for gradual introduction of cost recovery and for expansion of facilities and staff.

We also suggest that TIAC provide a service other than Dialogue which is widely available at other information centers in Thailand. We propose that it be a product that will serve as an attraction to industry. As an approach to locating this product, we recommend that the Director of TIAC conduct an informal survey of industrialists, starting with those on the Executive Committee and the Board. Discussions with them about currently available information bases and services would elicit suggestions about their relevance for Thailand, or for other services having a potential market here. (See Chapter II, Section G for a counter argument to this recommendation from the technical assistance advisor who developed the Plan for the this project.)

Standards, Testing and Quality Control Program

The Team recommends continuation of the Program's current reported emphasis on improving the quality of specific Thai industrial products, particularly those aimed at an export market. Upon identification of a specific product or category of products requiring support unavailable from primary and secondary standards organizations, the Program should provide the standards organizations the assistance, equipment, training, and resources needed to support the product quality of concern. We suggest that support to "core" standards organizations can be linked to a specific product-quality improvement project. Conduct of the STQC Program in the manner we suggest will require a larger STQC professional and support staff.

RD&E Coordinators and Industry

Program coordinators should start interacting more with Designated and Competitive RD&E targeted firms and industries. This effort should include working visits with interested firms and industries for 1) learning their problems (and opportunities) and jointly defining appropriate new projects that address these issues, including projects under consideration at the proposal stage, and 2) to jointly review progress in existing projects and potential utilization of anticipated project results. Appropriate principal investigators (PIs) should participate in these visits. Program coordinators should also involve company and industry representatives in the formal semi-annual project reviews.

Because of the lack of industrial experience among the program coordinators, we recommend expanding and enhancing STDB's industrial outreach capabilities by entering into indefinite quantity type contracts with two or three local business consulting firms that have broad perspectives of Thai industry. These firms would assist STDB coordinators and their associated PIs to identify potential industrial users of specific RD&E results, to facilitate the establishment of linkages among them, and where appropriate to assist in related market and economic assessments. Implementation of this outreach activity will require more coordinator staff.

STDB Relationships with the Board of Investment and the Industrial Finance Corporation of Thailand

A number of STDB's programs have relevance to two major development promotion institutions in Thailand, namely IFCT and BOI. We believe that STDB can develop useful working relationships with these two agencies. STAMP could serve as the centerpiece for assistance to both of them. One of the STAMP Program's first implementation activities should be to develop protocols and procedures for working with each institution. We believe a designated STDB office at each location would be appropriate, with two appropriately qualified STDB staff members each spending approximately half of their time at the two institutions, and the remainder at STDB. In addition to STAMP, the other industrial support services as well as the Company Directed and Competitive RD&E programs should be represented and involved.

Public Relations and Marketing

Although STDB's activities are well known in the research community by virtue of its research support, its goals and activities are not well known nor understood in many relevant private sector and government circles. Consideration might be given to use of a professional firm for assistance in developing a suitable program of publicity to designated constituencies and of a strategy for marketing of STDB's services to the private sector.

Expanding Funding Sources

The Team recognizes that STDB has interest in broadening the base of donor support. We suggest that the timing of this interest is appropriate. To avoid excessive burden on senior management, consideration should be given to establishing a "development office" staffed by a suitably qualified executive. Quality of the individual should transcend issues of office location or hours to be expended.

As STDB's maturing programs generate visible achievements, they can be utilized to justify the solicitation of additional funds. One STDB program, the Fellowship Program, has already demonstrated considerable success and has in place an effective structure and set of mechanisms for program management. The Fellowship Program may thus be an appropriate first initiative for such a development office.

The Future

We understand that USAID is planning to extend the PACD and is considering funding a second phase of STDB's development. We recommend that the PACD be immediately extended to 1995. This extension will help create a feeling of permanence at STDB and diminish the uncertainty associated with planning for the expenditure of funds that exist as a result of the slower than expected establishment and making operational of STDB. Passage of the currently proposed Government legislation, to change STDB's status from a project under TISTR to a state enterprise in its own right with an initial proposed five year budget, will make an even greater contribution to the stability of STDB. Stability is important for maintaining STDB's current staff and providing a basis for attracting additional quality personnel, especially some with private sector experience. We believe USAID's funding of a second phase of its STDB program, following the extension of the current PACD, should be contingent upon passage of the before mentioned legislation. Indeed, a contingent offer of intent should be made soon to encourage passage of the legislation. STDB will require additional funding in approximately two years (1991) to prevent a "tailing off" of its programs. It is unlikely, in our opinion, that the proposed legislation will be passed much before this date.

APPENDIX A

WORK STATEMENT

APPENDIX A

Work Statement :
Interim Evaluation - Bi-lateral S&T Project

Objective

This will be a "mid-term or "interim" (process) evaluation of the Science and Technology for Development Project being implemented by the Science and Technology Development Board (STDB). The purpose of the evaluation is to assess the efficiency with which various programs are being carried out by the STDB, review the development relevance of these programs, and consider the extent to which they appear to be contributing toward attainment of the overall project objectives. In producing answers to these questions, the organizational structure of the STDB itself will be reviewed, as well as the criteria and guidelines under which its various programs operate. The evaluation should conclude with recommendations as to steps that can and should be taken to improve effectiveness of the programs, and the efficiency with which they are being carried out. Recommendations for modification of STDB's organizational structure or procedures should be made if deemed appropraite. In addition, the recommendations may also as appropriate cover issues regarding the long term status (beyond) the project PACD), role and structure of the STDB.

Background

The project agreements for the Science and Technology for Development Project were signed in August 1985. The project was to have a 7 year life, and has a PACD of 30 September 1992. The project is funded at a level of US$ 49.4 million, of which US$ 35.4 million is the USAID contribution.

The purpose of the Science and Technology for Development project, as stated in the Project Paper and the Project Agreements, was quite broad: "To enhance the effectiveness and the extent of public and private sector application of science and technology to Thailand's development". This very broad statement of purpose was not inappropriate as a wide range of ambitious and complex activities were anticipated under the project. A somewhat more specific statement of purpose i.e. "to assist Thailand to increase its capability to identify, develop, acquire, and/or produce the scientific knowledge and the technology it requires to resolve problems or exploit opportunities facing its production sectors" - is now more commonly used.

In order to implement the project, the PP and the PROAGs called for the creation of a new quasi-governmental organization - to be called the Science and Technology Development Board (STDB). The establishment, staffing, and functioning of this organization became the first major objective of the Project. The creation of the organization was formally

announced in March 1986. It became formally empowered to conduct business in July 1986, and its Offices were formally opened in November 1986.

The programs and activities STDB was charged with carrying out include:

1. administering a "Research, Development, and Engineering (RD&E) Funding Support Program which includes the following elements:

a) a "Designated RD&E" program under which funding support was to be awarded to specific institutions to enable those institutions to develop their capabilities to be responsive, on a continuing basis, to the science and technology research and information needs of particular industries.

b) a "Competitive RD&E" program under which STDB would identify various "problems" which they believed were substantially hindering industrial profitability and/or ability to expand, and which they also believed may be subject to resolution or amelioration by the development of new scientific knowledge or new technologies. STDB would then invite proposals from the S&T community to undertake the RD&E efforts needed to address the problems. The proposals would be judged on a "competitive" basis.

c) a "Company-Directed" RD&E program under which STDB funds would be provided to a private sector firm or organization to facilitate that organization's carrying out RD&E efforts which it perceives as being in its best interest and which the STDB perceives would also be of value to the nation as a whole.

2. Organizing and implementing a continuing systematic and comprehensive review of public policy as it affects (positively or negatively) the extent and pace of scientific and technological development in Thailand, and the extent and pace of the emergence of "higher-tech" industries in the country. (This would emphasize conduct of policy studies).

3. Organizing and implementing, in conjunction with relevant RTG agencies, a scholarship program under which individuals will receive training in Thai universities leading to M.S. or Ph.D. degrees in priority technical areas.

4. Organizing and implementing a program aimed at increasing domestic and export salability of Thai-produced products by reducing acceptability problems traceable to deficiencies in conformance to acceptable standards, absence of adequate testing facilities, or poor quality control.

5. Overseeing the establishment, and monitoring the performance of a "Technical Information Access Center (TIAC)" which will quickly provide, for a fee, technical and scientific information to Thai decision makers, investors and researchers in private and public sectors.

6. Overseeing the establishment and monitoring the performance of a "Diagnostic/Research Design Service (D/RDS)" which will provide RD&E consulting services to private sector firms in key industrial areas.

As indicated above, the Agreements between USAID and the RTG which initiated this 7-year project were signed in August 1985. At this point, some three-plus years after the signatures, it had been anticipated that all programs contemplated under the project would be fully operational. However, due to some difficulties associated with having the STDB legally established, and with negotiating and concluding the major technical assistance contracts for the project, implementation was somewhat delayed. Consequently, at this point, while all anticipated programs and activities of the STDB are in fact underway, the programs discussed under 4, 5, and 6 above (i.e. the Standards, Testing, and Quality Control - STQC - Program, the TIAC Program and D/RDS Program) are in the final stages of planning for implementation.

Scope of Work

The evaluation team is to assess and analyze:

- the structure and functioning of the STDB itself;

- the extent to which the programs/activities being carried out by the STDB are being facilitated by existing STDB organizational/administrative arrangements, including arrangements and linkages with other organizations/agencies; and

- the efficiency with which various programs/activities are being implemented by the STDB (including an assessment as to whether these programs/activities remain relevant to the changing scientific/technological/industrial development needs and the extent to which they are contributing toward attainment of overall project objectives).

In making the above assessment/analysis, the evaluation team is expected to examine the following specific topics/issues:

A. STDB Operations

Is the organizational appropriately staffed and structured? Are administrative and financial control systems

within STDB adequate and efficient? Are linkages and relationships with other organizations (public and private) appropriate? Are relationships and interaction with USAID, BOB, MOF and DTEC adequate? Is technical assistancse soundly used?

B. S&T Policy

Is STDB's plan/approach in this area appropriate? Have studies carried out thus far and follow-up action been appropriate? What steps might be taken to enhance activities in this area?

C. Research, Development, and Engineering (RD&E) Program

Are guidelines/criteria/implementation procedures clear and appropriate? Is proposal review process efficient and objective? Have funded projects generally met criteria?

D. Fellowship Program

Are program guidelines, mechanisms for identifying priority subject areas to receive support, and procedures for selecting fellows, appropriate and adequate? Are they adhered to? What changes may be useful?

E. Industrial Support Programs

- Standard, Testing and Quality Control (STQC) Program
- Technical Information Access Center (TIAC) Program
- Diagnostic/Research Design Service (D/RDS) Program

Because of the reasons discussed in the "Background" section, initiation of STDB's "Industrial Support Programs" i.e. STQC, TIAC, and D/RDS --- was delayed for some 12-18 months. As such, the program have only recently gotten underway. Accordingly, the evaluation team should focus more on reasonableness and feasibility of STDB's plans for the Programs, and how they are approaching their implementation, and less on the quality of implementation of the Program.

F. Professional Exchange Activities (Conference/ Workshops/Seminars)

Do the conferences, etc. arranged by the STDB appear to be soundly conceived and approprite to the given objectives of STDB, both in terms of quality and quantity? Does participation in the conferences appear appropriate? Are

conferences structured so as to maximize useful outputs? What changes may be useful?

The assessment and analysis as outlined above should conclude with a report which describes findings in each of the above areas, recommends steps to improve performance in each of the areas as well as overall effectiveness of the project and efficiency of the STDB itself. The report should also indicate responsibility for taking follow-up actions on the recommendations.

Although the Project Paper left open the question of the existence of the STDB beyond the life of the project, it indicated clearly that "the evaluation scheduled for 1989 will provide basis for determining the future course and structure of STDB" (page 42). As such, it is appropriate for the evaluation team to make recommendations on the prossible future course, role and structure of the STDB beyond the PACD. Regarding this issue, recommendations should be based upon information gathered and analyses conducted in connection with the "evaluation" task, as well as upon information and analyses conducted specifically for this purpose.

With respect to the recommendations which may be useful for determining the future development of STDB after the PACD, the team could address the following:

- desirability/necessity of continuing/expanding some or all of the activities presently being carried out by STDB beyond the current PACD.

- additional "S&T" programs/activities which may be useful for STDB (or a sucessor agency) to carry out;

- various organizational structures and roles suitable for STDB (if it is determined that existing or additional programs/activities should be continued, and that STDB should implement them). In making recommendations on this, the team would need to a) look into work that has already been done, or is in process, concerning this issue; b) investigate and clarify legal, institutional, programatic, and funding considerations associated with different possible organizational forms (i.e. private foundation, public enterprise, etc.); c) identify significant changes that would have to take place in STDB's present organizational makeup in order to allow it to evolve into the new organizational status; d) make estimates of program funding requirements and identify suitable/probable sources of funding.

In making recommendations about the possible future course and organizational status of STDB, the team would also need to consider the underlying "S&T environment" in Thailand in which the STDB will operate - with an eye to ascertaining whether on-going and planned actions to develop and expand the basic "S&T infrastructure" are adequate and appropriate given Thailand's pace of development. With respect to this, consideration should be given to issues concerning output of "S&T training institutions", and RTG and private investment in "S&T infrastructure".

Approach

Gathering information necessary for making analyses and recommendations as indicated in the scope of work will require that evaluation team members visit and hold discussions with a wide range of individuals associated with the project - including USAID and STDB Staff, STDB board members, RD&E grant recipients, staff of supporting RTG institutions (i.e. DTEC, MOSTE, MOF, etc.) university administrators, private sector organization, etc. It is anticipated that services of 5 individuals for periods of up to 6 weeks will be required. The composition of the team, duties and qualifications of the team members will be as follows:

- Science and Technology Institutional Development Analyst (6 weeks). This individual will serve as Evaluation Team Leader. In addition to having responsibility for coordinating the entire effort, he/she will have particular responsibility for conducting the research and carrying out the analyses required for making recommendations on the possible future of STDB beyond the present PACD. The individual should have experience in designing, implementing, and evaluating S&T development projects and institutions. Senior-level experience in managing a large S&T institution (or institutional unit) will be helpful, as would experience in research project design and research management. Familiarity with USAID policies and regulations, and previous experience in the evaluation of USAID projects is desired.

- Science and Technology Program Analyst (2) (6 weeks each). These individuals would have prime responsibility for gathering the information and conducting the analyses associated with determining the sensibility/feasibility and quality of implementation of the ongoing STDB programs - i.e. "RD&E", "S&T Policy", "Fellowships", "STQC", "TIAC", and "D/RDS". They will also contribute to the work being done to provide information for determining the possible future of STDB beyond the present PACD. The individuals should have advanced

degrees in appropriate scientific/engineering fields and be able to deal with senior-level Thai researchers and administrators on a peer basis. Previous experience in the design and conduct of R&D efforts is required. Previous experience in evaluation of USAID projects is desirable. At least one of the individuals should be a Thai national and have extensive experience working in Thai institutions.

- Organizational Development Analyst (4 weeks). This individual will have prime responsibility for looking at organizational, administrative and financial aspects of STDB, how it organizes itself to conduct its business, and how it might be modified so as to facilitate attainment of organizational objectives. The individual should be a Thai national, have an advanced degree in an appropriate field (i.e. management, public administration, etc.) and have extensive experience in analysis of organizational performance.

APPENDIX B

EVALUATION TEAM MEMBERS

APPENDIX B

CURRICULUM VITAE - EVALUATION TEAM MEMBERS

RONALD P.BLACK
Consultant
International Science and Technology Institute, Inc.

EDUCATION

1964	Ph.D., Nuclear Chemistry, Massachusetts Institute of Technology. Recipient of Minnesota Mining and Manufacturing Company Fellowship and National Institutes of Health Fellowship.
1958-1960	U.S. Department of Agriculture, Southern Utilization Research and Development Fellow, Thermodynamics, Tulane University.
1958	B.S., Chemistry, Millsaps College

PROFESSIONAL HISTORY

1985-present	As **Chairman and Chief Executive Officer**, World Technology Group, Incorporated, Dr.Black has overall responsibility for the corporation's performance. Developing and assessing corporate strategy is a major concern. In terms of operations, he is responsible for international marketing and client relations.
1980-1985	**Technical Director and Senior Research Scientist**, Office of International Programs, Denver Research Institute (DRI) and **Adjunct Professor**, Graduate School of International Studies, University of Denver. As Technical Director, Dr.Black was responsible for the development, management and marketing of the international programs of DRI. These focused primarily on institution building through the international transfer of technology and management skills. During this period, DRI had major technology transfer programs in Brazil, Columbia, Costa Rica, Egypt, Guatemala, Haiti, Indonesia, Korea, Pakistan, Thailand, and Venezuela.
1975-1980	**Assistant Director and Senior Research Scientist**, Office of International Programs, Denver Research Institute. Dr.Black was responsible for DRI's programs in Asia as well as the Institute's management development and consulting programs worldwide. This

often required international searches for human resources and technology to meet project objectives.

Dr.Black designed and oversaw management development and consulting programs for officials from hundreds of organizations in 40 countries of Asia, Africa, Latin America, and the Middle East. During this period, he managed institution building projects in Indonesia, Thailand, and Pakistan; and assessments of (1) agricultural equipment development projects in governmental and industrial organizations in the Philippines, Thailand, Sri Lanka, and India, and (2) industrial operations concerned with the production of high-fructose syrup and cassava equipment manufacturing and processing in Thailand, brick manufacturing in Malaysia, coconutmilk production in the Philippines, and engineering consulting in Singapore.

1974-1975 **Senior Research Scientist**, Denver Research Institute. In this position, Dr.Black developed an institution building program with the Thailand Institute of Scientific and Technological Research. This included management consulting and training, assistance with the choice and transfer of industrial technology, the location and placement of foreign technical experts, and the placement of Thai technical personnel in on-the-job and academic programs in the U.S. and other countries. Other programs that Dr.Black developed during this period include a national-level R & D management development and consulting program in Indonesia and a village-level food processing program in Pakistan.

1970-1974 **Senior Systems Analyst**, Stanford Research Institute (SRI). Dr.Black served as science and technology policy advisor to the Secretary General of the National Research Council (NRC) of Thailand and directed a joint SRI/NRC team that developed the system currently utilized for measuring Thailand's scientific and technological potential. During this period he also provided consultative and technical support to the Military Research and Development Center of Thailand.

1968-1969 **Guest Lecturer**, Middle East Technical University, Ankara, Turkey. Dr.Black taught and participated in the development of university-level science education courses.

CURRICULUM VITAE

Name - Burapa Atthakor

Education
- Dhebsirindr School, Bangkok
- Vajiravudh College, Bangkok
- Haileybury and Imperial Service College (England)
- M.A. (OXON) - Politics, Philosophy, Economics (Economics Major)
- Barrister - At-Law (Called to the Bar. At Middle Temple in 1967)

Some Past Positions
- Ministry of Economic Affairs :

Legal Officer, Department of Internal Trade	1967-1968

- Ministry of Communications :

Secretary of the Minister	1969-1971 & 1972-1974
Secretary of Department of Land Transport	1971-1972
Inspecting Commissioner	1975

- Ministry of Agriculture and cooperatives :

Secretary of The Minister	1971-1972

- Prime Minister's Office :

Attached to The Prime Minister's Office	1974

- Special Lecturer At :

Thammasat University Political Science Department in Public Finance	1968
Chulalongkorn University Political Science Department on Taxation	1976

- Bank of Ayudhya

Vice President : Business Development	1975-1977
European Representative Based in London	1977-1981
Vice President : International Relations	1982-1985

- Thai Sreshthakich Insurance Co.

Managing Director	1985-1986

Government Committees Served on Numerous Government Committees and Sub Committees. To Mention Only the More Important ones :-

- Secretary of Committee to Explore Ways of Correcting the Trade Imbalance with Japan	1969
- Western Region Development Committee	1969-1974
- Secretary of The Second Bangkok Airport Project Committee	
- Committee to Consider Merging Bangkok Bus Companies	1971
- Maritime Law Drafting Committee	1970
- Water Transport Promotion Committee	1982
- Committee to Consider The Reorganization of The Telephone Organization of Thailand	1982
- Committee to Consider The Reorganization of Ministry of Industry	1984

Company Board Membership :

- Thai Maritime Navigation Co. Ltd	1971-1975
- Telecommunication for Mass Media Co. Ltd.	1971-1975

	- Secretary to The Board of The Telephone Organization of Thailand	1974
	- Secretary to The Board of The Express Transport Organization of Thailand	1976
	- Siam Machinery & Equipment Co. Ltd.	1975-1977
	- Thai Sreshthakich Insurance Co. Ltd.	1984-1986
	- T.S.Life Assurance Co. Ltd.	1984-....
Sports	- Boxing Blue	1963
	- Member of Thailand National Squash Rackets Team	1976-1977
	- Golfer	
	- Vice President of Thailand Squash Rackets Association	1982-....
	- Chairman of The Royal Bangkok Sports Club Squash Committee	1984-1986
Other Activities	- Foundation for The Blind Member of The Board	1975-1977
	- Professor Bunchana Atthakor Foundation for Education and Research Secretary of The Board	1981-....
Publications	- The new Concept of Public Finance (in Thai)	1973
	- The Northrop Project (in Thai)	1974
	- Taxation (in Thai)	1976
	- Numerous Articles	
Present Position	- President Gavintorn Consultancy International Co., Ltd.	

SUCHITRA PUNYARATABANDHU-BHAKDI

Graduate School of Public Administration
National Institute of Development Administration
Klong Chan, Bangkapi
Bangkok 10240, THAILAND

Tel.: 3777400 - 9, ext. 389, 386
377-7415

EDUCATION

Ph. D. (Political Science), University of California at Berkeley, 1979

M.A. Oxford University, 1972

B.A. Hons. (Philosophy, Politics & Economics), Oxford University, 1968

EMPLOYMENT

National Institute of Development Administration, Bangkok
- Associate Professor, 1984-present
- Assistant Professor, 1980-84
- Lecturer, 1979-80

Institute of Governmental Studies, University of California at Berkeley
- Visiting Assistant Research Political Scientist, 1981-82

Survey Research Center, University of California at Berkeley
- Junior Specialist - Survey Sampling, 1977-78
- Research Assistant - Survey Sampling, 1975-76

Political Science Department, University of California at Berkeley
- Teaching Assistant, PS 101 - Political Inquiry, Fall 1974

American Institutes for Research/Thailand
- Senior Research Associate, 1972-73
- Research Associate, 1970-72
- Research Assistant, 1968-70

TEACHING FIELDS

Public Policy and Policy Analysis
Organization Theory
Research Methodology

RESEARCH PAPERS & PUBLICATIONS

In Thai: (Selected)

Survey of MPA Graduates' Opinions Toward the School of Public Administration's MPA Program (Bangkok: NIDA School of Public Administration, 1987)

"Public Policy and Development Administration," in Uthai Laohavichien (ed.), The Administration of Development (Bangkok: Phab Pim Press, 1985)

Bangkok Metropolitan Administration: Dynamics and Mechanisms, (senior author) with T. Kambhu, et al. (Bangkok: National Institute of Development Administration, 1981)

"On the Reliability of Nathapol's Morale Index," Thai Journal of Development Administration, Vol. 21, No. 3, July 1981

"A Note on the Concept of Redundancy," Thai Journal of Development Administration, Vol. 20, No. 2, March 1980

In English:

"Race and Race Relations in Thailand," (senior author) with Juree Vichit Vadakan, in Jay A. Sigler (ed.), Handbook on Race and Race Relations (Greenwood Press, 1987).

"Shelter and Urban Services for the Poor in Metropolitan Bangkok," Regional Development Dialogue, Fall 1987

"Development Administration in Thailand: Changing Patterns?", Thai Journal of Development Administration, 1987

Delivery of Public Services in Asian Countries: Cases in Development Administration (Editor), with P. Piumsombun, V. Chandarasorn, et al. (Bangkok: Thammasat University Press, 1986)

"Structural Problems in the Governance of Bangkok," Crossroads: An Interdisciplinary Journal of Southeast Asian Studies, Vol. 2, No. 2, 1985

"Thailand in 1983: Democracy, Thai-Style," Asian Survey, Vol. XXIV, No. 2, February 1984

"Individual Values, Organizational Structure, and the Problem of Performance: Thailand as a Case Study," Public Administration Review, Vol. 43, No. 6, Nov.-Dec. 1983

"Thailand in 1982: General Arthit Takes Center Stage," Asian Survey, Vol. XXIII, No. 2, February 1983

"Measuring Village Commitment to Development," with R. E. Krug and P.A. Schwarz, in H. Lasswell, D. Lerner, and J.D. Montgomery (eds.), Values and Development: Appraising the Asian Experience (MIT Press, 1977)

CONFERENCE & SEMINAR PAPERS

"Shelter and Urban Services for the Poor in Metropolitan Bangkok," report prepared for the Expert Group Meeting on Shelter and Services for the Poor in Metropolitan Regions, United Nations Centre for Regional Development, Nagoya, Japan, January 12-16, 1987

"Development Administration in Thailand: Changing Patterns?," Panel on Changing Patterns of Development Administration in Asia, Annual Meeting of the American Society for Public Administration, Anaheim, California, April 13-16, 1986

"Low Cost Public Housing in Thailand from a Policy Perspective," paper prepared for the Planning and Management of Low Cost Public Housing Course, National Institute of Public Administration (INTAN), Kuala Lumpur, Malaysia, Sept. 11 - Oct. 4, 1983

"The Politics of Bangkok," Panel on Urban Processes in Thailand, Annual Meeting of the Association for Asian Studies, San Francisco Hilton, March 25-27, 1983

"Governing Metropolitan Bangkok," Conference on "Two Hundred Years of the Chakri Dynasty" in celebration of the Rattanakosin Bicentennial, Northern Illinois University, De Kalb, November 11-13, 1982

CONSULTING EXPERIENCE

Administrative Analysis for the Thailand-Management of National Resources and Environment for Sustainable Development Project, sole author, report prepared for USAID/Thailand, May 1988

Analysis of the Legal, Institutional, and Budget Framework for Environment and Natural Resources in Thailand, Principal Investigator, with Somsak Dumrichob, report prepared for USAID/Thailand, January 1988

Mid-Term Review: Rural Development Monitoring and Evaluation Project (Team Leader), with J. VanSant, J. Gibbs, S. Holloran, report prepared for USAID/Thailand, February 1987

Mini-Evaluation of the Municipality of Phuket's Managing Energy and Resource Efficient Cities Program, (Principal Investigator), report prepared for USAID/Thailand, April 1985

Mid-Term Evaluation Report: Decentralized Development Management Project, (senior author) with Chinda Suetrong, prepared for USAID/Thailand, July 1984 (in Thai)

Reorganization of the Land Development Department, with T. Kambhu, et al. (Bangkok: National Institute of Development Administration, 1980) (in Thai)

Final Report: Evaluation of the Provincial Development Assistance Program, The Philippines, with Martin Landau, et al. (Berkeley: Institute of International Studies, 1980)

OTHER PROFESSIONAL ACTIVITIES

Advisor to the Minister of Agriculture and Cooperatives, 1988-present

Member, Board of Governors, the Fish Marketing Organization, 1988-present

Member, Subcommittee on Administrative Development, Board of Governors, Provincial Waterworks Authority, 1988-present

Consultant to the Local Administration Academy, Department of Local Administration, on revision of the District Officer Academy curriculum, 1987-88

Member, Personnel Subcommittee of the Board of Governors, Provincial Waterworks Authority, 1985-88

Consultant to the Survey of Civil Servants' Attitudes Toward Pre-Promotion Training, Civil Service Training Institute, 1985-86

Chair, Committee To Organize a Workshop on "Delivery of Public Services in National Development: Problems, Solution Alternatives, and Structural Adjustments," Eastern Regional Organization for Public Administration, Asia Hotel Pattaya, July 1-5, 1985

Member, Committee To Produce Teaching Modules in "Modern Political Analysis: Principles and Methods," Political Science Faculty, Sukhothai Open University, 1984-85

Lecturer in Public Policy and Policy Analysis, School of Public Administration's Continuing Education Program, National Institute of Development Administration, 1984 and 1985

Lecturer in Research Methods in Training Programs of various government agencies, e.g., Ministry of Public Health, National Research Council, Civil Service Training Institute, Office of the Narcotics Control Board, 1984 and 1985

Lecturer in Decisionmaking, Training Program of the Civil Aviation Commission of Thailand, 1986

Seminars on Systems Design, Systems Analysis, and Logical Framework given at the Asian-Pacific Postal Training Center, 1984 and 1985

Seminars on Program Evaluation given to: Thai senior civil servants (NIDA public service program), 1980; Bangladesh and Nepalese civil servants (USAID/Thai Government sponsored program), 1981, 1983, 1984; Rubber Promotion Organization of Thailand, 1980

Member, Subcommittee for the Evaluation of the Rural Jobs Creation Program, Office of the Prime Minister, Bangkok, 1981

Member, Inter-University Committee To Design a Curriculum in Public Administration, Sukhothai Open University, Bangkok, 1980-81

Rapporteur for the Conference on Managing Integrated Rural Development, Eastern Regional Organization for Public Administration, Jakarta, June 1981

Consultant to the Project on Managing Decentralization, Institute of International Studies, University of California, Berkeley, 1979-80

A. B. Van Rennes

MAJOR EXPERIENCE AREAS:

Engineering education (emphasis on electrical engineering), technology and R&D management, the innovation process, corporate technology strategy, international (trans-cultural) technology transfer, industrialization of third-world countries, and industrial consulting. Knowledgable in aerospace. Especially experienced in working with executives from differing cultures, notably Indonesia and Western Europe.

CURRENT ACTIVITY:

U.S. Technical Advisor to Minister of State for Research and Technology (and Chairman - Agency for the Assessment and Application of Technology), Republic of Indonesia. (under consulting contract with U.S. Agency for International Development - resident in Indonesia 1982-88, in Seattle 1988-)

CURRENT RESPONSIBILITIES:

Advise and assist Minister on matters of technology, technology policy and technology management related to Indonesia's industrialization and to the development of key "strategic" state-owned manufacturing industries. Promote U.S. technology and business interests in the above programs. Counsel U.S. business executives and facilitate their contacts with the Minister and other Indonesian government officials. Maintain liaison between the Minister and the U.S. Embassy, including the Economic and Foreign Commercial Service sections as well as the Ambassador. Help in formulating and implementing science and technology programs under the formal USG/GOI government-to-government Science-and-Technology Agreement. Provide executive assistance to the Minister in development of the Institute of Technology, Indonesia - a new private technical university with engineering education patterned after the U.S. model. Plan and implement the Minister's biennial technology tour to the U.S.

PRIOR EXPERIENCE:

Bendix Corporation (now Allied-Signal Corporation):

1979-82	- Corporate Director, External Research and Development
1970-79	- Associate Director, Bendix Research Laboratories
1966-69	- Technical Director, Bendix International
1961-66	- Director, European Science and Technology Liaison (resident in Europe)
1956-60	- Head, Nuclear Technology Group, Bendix Research Laboratories.

Massachusetts Institute of Technology:

1946-56 - Faculty Member, Electrical Engineering (Assoc. Professor)
1951-56 - Associate Director, Electronic Nuclear Instrumentation Group

CONSULTING: Miscellaneous U.S. industrial and consulting firms, 1952-

EDUCATION: ScD, SM, and SB in Electrical Engineering, M.I.T.

LANGUAGES: Dutch, German, some French, some Indonesian

MEMBERSHIPS: Institute of Electrical and Electronic Engineers
American Society for Engineering Education
American Association for the Advancement of Science
Former member, Advisory Board - Industrial Science and Technological Innovation, National Science Foundation.

3-89

APPENDIX C

INDIVIDUALS INTERVIEWED

APPENDIX C

INDIVIDUALS INTERVIEWED

Name and Position	Office
1/ Mr. Prachaub Chaiyasarn Minister	Ministry of Science Technology and Energy
1/ Dr. Sa-nga Sabhasri Permanent Secretary	Office of the Permanent Secretary Ministry of Science Technology and Energy
3/ Dr. Yongyuth Yuthavong Director	National Centre for Genetic Engineering and Biotechnology Ministry of Science Technology and Energy
Dr. Thalerng Thamrong-Nawasawat Director	Office of the Science and Technology Development Board
Dr. Wirojana Tantraporn Deputy Director	Office of the Science and Technology Development Board
Dr. Montri Chulavatnatol Assistant Director	Office of the Science and Technology Development Board
Dr. Nit Chantramonklasri Director of Planning Program Development	Office of the Science and Technology Development Board
Mr. Richard B. Kalina Management Advisor	Office of the Science and Technology Development Board
Dr.Sudhiporn Pratumtaewapibal Director of TIAC	Office of the Science and Technology Development Board
Dr. Sumin Smutkupt Bioscience/Biotechnology Coordinator	Office of the Science and Technology Development Board
Dr. Kriengsak Chalermtiragool Applied Electronic Technology Program Coordinator	Office of the Science and Technology Development Board
Dr. Benjapol Wethyavivorn Program Associate (Material Technology)	Office of the Science and Technology Development Board
Dr. Palarp Singhaseni STQC Coordinator	Office of the Science and Technology Development Board

Name and Position	Office
Dr. Maitree Wasuntiwongse Planning and Management Specialist	Office of the Science and Technology Development Board
Mrs. Ladda Trongtorsuk Chief of Finance	Office of the Science and Technology Development Board
Dr. Mandhana Bijaisoradat Program Associate (Bioscience)	Office of the Science and Technology Development Board
Miss Thawilwadee Pongsaksri Program Associate (STQC)	Office of the Science and Technology Development Board
Mr. Weerawat Chantanakome Program Associate (IDS)	Office of the Science and Technology Development Board
Mr. Suchin Vatcharapongpreecha Information/Publicity Specialist	Office of the Science and Technology Development Board
Mrs. Noppawan Tienkarojanakul RD&E Finance Officer	Office of the Science and Technology Development Board
2/ Mr. Tophong Vachanasvasti Director	Technology and Environmental Planning Div. Office of the National Economic and Social Development Board
Mr. Krisda Piampongsant Chief	United States of America Sub-Division Department of Technical and Economic Cooperation
Mrs. Ubolwan Usawattanakul	Loan Policy and Management Division The Fiscal Policy Office Ministry of Finance
Mrs. Chaweewan Kanthawat	The Bureau of the Budget Office of the Prime Minister
4/ Dr. Natth Pramarapravati Rector	Mahidol University
5/ Dr. Amaret Bhumiratana	Department of Science and Technology Faculty of Science, Mahidol University
5/ Dr. Ekachai Leelarasmee	Faculty of Engineering Chulalongkorn University

Name and Position	Office
5/ Dr. Mongkol Dejnakarintra	Faculty of Engineering Chulalongkorn University
Dr. Prayoon Chiowattana	Chulalongkorn University
1/ Dr. Ajva Taulananda Group Vice President	Charoen Pokphand Co., Ltd.
2/ Dr. Pakorn Adulphan Managing Director	Micronetic Company Limited
1/ Dr. Sippanondah Ketudat President	National Petrochemical Corporation
1/ Dr. Tawee Butsuntorn Senior Vice President	Siam Cement Co. Ltd.
Mr. Larry Wesphal	Thailand Development Research Institute
Mr. Sugree Kaeocharoen	The Industrial Finance Corporation of Thailand
Mr. Chira Panupong Secretary General	Office of the Board of Investment

1/ Member of STDB Executive Committee and STDB Board of Directors.

2/ Member of STDB Executive Committee.

3/ Member of STDB Technical Advisory Committee.

4/ Former Director of STDB.

5/ RD&E Principal Investigator.

APPENDIX D

DOCUMENTS REVIEWED

APPENDIX D

DOCUMENTS REVIEWED

1. United States International Development Cooperation Agency, Agency for International Development, Washington, D.C., Project Paper Thailand "Science and Technology for Development (493-0340), June 1985.

2. STDB, Translation : Order of the Board of Director of the Thailand Institute of Scientific and Technological Research (TISTR) No. 5/1985.

3. STDB, Translation : Memorandum of Principle and Rationale the Science and Technology Development Fund Bill B.E....., 02/06/89.

4. STDB, Translation : Order of the Science and Technology Development Board (STDB) No. 1/1986.

5. TISTR, Appointment of Designated Officer in the Science and Technology for Development Project, 16 June 1986.

6. TISTR, Authorize of Power in Financial Management of the Science and Technology for Development Project, 18 July 1986.

7. TISTR, Thailand Institute of Scientific and Technological Research Directive Delegation of Authority from the Governor to the Science and Technology Development Board Project Director in Administration of Activities and Operations of the Science and Technology for Development Project B.E. 2529 (A.D. 1986).

8. Office of the Juridical Council, Memorandum - Juridical Council "Loan and Grant Agreements with USAID for Science and Technology for Development Project", February 1986.

9. AID, Memorandum of Understanding Between DTEC and STDB on Funds Disbursements of Project 493-0340.

10. STDB, Guidelines "Designated RD&E Support Program", 02/01/88.

11. STDB, Term of Reference "Commercialization Services in Connection With RD&E Projects", 10/03/88.

12. STDB, STDB Staff Manual, February 1989.

13. STDB, STDB Professional and Support Staff, June 1989.

14. STDB, List of Designated RD&E Proposals Received by STDB - Classified by Institution.

15. STDB, List of Bioscience & Biotechnology Projects, 31 May 1989.

16. STDB, Number of RD&E Approved Projects, 15 May 1989.

17. STDB, Flow Chart of RD&E Projects to Be Funded.

18. STDB, Outline for "Competitive" RD&E Project Proposals.

19. STDB, Active STDB "Designated" and "Competitive" RD&E Grants.

20. STDB, Terms, Criteria and Procedures for Company Directed Research Development and Engineering Projects (Proposed - Grant - Fund).

21. STDB, Terms, Criteria and Procedures for Company - Directed Research Development and Engineering Project (Project Loan).

22. STDB, Science and Technology for Development Project "Technical Assistance", 10 May 1988.

23. STDB, Contract Between the Department of Technical and Economic Cooperation and the National Academy of Sciences for Science and Technology Advisory Services to STDB.

24. STDB, Request for Technical Proposal for Implementation of the Diagnostic/Research Design Services (D/RDS) Program, March 1989.

25. STDB, D/RDS Flow Chart.

26. STDB, Conditions Precedent of D/RDS, 4 July 1988.

27. STDB, List of Registered Bidders (D/RDS).

28. Information/Publicity Specialist, Memorandum No. 79/1988 "PR Unit's Performance Report", 25 November 1988.

29. STDB, Guidelines for Final Evaluation of RD&E Project Supported.

30. STDB, Guidelines for Making Site - Visits to RD&E Projects.

31. STDB, STDB's RD&E Project Site Visit Report (Form).

32. STDB, RD&E Project Semi-Annual Report (Form).

33. STDB, Concept Paper for Discussion "Guidelines for Developing Monitoring and Evaluating System for RD&E projects.

34. STDB, RD&E Project Semi-Annual Report Preparation Instructions.

35. STDB, RD&E Project Review Task Force.

36. STDB, Support for Technology Assessment and Mastery Program, 9 December 1989.

37. STDB, Overall Plan for Science and Technology Policy Studies.

38. STDB, **Consolidate Financial Report**, 31 March 1989.

39. STDB, **STDB Annual Report 1989**.

40. David McConnell, **ASEAN - ECC Programme "Development of Specialty Chemicals Derived from Biotechnology in Thailand" Technical Assistant**, 20 April 1989.

41. Strategy Paper, **A Strategy for Proposed Writers**.

42. Test Question, **A Strategy for Writing Proposal**.

43. Peter C. Hall, and William H. Klausmeier, **Opportunities to Commercialize Life Science Applications in Less Developed Countries A Strategy Plan**, December 1988.

44. MOSTE, **Ministry of Science Technology and Energy** (Brochure).

45. Larry E. Wesphal, Kopr Kritayakirana, Kosol Petchsuwan, Harit Sutabutr, and Yongyuth Yuthavong, **The Development of Technological Capability in Manufacturing : A Microscopic Approach to Policy Research for Thailand**, May 1989.

46. The Board on Science and Technolcgy for International Development, Office of International Affairs, National Research Council, **Workshop on Thai - U.S. Science and Technology Collaboration Summary Report**, National Academy Press, Washington, D.C., 1984.

47. C. Le Pair, **Some Comments on the Organization of Science and Technology in Thailand**, STW, Utrecht, the Netherlands, 1986.

48. Office of the Board of Investment, **Thailand into the 1990s**, Communication Resources (Thailand) Ltd., April 1989.

49. Thailand Development Research Institute (TDRI), **The Development of Thailand's Technological Capability in Industry**, October 1988.

50. STDB, **STDB Executive Committee**.

51. STDB, **STDB Board of Directors**.

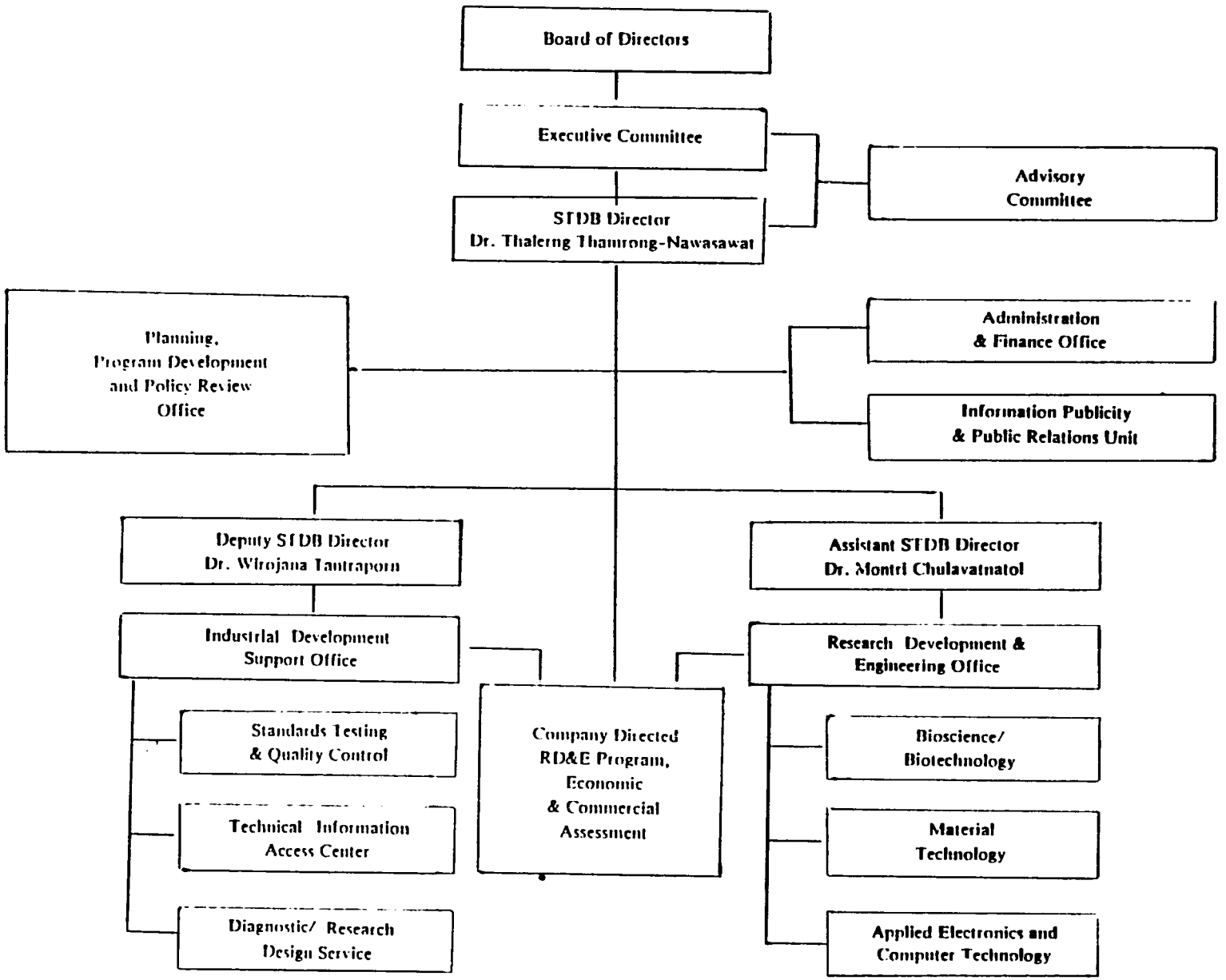
APPENDIX E

STDB ORGANIZATION CHART

APPENDIX E

STDB ORGANIZATION CHART

Office of the Science and Technology Development Board



APPENDIX F

COMMITTEES OPERATING IN/WITH STDB

APPENDIX F

COMMITTEES OPERATING IN/WITH STDB

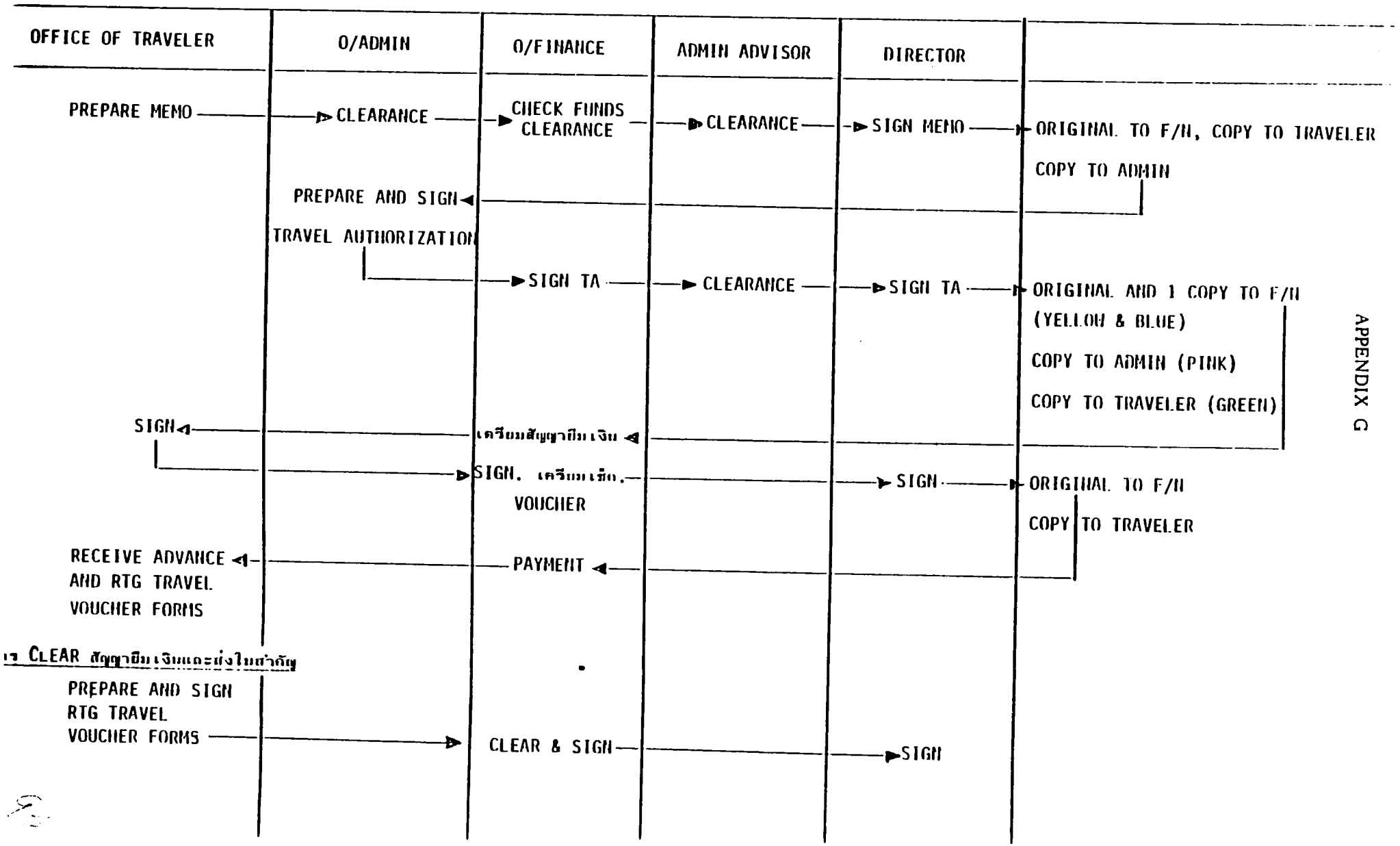
1. Board of Directors
2. Executive Committee
3. Technical Advisory Committee
*4. Fellowship Committee (appointed on yearly basis)
*5. Public Relations Committee
*6. Committee on Consultant Engagement for Diagnostic/Research Design Service (DRDS)
*7. Company Directed RD&E Committee
*8. RD&E Project Review Task Force
*9. Committee on Equipment and Supply Procurement (established per transaction)
*10. Pre-Budget Committee
11. Budget Committee
12. Committee on Monitoring and Evaluation of Contract Projects
*13. Committee on Staff Recruitment (established per position)
14 Committee on the Cooperation Between STDB and Three National Centers of MOSTE •

• in-house committee

APPENDIX G

TRAVEL AUTHORIZATION FOR STDB STAFF (COUNTERPART FUND)

การขออนุมัติ, การเบิกจ่าย TRAVEL AUTHORIZATION FOR STDB STAFF (COUNTERPART FUND)



APPENDIX G

APPENDIX H

ACTIVE STDB "DESIGNATED" AND "COMPETITIVE" RD&E GRANTS

APPENDIX H

ACTIVE STDB "DESIGNATED" AND "COMPETITIVE" RD&E GRANTS

Project	P.I./Institution	Total Amount (Baht)	USAID-Loan Contribution (Baht)	STDB Agreement No./Date *	Duration (yrs.)
1. Improved Broodstock Maturation Techniques for the Giant Tiger Prawn (Penaeus monodon) in Thailand	Piamsak Menasveta Chulalongkorn University	4,344,265	2,495,718	DSN87A-1-06-085 AG-87-2-0001 AG-87-4-0001 July 3, 1987	3
2. Production of Modified Starch with Desired Rheological and Physical Properties from Cassava Starch	Chaisagna Taeratanacnai Manidol University	4,379,257	3,539,652	DSN87A-1-05-098 AG-87-2-0002 AG-87-4-0002 July 3, 1987	3
3. Ceramic Materials and Products for Electronic Industries Part I: Material Development	Tawee Tunkasiri Chiang Mai University	4,003,428	3,233,892	DSN87A-2-02-009 AG-87-2-0003A AG-87-4-0003A July 20, 1987	3
4. Part II: Development of Ferrite Products for Radio and Television Appliances	Charussri Lorprayoon Chulalongkorn Univ.	3,908,742	3,187,514	DSN87A-2-06-094 AG-87-2-0003B AG-87-2-0003B July 20, 1987	3
5. Employ Plant Regeneration and Other Tissue Culture Methods in Clonal Propagation and Improvement of Aracaceae	Kamnoon Kanchanapoom Prince of Songkla University	3,551,636	2,663,727	DSN87A-1-01-072 AG-87-2-0004 AG-87-4-0004 July 20, 1987	3
6. Develop and Apply Plant Biotechnological Methods for the Production of Virus Resistant Plants	Supat Attathom Kasetsart University	5,211,032	4,301,247	DSN87A-1-08-074 AG-87-2-0005 AG-87-4-0005 July 20, 1987	3
7. Research and Development on Engineering Production of Small and Medium Size EPABX Part A	Narong Yamphayak TISTR	2,253,515	1,451,569	DSN87A-3-07-100 AG-87-2-0006-A AG-87-4-0006-A September 30, 1987	2
8. Part B	Pramote Srisuksant Kasetsart University	3,295,013	2,316,854	DSN87A-3-08-083 AG-87-2-0006-B AG-87-4-0006-B September 30, 1987	3
9. Development of Specific DNA Probes for the Diagnosis of Babesiasis in Cattle	Chariya R. Brockelman Mahidol University	3,674,868	2,560,934	CPT87A-1-05-006 AG-87-2-0007 AG-87-4-0007 September 30, 1987	3
10. Development of Application of Tissue Culture Methodsfor Rapid Multiplication and Improvement of Coconut and Arecanut	Oradee Sahavacharin Kasetsart University	2,985,200	2,266,274	CPD87A-1-08-097 AG-87-2-0008 AG-87-4-0008 September 30, 1987	3
11. In Vitro Selection for Soybean Lines Tolerant to Saline Soils and Acid Sulfate Soils	Peerasak Srinives Kasetsart University	1,929,500	1,656,458	CPD87A-1-08-006 AG 87-2-0009 AG 87-4-0009 September 30, 1987	3

Project	P.I./Institution	Total Amount (Baht)	USAID-Loan Contribution (Baht)	STDB Agreement No./Date	Durati (yrs.
12. High Efficiency Low Cost Shuttle Kiln	Ampon Wattanarangsan Chulalongkorn University	2,175,462	1,922,238	CPT87A-2-06-021 AG 87-2-0010 AG 87-4-0010 September 30, 1987	2
13. Research and Development of Switched Mode Power Supplies	Mongkol Dejnakarintra Chulalongkorn University	1,336,126	1,217,684	CPD87A-3-06-088 AG 87-2-0011 AG 87-4-0011 September 30, 1987	2
14. Construction of Hybrids from Aspergillus sp. for High Yield Citric Acid and Glucoamylase Activity	Supapong Bhuwapathanapun Kasetsart University	3,764,900	2,923,960	CPD 87A-1-08-081 AG 87-2-0013 AG 87-4-0013 September 30, 1987	3
15. Development of High Power CO_2 Laser for Materials Processing	Pichet Limsuwan King Mongkut's Institute of Technology-Thonburi	3,964,800	3,062,552	DSN 87B-2-09-112 AG 87-2-0015 AG 87-4-0015 September 30, 1987	3
16. Improvement of Rubber Product Manufacture Through Efficient Processing	Krisda Suchiva Mahidol University	4,626,000	4,407,731	DSN 87B-2-05-105 AG 87-2-0016 AG 87-4-0016 September 30, 1987	3
17. Organotin Compounds Innovative Uses of Tin	Manoo Veeraburus Chulalongkorn University	3,511,000	2,830,374	DSN 87B-2-06-110 AG 87-2-0017 AG 87-4-0017 September 30, 1987	3
18. Development of a Computer Aided Engineering (CAE) System for Electronic	Ekachai Leelarasmee Chulalongkorn University	1,403,900	1,275,139	OSC 87A-3-06-020 AG 87-2-0018 AG 87-4-0018 September 30, 1987	3
19. Development of the Thai Microcomputer Package for General Application	Pichit Sukchareonpong Kasetsart University	3,024,100	2,778,900	CPD 87A-3-08-073 AG 88-2-0001 AG 88-4-0001 December 30, 1987	2
20. Research and Development for a Complete Cycle of Seaweed Hydrocolloid Industry in Thailand	Suwalee Chandrkrachang Srinakarinvirot University	5,471,000	5,223,988	DSN 87B-1-16-116 AG 88-2-0002 AG 88-4-0002 December 30, 1987	2
21. Prevention and Control of Aflatoxin in Corn	Chamnan Chutkaew Kasetsart University	3,957,100	3,024,807	CPT 87A-1-08-012 AG 88-2-0003 AG 88-4-0003 December 30, 1987	3
22. Appropriate Process Control in Kaolin	Quanchai Leepowpanth Chulalongkorn University	4,411,300	3,568,470	CPT87B-0-06-038 AG 88-2-0004 AG 88-4-0004 February 29, 1988	3
23. Application of Tissue Culture Techniques for Improvement of Steroid and Alkaloid Yield From Solanum and Duboisia Spp.	Phannipha Chumsri Mahidol University	5,544,600	4,778,267	DSN87B-1-05-106 AG-88-2-0005 AG-88-4-0005 March 31, 1988	3
24. Electronic Equipment for Energy Management in Spinning Industry	Surapong Chirarattananon KMIT-T	2,430,900	1,658,151	CPT87B-3-09-039 AG-88-2-0006 AG-88-4-0006 March 31, 1988	1

Project	P.I./Institution	Total Amount (Baht)	USAID-Loan Contribution (Baht)	STDB Agreement No./Date	Duration (yrs.)
25. The Development of Biotechnology for an Improvement in the Production of Dairy Cattle	Kanok Pavasuthipaisit Mahidol University	5,338,000	3,953,993	DSC87B-1-05-029 AG-88-2-0007 AG-88-4-0007 March 31, 1988	3
26. Improvement of Aquaculture of Giant Freshwater Prawn (Macrobrachium rosenbergii de Man) Through Hormonal and Reproductive Manipulations	Boonsirm Poolsanguan Mahidol University	5,123,600	3,964,560	DSN88A-1-05-117 AG-88-2-0008 AG-88-4-0008 March 31, 1988	3
27. Scientific Technique for Improving Color of Gem Minerals	Ladawal Chotimongkol TISTR	4,189,700	3,243,895	CPT87A-2-07-016 AG-88-2-0009 AG-88-2-0009 April 12, 1988	2
28. Beneficiation Process of High Quality Kaolin	Ladawal Chotimongkol TISTR	6,659,800	4,963,810	DSN88A-2-07-123 AG-88-2-0010 AG-88-4-0010 April 12, 1988	2
29. Dry Bean (Phaseolus Vulgaris) Improvement Through Mutation Breeding and Tissue Culture Technique	Siranut Lamseejan Kasetsart University	3,770,700	3,320,276	CPT87A-1-08-76 AG-88-2-0011 AG-88-4-011 August 22, 1988	3
30. Biological and Economical Studies on the Mekong Giant Catfish	Sanay Pholprasith Dept. of Fisheries	6,048,400	3,826,676	DSN88A-1-14-128 AG-88-2-0012 AG-88-4-0012 August 22, 1988	3
31. High Temperature Superconductivity on Theoretical Investigations of High Temperature Superconductivity and Coordination of Superconductivity Projects in Thailand	Virulh Sa-yakanit Chulalongkorn Univ.	3,607,600	2,616,109	DSN88B-2-06-131 AG-88-2-0013 AG-88-2-0013 September 26, 1988	3
32. Research on High Temperature Superconductivity: Thermal Property	Nikorn Mangkorntong Chiang Mai University	3,287,000	2,737,164	DSN63B-2-02-133 AG-88-2-00014 AG-88-4-0014 September 26, 1988	3
33. High Temperature Superconductor: An Investigation of the Magnetic Properties of High Tc Superconductors and of Possible Structural Transition into the Superconducting Phase	Rassmidara Hoonsawat Mahidol University	2,996,700	2,586,155	DSN88B-2-05-134 AG-88-2-0015 AG-88-4-0015 September 26, 1988	3
34. High Temperature Superconductivity: Fabrication, Characterization and Applications of the High Tc Superconductor Thin/Thick Films	Poonpong Boonbrahm Prince of Songkla Univ.	3,298,300	2,740,704	DSN88B-2-01-135 AG-88-2-0016 AG-88-4-0016 September 26, 1988	3
35. Research on High Tc Superconductors: Operative Mechanisms in High Tc Superconductors	Suthat Yoksan Srinakharinwirot Univ.	663,500	438,931	DSN88B-2-16-137 AG-88-2-0017 AG-88-4-0017 September 26, 1988	3

Project	P.I./Institution	Total Amount (Baht)	USAID-Loan Contribution (Baht)	STDB Agreement No./Date	Duration (yrs.)
36. High Temperature Superconductor: An Investigation of the Crystal Structures and Transport Properties of the High Temperature Superconducting Materials and of the Effects of the Variation of the Fabrication Process in the Production of High Temperature superconducting Materials	Narongsak Chaichit Silpakorn University	2,103,700	1,760,512	DSN88B-2-20-138 AG-88-2-0018 AG-88-4-0018 September 26, 1988	3
37. The Application of Biotechnology for Processing and Product Improvement of Fermented-Rice Noodle	Malee Suwana-Adth Kasetsart University	2,166,400	1,848,823	CPT87A-1-08-018 AG-88-2-0019 AG-88-4-0019 September 27, 1988	2
38. Industrial Fish Sauce Fermentation by Recycling System	Saipin Chaiyanan King Mongkut Institute of Technology Thonburi	3,817,100	3,199,272	CPT88B-1-09-065 AG-88-2-0020 AG-88-4-0020 September 27, 1988	3
39. Development of Innovative Technique for "Local Production" of Bacterial Agents for Biological Control of Agricultural Pests	Amaret Bhumiratana Mahidol University	3,801,400	3,073,665	CPT88A-1-05-049 AG-88-2-0021 AG-88-4-0021 September 27, 1988	3
40. Comprehensive Study of the Control, Treatment and Prevention of the Diseases of Cultured Penaeus Monodon Fabricius	Chalor Limsuwan Kasetsart University	5,270,000	4,031,104	DSN88B-1-08-141 AG-88-2-0022 AG-88-4-0022 September 27, 1988	3
41. Potential Utilization of the Rock Salt-Affected Area in the Northeast of Thailand for Aquaculture and Fisheries Development	Department of Fisheries Ministry of Agriculture and Cooperatives	4,840,900	2,857,410	DSN88B-1-14-139 AG-89-2-0001 AG-89-4-0001 February 15, 1989	3
42. Modification of the Annealing Processes in the Fabrication of 'High Technology' Ferrites and Yig Garnets to Achieve Optimal Magnetic Properties for Use in Microwave Devices	Santi Vatanayon Mahidol University	3,684,800	2,559,120	CPT88B-2-09-055 AG-89-2-0002 AG-89-4-0002 May 10, 1989	3
43. Tissue Culture for the Propagation and Development of Payapa that are Tolerant to Papaya Ringspot Virus	Boonyuen Kijwijan Khon Kaen University	4,438,900	3,019,800	DSN88A-1-04-127 AG-89-2-0004	3
44. Development of Silkworm Seed Technology for Commercial Production	Kasetsart University	4,467,400	2,995,687	DSN88B-1-08-146 AG-89-2-0005 AG-89-4-0005 May 10, 1989	3

Project	P.I./Institution	Total Amount (Baht)	USAID-Loan Contribution (Baht)	STDB Agreement No./Date	Duration (yrs.)
45. Halophytes	Somsri Arunin Land Development Dept. MOAC	4,651,600	3,178,061	DSN888-1-14-144 AG-89-2-0003 AG-89-4-0003 May 17, 1989	3
TOTAL		169,383,154 ($6,775,326)	131,281,827 ($5,251,273)		

@ Baht 25.00 = US$1.00

USAID:RTG Contributions = 77.8% : 22.2%

* DSN - A designated project from the beginning

DSC - Converted from a competitive project to designated

CPT - A competitive project from the beginning

CPD - Converted from a designated project to competitive

APPENDIX I

TARGET SCHEDULE FOR TIAC PROGRAM

APPENDIX I

TARGET SCHEDULE FOR TIAC PROGRAM

TIAC ACTIVITIES (Office)	Date	TIAC ACTIVITIES (Equipment)
	- May 1	NCC Approval
Staff Contract	- May 15	RFP in Newspaper (U.S.A. and Thailand)
Space & Decoration Contract	- June 1	
Openning TIAC Office	- June 15	
Overseas Training	- July 1	
	- July 15	RFP Deadline
Leasing Computer System for in-house software development (9 months)	- August 1	
	- August 15	
	- September 1	
	- September 15	Vendor Contract
	- October 1	
Local Training (TIAC and Consortium Staff)	- October 15	
	- November 1	
	- November 15	TIAC Computer System
	- December 1	TIAC Computer System (Installation, Test Completed)
	- December 15	PC, FAX installation, test-Completed
Start TIAC Service	- January 1	

APPENDIX J

ANALYSIS OF D/RDS TARGETED ACHIEVEMENTS

APPENDIX J

ANALYSIS OF D/RDS TARGETED ACHIEVEMENTS

The magnitude of some of the project targets such as number of consulting assignments to be completed seems ambitious with the available staffing (which is not altogether clear from the RFP).

To clarify this, a very successful U.S. consulting firm might obtain contracts on thirty percent of its proposals--although this is a very high percentage. This same U.S. firm would likely examine three leads for each proposal it writes. What does this mean with respect to the D/RDS project?

For one consulting assignment, D/DRS will have to make an introductory visit to a manufacturer. A problem will have to be identified and analyzed, probably on a second or third visit. Next the best consultant will be selected and will have to accompany D/RDS to visit the manufacturer. After the terms of an agreement are reached by all concerned, D/RDS will have to prepare a contract. This will have to be taken back to the manufacturer. The manufacturer will want to study the contract and at least one more visit will be required before D/RDS is likely to have a signed contract. For a U.S. consulting organization this would be considered an extremely smooth example of acquiring a contract. For monitoring the consultant's progress on the project D/RDS should make at least one visit to the manufacturer during the course of the assignment and another at it conclusion to assess the results of the consulting service. To carry out the above visits in Bangkok, to prepare for them, and to analyze and document the results would take a minimum of one person week.

D/RDS is targeted in the RFP to provide up to 100 consultant assignments in its fourth year of operation. This would take a minimum of 100 person weeks of D/RDS staff time. If D/RDS is as successful in obtaining contracts as some of the best U.S. consulting firms, it would have gotten to this point by submitting 200 additional proposals that did not result in contracts. While these latter proposals do not result in contracts, follow up visits in attempting to sell the client on the proposed project may easily require as much additional time of D/RDS staff as they would have spent monitoring and assessing the project (which is assumed to be minimal). Thus, we may be well envisioning 300 person months of D/RDS time up to this point. As noted, however, the highly successful U.S. consulting firm would likely explore three leads for each proposal. If this were done in the D/RDS case, say each lead takes, on the average, a half person day to determine a proposal is not warranted; then we need an additional 600x1/2 person days or 60 person weeks. So far we have over seven person years of support needed from D/RDS "technical managers" and we have not begun figuring the time required for the twelve or so industrial surveys which must be done nor to consider the time implications of up-country consulting activities. It also does not take into account the additional time that we believe D/RDS should devote to each project in its role as prime contractor.

APPENDIX K

STDB PROFESSIONAL STAFF

APPENDIX K

STDB PROFESSIONAL STAFF

Name		Position	Starting Date
Dr.Thalerng	Thamrong-Nawasawat	Director	February 22, 1988
Dr.Wirojana	Tantrapc:n	Deputy Director	April 20, 1988
Dr.Montri	Chulavatnatol	Assistant Director	October 3, 1988
Dr.Nit	Chantramonklasri	Director of Planning Program Development, and Policy Review	October 6, 1987
Dr.Sudhiporn	Pratumtaewapibal	Director TIAC	February 16, 1989
Dr.Sumin	Smutkupt	Bioscience/ Biotechnology Coordinator	December 1, 1986
Dr.Palarp	Sinhaseni	Standards Testing Quality Control Services Program Coordinator	January 5, 1989
Dr.Kriengsak	Chalermtiragool	Applied Electronic Technology Program Coordinator	February 1, 1989
Mrs.Ladda	Trongtorsuk	Chief of Finance	November 1, 1986
Mr.Suchin	Vatcharapongpreecha	Information/ Publicity Specialist	May 18, 1987
Dr.Maitree	Wasuntiwongse	Planning and Management Specialist	March 1, 1989
Dr.Benjapon	Wethyavivorn	Program Associate	October 1, 1987
Dr.Mandhana	Bhijaisoradat	Program Associate (Bioscience)	February 16, 1989
Mr.Weerawat	Chantanakome	Program Associate (IDS)	February 7, 1989
Miss Thawilwadee	Pongsaksri	Program Associate (STQC)	December 1, 1988
Miss Noppawan	Tienkarodjanakul	RD&E Financial Officer	November 20, 1987
Mr.Richard	B.Kalina	Management Advisor	July 1, 1986

APPENDIX L

STDB EXECUTIVE COMMITTEE

APPENDIX L

STDB EXECUTIVE COMMITTEE

1. Mr.Prachuab Chaiyasarn Minister	Ministry of Science Technology and Energy	Chairman
2. Dr.Sa-nga Sabhasri Permanent Secretary	Office of the Permanent Secretary Ministry of Science Technology and Energy	Member
3. Dr.Smith Kampempool Governor	Thailand Institute of Scientific and Technological Research	Member
4. Mr.Sommai Phasee Director or Mr.Prasit Ujjin Chief	Loan Policy and Management Division, The Fiscal Policy Office Ministry of Finance	Member
5. Mr.Thamarak Karnpisit Assistant Secretaries - General or	Office of the National Economic and Social Development Board	Member
Mr.Tophong Vachanasvasti Director	Technology and Environmental Planning Division Office of the National Economic and Social Development Board	
6. Mr.Wanchai Siriratana Director - General or Mr.Pracha Chaowasilp Deputy Director - General or Mr.Thawal Polpuech Director or Mr.Achari Yuktanandana Chief	Department of Technical and Economic Cooperation	Member
7. Lt. Gen. Preecha Chum-nanvea, RTA Director	Directorate of Education and Research (E&R)	Member
8. Mr.Chote Sophonpanich Director	Watanachote Co., Ltd.	Member
9. Dr.Ajva Taulananda Group Vice President	Charoen pokphand Co., Ltd.	Member

10. Mr.Anan Panyarachun Executive Chairman	Saha-Union Corp., Ltd.	Member
11. Dr.Sippanondah Ketudat President	National Petrochemical Corporation Ltd.	Member
12. Dr.Anat Arbhabhirama Governor	Petroleum Authority of Thailand	Member
13. Dr.Tawee Butsuntorn Senior Vice President or	Siam Cement Co., Ltd.	Member
Dr.Pakorn Adulphan Managing Director	Micronetic Company Limited	
14. Dr.Thalerng Thamrong-Nawasawat Director	Office of The Science and Technology Development Board	Secretary

APPENDIX M

MISCELLANEOUS OBSERVATIONS; STDB IN THE WIDER CONTEXT OF S&T DEVELOPMENT

semi-annual research evaluations. Thereby the PI and STDB personnel will also better understand the company and its industry, and the company will become more aware of the benefits of S&T inputs. An understanding of the process of technology transfer will be beneficial.

3. Legal Issues in STDB Programs

Legal issues arising in STDB programs have not yet been given attention. These include protection of proprietary information, ownership of intellectual properties arising from project research, applications for patents, licensing arrangements from (or to) STDB, and the sharing of royalties among participating individuals (institutions). In addition, there will be legal issues associated with the new legislation.

Most R&D organizations have legal counsel in-house, or have ready access to such counsel. It is suggested that STDB anticipate this need and consider arrangements for legal counsel.

4. Additional Observations

- "Thai Industry Seminars" at STDB. STDB regularly interacts with defined private-industry sectors by means of its conferences, workshops and ACC meetings. These sessions are valuable but benefit in each case a selected group of STDB personnel. Through the cooperation of its Board and Executive Committee private-sector members, STDB could organize an in-house series of informal monthly "Thai Industry Seminars," at which industry executives share with all STDB professional staff information on their industry and the operations of their company. Speakers should come from the engineering or line management part of the company. Staff members can obtain valuable insight from executives in a variety of industries, including industries not served by STDB's three major science sectors.

- Internships for U.S. graduate students at STDB. The Team suggests consideration of an internship program in which U.S. graduate students in science and engineering management or policy spend perhaps six months at STDB for conduct of relevant thesis or post-graduate study. The focus of their studies should be a specific aspect of the programs and objectives of STDB. In particular, the students could assist in strengthening the S&T policy analysis capability at STDB. Their enthusiasm and training would benefit STDB, and the students would learn about the growing Thai economy and improving S&T environment. In addition to their contribution to Thailand's S&T programs, the U.S. technical and industrial-management community would derive increased understanding of Thailand's economic development as these students return to join U.S. companies, share the insight they have gained and perhaps establish ongoing linkages of business value. The cost of such a program should be modest. Candidate students could come from selected universities that have strong programs such as the Harvard Kennedy Center, the MIT Sloan School or University of Pennsylvania's Wharton School.

5. The Complexity of R&D Organizations

In his book Designing Complex Organizations, Professor Jay Galbraith (Wharton School) characterizes organizations according to the degree of diversity and uncertainty of their operations. He categorizes R&D organizations as having a high degree of diversity and uncertainty, and notes that because of the resultant complexity such organizations require a high degree of internal lateral communications for the successful conduct of their mission. (The Team's recommendation of weekly senior staff meetings results in part from a recognition of this requirement.) Galbraith also writes of the need, in such organizations, for delegating decision processes to echelons below the top and he emphasizes that high quality of decision-making can only result when there is an open and trustful sharing of information

APPENDIX M

MISCELLANEOUS OBSERVATIONS; STDB IN THE WIDER CONTEXT OF S&T DEVELOPMENT

In this mid-term evaluation study, the Team has followed the scope of work outlined in the work statement. During the study, a number of observations were made which lie outside the immediate scope of work but which are considered relevant to STDB and its future. The following section covers several of these observations and comments on the future of STDB in the context of its environment and its mission of support to the economic development of Thailand.

1. The Time Scale of Research, Development and Engineering

The anticipated commercial benefits from research, development and engineering programs are not often realized within the time scale anticipated. The time interval between the initiation of an R&D program and commercial fruition from its results varies widely. Certain fields, notably semiconductors and digital computers, are characterized by a rapid rate of technological evolution and introduction of new products with time scales of only a few years. But in many fields the rate is slower and longer than expected. In the magnetic recording example, as well as in such automotive developments as electronic fuel injection and anti-skid ("adaptive") braking systems, the time interval between the early development and significant commercial success was at least two decades.

As indicated in Chapter 4, this time duration is likely to be shorter when R&D results enter the industrial innovation sequence at a stage beyond basic or applied research, say at the point of applications development, of pilot production or even of industrial production or product/process improvement. Achievements can be expected to be more rapid when projects are for improving a process or product, qualifying a locally-available material to substitute for an expensive imported one, or improving product quality. The STQC, STAMP and D/RDS programs, and many RD&E projects fit these categories. It is thus suggested that STDB allocate sufficient resources to such projects. It is also suggested that observers of R&D be aware of the time that may be required to put R&D results into useful practice.

2. Technology "Push" Versus Market "Pull;" Liaison with the S&T User

There are outstanding examples of successful innovations driven by the force of new technology, but most successful innovations--especially those of product or process improvement--are driven by market demand. Analysis of some industries shows that product-improvement suggestions from customers can be fertile ideas for successful innovations. A company's marketing personnel thus participate in formulatng RD&E strategy. The instrumentation industry is a good example.

An RD&E program may be a technical success, but not a commercial one, for a variety of reasons: lack of economic viability, inadequate market size, lack of fit between the company and the market, manufacturing processes inappropriate to the company, failure of one or more technology-transfer stages in the industrial innovation sequence, etc. Commercial success is thus enhanced when an RD&E project is conducted in close collaboration with the "user" to ensure that the project satisfies all criteria necessary for success beyond the straightforward technical requirements. Such collaboration will early indicate whether the company possesses the "capacity to assimilate" the fruits of the project.

Thus, for competitive RD&E, it is well that STDB not approve a project until there is a working relationship between the potential user of project results, with the user having determined from economic and market analysis (with help if necessary) that project results will likely lead to a commercial success. To this end, periodic liaison with the company should be maintained during the course of the project by the PI and the project coordinator, with the company participating in STDB's

among (lateral) individuals, a mutual building on this information, and a climate in which group problem solving can take place effectively.

As STDB grows and progresses, it would be useful for STDB executives together to study the design of complex organizations and gain insight into the anatomy of the type of organization represented by STDB. The insight gained might suggest modifications in structure and operation that could further improve organizational efficiency. For example, as STDB grows in implementation of its brokerage role between R&D resources and private industry, it is conceivable that a matrix structure would be useful. Further, a deeper understanding by STDB staff of the various roles of R&D workers (see 4.6), the role mix needed to perform their various functions, and the individuals' own ability to fill these different roles can lead to increased job understanding, increased job efficiency and increased job satisfaction. Consulting assistance from a specialist experienced in R&D organizations may be helpful in undertaking such a program of self education.

6. STDB in the Broader Context of S&T Development

For convenience, the following discussion will be based on U.S. dollars, with approximations accurate to 10 or 20 percent. The exchange rate is assumed to continue at approximately 25 Baht per dollar.

The Thai GDP is currently about $50 billion, growing at an annual rate of approximately 10 percent, i.e., $5 billion per year. Thailand is rapidly becoming an economically more significant member of the Pacific Rim community of nations. Increasing competence in science and technology is needed as the country moves more strongly into an export position with agricultural commodities, packaged food products and manufactured goods among the important export items.

Today, much of Thailand's export-oriented manufacturing is based on technology purchased from the parent by local subsidiaries/joint ventures of overseas licensor companies--with little reliance on indigenous science and technology resources. As noted recently by The Economist, large multinational corporations are finding centralized management, including product development, marketing, and financing, increasing difficult to conduct entirely from headquarters countries. Certain European and U.S. multinationals such as Philips and IBM have led the way in global decentralization of their businesses, providing greater autonomy to regional managers and establishing in various countries R&D and product development centers to serve not only the needs of the local market but the company's global strategy as well.

Partly from the pressure of a more costly domestic economy, Japanese firms are now also going multinational, meaning not only the opening of foreign assembly operations with increasing local autonomy (through greater numbers of local directors on the boards of these subsidiaries), but also through product development and even R&D activities that follow in the wake of new offshore manufacturing operations. Japanese firms are implementing such a policy in the U.S. and in Europe, with companies such as Hitachi, NEC and Sony establishing an R&D and product-development presence. This phenomenon is now extending to Singapore, and can be expected to develop in Thailand as well.

In addition, perhaps encouraged through BOI action, one can expect to see existing subsidiaries in Thailand beginning to depend more on local vendor sources, product development and R&D, not only for Thai markets but for export as well. Together, these two trends will mean a great demand for science and technology resources.

As noted earlier, the Royal Government of Thailand wishes by 1991 to increase the annual expenditure on research, development and engineering to one percent of the GDP, with the government share representing 70 percent. As is well known, a one percent allocation is not generous; many industrializing countries allocate more. Allowing for an economic growth totalling approximately 20

percent over the next two years, the above policy translates into an annual RTG expenditure for S&T which by 1991 would exceed $400 million.

An annual budget of this magnitude represents approximately five times the expenditure envisioned in the proposed STDB bill of 10 billion Baht over five years. In relation to what Thailand should be spending on S&T development, even 10 billion Baht over five years is not a substantial amount. However, a primary objective of STDB and the RTG should really be to encourage and stimulate more private sector interest and investment in S&T development so that the government can back off. Fiscal measures by the government to stimulate such private-sector investment may be one method. How STDB can best use its limited resources to stimulate such interest and investment is an appropriate subject for study by STDB's policy-analysis group.

Several conditions will need to be met if STDB is to succeed in its ongoing mission:

- Availability of sufficient financial resources;
- An unwavering dedication on the part of the RTG to provide political and institutional support to S&T development, allocating it sufficient priority among other demands for resources;
- An efficient, nonbureaucratic STDB organizational system led by high-caliber closely-cooperating management and staff as required for operation of a complex multi- and interdisciplinary science and engineering organization;
- Flexibility of operation within the government frame of reference so that the STDB can attract high-caliber personnel and provide efficient and responsive S&T support to private industry and other appropriate institutions; and
- An adequate supply of human resources with education and experience in the relevant science and engineering sectors, including the management of engineering and industry as well as an entrepreneurial spirit.

The last of the above requirements is the one most difficult to satisfy. This report has previously stressed the need for additional personnel at STDB suitably skilled for the mission. The same concern exists on a national level, for the rate of production of scientists and engineers at Thai universities falls far short of the need. To compensate for the shortfall, the Team urges early implementation of the plan, expanded if possible, to send promising students to overseas universities for S&T educations. Thailand needs more qualified graduates to take up faculty positions in public or private universities, as well as to enter private industry, and the sooner the better. The currently planned program of 800 students over five years is a good start.

Simultaneously, for the long term, it is urged that consideration be given to the "pipeline problem"--meaning the stimulation of an adequate flow into secondary and tertiary education of bright young people who want to pursue science and engineering careers. Statistics available to the Team indicated that in 1985 the percentage of science and engineering students in state educational institutions, including vocational programs, was only 5.5 percent of the total. By contrast, the percentage in law was 24.9 percent and in the social sciences 45.4 percent. As reported to the Team, the major reason for the large disparity is that engineering is not taught in the two state-run open universities.

The question of how Thailand might expand the pipeline capacity for science and engineering at the university level is a challenging one. Perhaps a curriculum could be designed which combines certain elements of the open university and the traditional university--the latter because laboratory work is essential to a scientific or engineering education. This question could well be addressed, in an innovative spirit, by STDB's Office of Planning, Program Development and Policy Review in

collaboration with the Ministry of University Affairs, the Engineering Institute of Thailand and the Science Society of Thailand.

In the long term, with an expanded pipeline, it is important to assure an adequate input of motivated young people of high scholastic calibre. Efforts to enhance young people's awarenessof science at an early age, beginning as early as six, can be helpful. Methods can be applied in the early grades of public school to stimulate the sense of wonder at our natural world, at the structureof the astronomical universe on one hand--or of the atom on the other, or to experience the "aha" joy of discovery or of sudden comprehension of a simple principle of physics. The successful completion of a simple chemical experiment or assembly of an electronic kit can do wonders for stimulating a young person's interest in science and engineering. Especially useful are planetaria and "hands-on," interactive educational science centers (museums)--of which one outstanding example is to be found in Singapore, and another at the Exploratorium in San Francisco.

It may seem a long way from educational science centers to "STDB in the broader context of economic development," but the fact remains that public awarenessof science and technology is a parameter in economic growth. It is not unrealistic to ask STDB, as part of its broader mission, to stimulate this awareness.

The U.S Agency for International Development Mission in Thailand has with foresight assisted the Royal Thai Government to establish the Science and Technology Development Board and has actively supported its early growth. The STDB Project has succeeded in its ambitious effort to develop a Thai institutional structureand mechanism for encouraging, financing and coordinating research and development activities. Rather than terminating its existence (as a Project) after a defined number of years, STDB will become--according to the proposed law--a permanent S&T institution.

STDB has passed through infancy and can be said to be at an early stage of adolescence. Ahead lies much growth, many challenges but many more opportunities than challenges. As indicated above, STDB has a vital role to play in Thailand's continuing economic development. The Evaluation Team wishes it success in its mission.

APPENDIX N

RECOMMENDATIONS TO ACTION/INFORMATION ORGANIZATIONS

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RECOMMENDATION	CHAPTER/ SECTION	ACTION BY OR INFO TO (*)
STDB should consider holding staff meetings on a regular basis.	2.A.1.b	STDB * EC
STDB should hire a Commercial Development Coordinator or Specialist who will serve both the RD&E and IDS groups, including the marketing function.	2.A.1.b	STDB * EC
STDB should appoint a Director of Administration and Finance and a Chief of Administration.	2.A.1.b	STDB * EC
STDB should make a special effort to attract private sector personnel.	2.A.1.b	STDB * EC
STDB should review its internal administrative and financial controls to see if it is possible to reduce the number of steps presently required to obtain clearances and authorizations.	2.A.2	STDB
STDB should strengthen its linkages and improve the quality of its relationships with the public and private sector organizations that are represented on its Board of Directors and on the Executive Committee.	2.A.3	STDB
STDB should strengthen its direct linkages with the industrial sector. It should increase the number of purposeful factory visits and should increase its interaction with BOI and IFCT.	2.A.3	STDB
STDB's Executive Committee should schedule meetings on a regular basis, preferably on a fixed day-of-the-month basis.	2.A.3	EC EC Secretary
STDB might consider ways to disseminate information about its objectives and activities to foster greater understanding on the part of RTG agencies which exercise financial control and oversight. Circulating newsletters and annual reports to these agencies might be one means for generating greater support. More importantly, efforts should be made by STDB staff to develop closer personal relationships with relevant officials in the various agencies.	2.A.4.d	STDB

USAID and DTEC should review the detail of current involvement with STDB in their requirements/approvals procedures, and should determine how much is appropriate at this time.	2.A.4.d	USAID *DTEC
Reduce the number of RD&E project selection criteria to two, namely that they 1) have industrial and commercial relevance and 2) that they have a good probability of success with all factors being taken into account.	2.C.1	STDB * EC
Explore the possibility of eliminating the mixing of funds from various sources on projects where this can be done, thus simplifying the administrative procedures and allowing the use of solely RTG funds on projects where this will provide desired flexibility.	2.C.1	STDB USAID MOF DTEC
STDB should continue to strengthenits internal screening processes so that less involvement is needed at higher levels--by the TAC, EC, DTEC and the Budget Committee.	2.C.2	STDB
Although the activities of STDB are well known in the research community by virtue of its research support, STDB's goals and activities are not well known nor understood in many relevant private sector and government circles. The Team received a number of negative comments on the value to the private sector from STDB's RD&E Program, which it feels were not fully justified. This leads the Team to recommend that STDB consider how to increase the effectiveness of its industry directed public relations activities.	2.C.3	STDB
We understandthe USAID is planning to extend the PACD and is considering funding a second phase of STDB's development. We recommend that the PACD be immediately extended to 1995. This will help create a feeling of permanence at STDB and diminish the uncertainty associated with planning for the expenditure of funds that exist as a result of the slower than expected establishment and making STDB operational. Passage of the currently proposed Government legislation, to change STDB's status from a project under TISTR to a state enterprise in its own right with an initial proposed five year budget, will make an even greater contribution to the stability of STDB. Stability is important for maintaining STDB's current staff and providing a basis for attracting additional quality personnel, especially some with private sector experience. We believe USAID's funding of a second phase of its STDB program, following the extension of the current PACD, should be contingent upon passage of the before mentioned legislation. Indeed, we believe a contingent offer of intent	2.C.4	USAID

should be made soon to encourage passage of the legislation.		
Program coordinators should begin to take a more active role in interacting with Designated and Competitive RD&E targeted firms and industries. This should include visits to get to know the firms and industries, begin to learn their problems and work with them to enunciate potential projects. The coordinators should visit firms and industries with PIs to market their RD&E both while it is in progress and when completed and to identify new projects. They should attempt to involve firm and industry representatives in the semi-annual reviews.	2.C.4	STDB
Because of the lack of industrial experience among the program coordinators, we recommend expanding and enhancing STDB's industrial outreach capabilities by entering into indefinite quantity-type contracts with two or three local business-consulting firms that have broad perspectives of Thai industry. These firms would assist STDB coordinators and their associated principal investigators (PIs) to identify potential industrial users of specific RD&E results, to facilitate the establishment of linkages among them, and where appropriate to assist in related market and economic assessments. Implementation of this outreach activity will require more coordinator staff.	2.C.4	STDB *USAID * EC
Ask the National Academy of Sciences, and its peer reviewers, to take a more active role in making suggestions as to how U.S. scientists, engineers, and facilities could contribute to STDB's RD&E Program.	2.C.4	NAS
Involve the Board of Investment and the Industrial Finance Corporation of Thailand in this Program. RD&E grants could, for example, be part of the privilege provided a promoted company under a BOI project. The IFCT, in its efforts to develop industry, will be able to assist STDB in identifying potential clients for the Company Directed Program.	2.D.1	STDB * EC *BOI *IFCT
Use the Fellowship Program, and the experience, structure and mechanism that STDB has achieved in managing it, to launch an effort to expand STDB's donor support. A good starting place would be with major Thai industrial firms. Attention should also be given to donor assistance organizations, in addition to USAID, as sources of funding.	2.E.2	STDB * EC
Continue the STQC Program's current emphasis on improving the quality of Thai industrial products, particularly those aimed at an export market. As it is determined that a specific product or category of	2.F.2	STDB * EC

products requires unavailable support from primary and secondary standards organizations, provide the standards organizations the assistance, equipment, training and resources needed to support the product quality of concern. We suggest support to "core" standards organizations be tied to a specific STQC project for supporting product quality in an industry. To conduct the STQC Program in the manner currently being pursued is going to require a larger STQC professional and support staff.		
Reconsider the initial establishment of TIAC as a separate entity from STDB. To the Team, it makes more sense to start it off in-house at STDB's current facility.	2.G.2	STDB, EC USAID DTEC, MOF
Have engineering firms determine if the electrical and telephone systems in the Jaran Insurance Building are adequate to accommodate the TIAC equipment specifications and, if not, how much it would cost to provide the necessary upgraded systems to accommodate the TIAC equipment.	2.G.2	STDB EC
Initiate TIAC services free of charge and build a market. Afterward, begin to consider the introduction of cost recovery approaches gradually.	2.G.2	STDB, EC USAID DTEC, MOF
Provide services at TIAC that are not so widely available at other information centers in Thailand. They should be products that will serve as an attraction to industry. As a first approach to identifying such products, we recommend that the Director of TIAC conduct an informal survey of industrialists, starting with those on the EC and the Board. Discuss with them what information bases and services are available and determine their thoughts on other markets.	2.G.2	STDB, EC USAID DTEC, MOF
This (STAMP) Program is directly related to the programs of two major development promotion institutions in Thailand, namely the Industrial Finance Corporation of Thailand (IFCT) and the Board of Investment (BOI). We believe that the STDB in general, and especially the STAMP, should work closely with these two agencies. One of the Program's first implementation activities should be to develop protocols and procedures for working closely with the IFCT and the BOI. We believe a designated STDB office at each location would be appropriate with an STDB staff member working out of each approximately half time, the other half of their time working out of STDB. The STAMP could be the center piece of this effort to tie the STDB to the BOI and the IFCT; however, all of the other industrial support services as well as the Company Directed RD&E should be represented.	2.I.2	STDB EC BOI IFCT

At BOI, STDB Programs could be made available to a promoted enterprise as a part of its promotional privileges. Since one objective of BOI is to increase licensees' utilization of Thai technical resources in lieu of technical dependence on the foreign licensor, STDB (and BOI) can assist in identifying and involving small and medium scale Thai technical resources. STDB may be able to help new licensees and joint ventures assess, purchase and achieve optimum use of production equipment with the help of the STAMP and TIAC, and enhance company in-house capability in S&T through use of the Company Directed RD&E Program. 2.I.2

The IFCT portfolio contains many small and medium sized companies. IFCT's program of support to these companies with management and marketing assistance (through its Industrial Management Company, Limited subsidiary) can be expanded to include technical assistance with testing, quality control, manufacturing methods, product extension and trouble shooting. IFCT's seminars for its portfolio companies provide an excellent interface at which STDB can publicize its capabilities and identify specific opportunities to assist. 2.I.2