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BASIC ISSUES AND RECENT DEVELOPMENT IN SCIENCE AND TECHNOLOGY POLICY IN THAILAND

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ABSTRACT

Major issues in the development of science and technology policy in Thailand are presented, with recent background information. The basic issues include development of suitable indicators of the status of science and technology, targets and prioritization, problems in co-ordination in policy formulation and implementation. Recent developments have seen highlighting of science and technology in the Sixth National Economic and Social Development Plan, the establishment of national centres as focus of support of specific technologies, and formation of other important institutional mechanisms.

INTRODUCTION

As Thailand slowly but firmly moves along the path to development, science and technology gradually pick up momentum. The field of science and technology policy, so important in determining the major thrust of efforts in science and technology, is becoming increasingly involved in specific and concrete issues, and the major concepts and goals are becoming more clearly defined by details and statistics. Although much improvement is still needed, the status of science and technology policy, like the whole spectrum of science and technology activities, has perceptibly advanced in Thailand over recent years. To be sure many basic issues and difficulties still have to be successfully tackled, as recent studies on the status of science and technology policy have indicated[1-4]. Recent developments as described in this paper have, however, cleared the way towards the solutions to some conceptual and structural problems. Other problems still remain to be tackled. Many of the problems are common for the ASEAN countries, and other neighbours[5]. It should therefore be beneficial for Thailand in particular and other developing countries in general, to study these basic issues and recent development in science and technology policy in Thailand.

BASIC ISSUES

1 Indicators of Status of Science and Technology

There are major difficulties in obtaining relevant and reliable indicators of

status of science and technology for all countries regardless of the level of development. The difficulties are amplified in a country like Thailand, where science-and-technology related statistical data are rare and often not reliable. The relatively small size of science and technology in Thailand, however, makes quite feasible the task of the development of a system of science and technology indicators. Major conceptual difficulties, as in other developing countries, involve the provision of meaningful output indicators. In countries like Thailand, where the research and development base is rather narrow and English is not the native language, output of scientific work such as covered by Science Citation Index may represent only a part of the real output. Nevertheless, the fact that it is internationally comparable, and that some measure of impact can be assessed, makes the bibliographic analysis based on Science Citation Index at least one of the possible tools. Technological output presents a far greater problem still, and up to now can only be gleaned from such figures as patent applications and registrations, most of which are from foreign companies. Data on value-added and export of technology products, such as engineering goods, may also add further information.

Table 1 shows the basic data on science and technology indicators in Thailand.

TABLE 1
SOME INDICATORS OF THE STATUS OF SCIENCE AND TECHNOLOGY IN THAILAND

Input indicators		
- R&D expenditure by government ($, 1984)	122	million
- R&D expenditure by government as % of GNP (1984)	0.34	
- R&D expenditure by large companies as % of sale (1982)	0.11	
- Scientists and engineers (1980)	55,790	
- Scientists and engineers per 10,000 population (1980)	12.1	
Output indicators		
- International publications (covered by Science Citation Index, 1983)	318	
- Total patent applications (1979 - 1985)	3539	
- Patents granted (1979-1985)	260	
- Value-added of engineering goods (1980, $)	1467	million
- Export of engineering goods (1980, $)	1059	million

Table 2 provides the output of various major institutions in Thailand in terms of international publications in science and technology.

TABLE 2
INDICATOR OF SCIENTIFIC ACTIVITY
INTERNATIONAL PUBLICATIONS IN SCIENCE AND TECHNOLOGY FROM THAILAND

Institution	Number of publications			
	1977	1979	1981	1983
Mahidol University	86	102	106	131
Chulalongkorn University	21	33	42	39
Chiang Mai University	15	8	17	8
Kasetsart University	2	6	7	9
Silpakorn University	0	5	1	8
Khon Kaen University	3	4	7	7
Prince of Songkla University	1	4	5	6
King Mongkut Institute of Technology	6	15	4	4
Thailand Institute of Scientific and Technological Research	2	1	3	2
Ministry of Science, Technology and Energy	0	0	3	3
Ministry of Agriculture and Cooperatives	1	5	9	16
Ministry of Public Health	1	4	9	14
Asian Institute of Technology	12	17	27	25
Others	3	34	27	46
Grand total	153	238	269	318

Source: Institute for Scientific Information, U.S.A. (see ref. 6)

It can be concluded that among ASEAN countries Thailand ranks quite highly in terms of available output indicators, but must still be considered as on the periphery on comparison with the bulk of international output. The crucial issue ahead is the development of more refined science and technology indicators, and indicators of linkage between technology and socio-economic status. Because Thailand is a country in the middle level of development, it may be worthwhile to make a comparative study of the OECD system[7] of input and output indicators, and the UNESCO system[8] of science and technological potential survey.

2 Targets and Prioritization

A close analysis of the status of science and technology in Thailand reveals that it is relatively strong in medical and biosciences, but rather weak in many areas of physical sciences. In engineering, while strong services are available, there is very little research and development activity. These considerations, plus considerations of relative advantage in terms of resources and demand led to selection of priority areas and targeting of goals in the medium term.[2,9] Such analysis contributes to the formulation of concrete targets in the science and technology development plan in the Sixth National Economic and Social Development Plan and the recently launched Science and Technology for Development Project (see below). In brief, the targets include strengthening of capability in three main areas : biotechnology, metallurgy and materials science, and electronics and computer technology. Specific sub-areas within these main areas were defined, so that the course of future development can be closely determined and monitored.

Although these refinements in targeting and prioritization represent major improvement in science and technology policy formulation in Thailand, they still suffer from lack of thorough and systematic studies on the status of technological capabilities, and the assessment of the impact of the introduction of new technologies or strengthening of presently existing technologies. Assessment of both present status and future impacts of various sub-areas of science and technology is a major issue in the attempt to improve the policy and planning process, especially in the medium and long term time scale.

3 Co-ordination in Policy Formulation and Implementation

The present status in formulation of science and technology policy still needs to be improved, considering the trans-sectoral nature of science and technology and the long time lag needed for many policy actions. Presently the National Economic and Social Development Board (NESDB) is responsible for five-year national plans which include science and technology aspects. The NESDB works in collaboration with Ministry of Science, Technology and Energy (MOSTE) in formulation of the plans and major projects. Major difficulties are encountered, however, in the implementation of the plans and projects, since they usually involved other agencies than MOSTE. Similar difficulties have been encountered in other countries, many of which have tried to resolve the issue by establishing a co-ordination agency of authoritative status in the form of a national council for science and technology. In Thailand, although the Fifth National Plan (1982-6) called for the establishment of a high-level National Council for Science and Technology to be chaired by the Prime Minister, little progress has been made towards this goal due to a number of reasons, both conceptual and pragmatic. Recently, the problem of policy formulation and implementation in the various agencies has been addressed by proposed formation of an inter-agency advisory committee.

An important area which has been mostly neglected until recently is the linkage between the private sector and the public sector. Presently the capabilities in science

and technology lie mainly in the public sector, mainly universities; yet the private sector largely ignores the existing endogenous capabilities, relying instead on import of technology as whole package from abroad. It is obvious that for effective technology transfer and further development, the private sector should be induced with various incentives to utilize the endogenous capabilities, and concurrently the public sector institutes should become more ready to serve the newly created demands provided that they produce no conflict of interest. Up to now there has been no effective legal and financial measure to promote research and development aimed towards the private sector, and existing rules and regulations make it very difficult for the required linkage. High-level policy decisions are still needed in this respect. There has been a suggestion to set up a subcommittee for science and technology for the Joint Public-Private Sector Coordination Committee, but this has yet to materialize.

RECENT DEVELOPMENTS

1 Science and Technology in the Sixth National Economic and Social Development Plan

Science and technology began to be given serious consideration only in the Fifth National Plan (1982-6), with explicit statement as a chapter of a major section in the Plan. Although most of the envisioned measures in the Plan still remain to be fully implemented, the Fifth Plan served as the initial landmark of systematic development and utilization of science and technology in Thailand. A preliminary assessment of the Fifth Plan up until early 1985 has been made by independent reviewers[3]. Some of the targets for the Fifth Plan have been reset or modified for the Sixth Plan.

The major thrust for science and technology in the Sixth Plan is in a major chapter of the Plan which contains ten chapters in total. This chapter deals mostly with development of science and technology. In addition, to ensure integration of science and technology in overall development process, other chapters of the Plan deal with the role of science and technology in production, marketing, job creation and manpower development. Hence, with regard to science and technology, the Sixth Plan uses the principle of "insertion and integration" to ensure both effective strengthening of the science and technology system, and productive interaction with various aspects of social and economic development. This approach was adopted as the optimal one after much consideration and debate on the merits and demerits of separating or integrating science and technology issues in the context of national development.

The major components of the science and technology development plan[10] proposed for the Sixth Plan are listed in Table 3. A preliminary estimate of the development the budget involved, excluding regular budget, has been put at approximately 1,879 million baht ($73 million) for the period of five years of the Plan. This modest estimate reflects the realistic forecast of a low or zero economic growth scenario made during the planning period. With recent changes in the economic outlook towards increased growth, a revision of this estimated low budget may be warranted. All of the components in Table 3 will be outlined in the individual chapter on science and

technology development, except that the section on scientific and technical manpower development will be integrated into a separate chapter on human resource development.

TABLE 3
MAJOR COMPONENTS IN SCIENCE AND TECHNOLOGY DEVELOPMENT OF THE SIXTH NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT PLAN 1987-1991

1. Policy formulation

- Establishment of National Committee for Science and Technology.
- Formulation of long-term policy.
- Strengthening of capability in science and technology policy management.
- Establishment of Technology Assessment Unit.

2. Institutional and infrastructural strengthening

- Strengthening of Science and Technology for Development Project.
- Strengthening of National Center for Genetic Engineering and Biotechnology.
- Establishment of National Center for Metal and Materials Technology.
- Establishment of Thailand Electronics and Computer Technology Center.
- Feasibility studies for establishment of other national centers for specific technologies.
- Strengthening of linkage between the government sector and private sector.
- Support for professional societies, especially through the Federation of Scientific and Technological Societies of Thailand.

3. Improvement of legal framework, rules and regulations

- Establishment of a unit for reform of the legal framework for support of science and technology.
- Enactment of laws for promotion of science and technology, including laws providing financial and tax incentives for R&D by the private sector, laws for promotion of technology transfer and laws for improvement of standards.

4. Development of scientific and technical manpower and promotion of climate

- Development of system for planning of scientific and technical manpower.
- Promotion of technical skill at the craftsman level.
- Supply of manpower in needed areas of science and technology, with emphasis on increase in supply of engineers.
- Promotion of science and technology teachers.
- Promotion of identified individuals with special ability in science and technology.
- Promotion of public awareness and appreciation of science and technology.

5. **Improvement in scientific and technological information system, including policy information.**
   - Establishment of Center and Network for Scientific and Technological Information.
   - Development of Science and Technology Indicator System.

6. **Promotion of research and development**
   - Formulation of research and development policies.
   - Formation of incentive packages for research and development, including loan and grant schemes.
   - Support for research and development especially in priority areas (biotechnology, materials and metals technology, electronics and computer technology).
   - Setting up systems for private-sector directed research and development.

7. **Promotion of technology transfer**
   - Setting up national policy and plans for technology transfer.
   - Setting up information bank on technology transfer agreements.
   - Development of patents information system.

A major section of the science and technology plan concerns their applications to various sectors.[10] Two important sectors, agriculture and industry, have been highlighted, and the components are summarized in Table 4. This part of the plan will be finally integrated into the plan for development of production, marketing and job creation.

TABLE 4
MAJOR COMPONENTS IN THE PLANS FOR UTILISATION OF SCIENCE AND TECHNOLOGY IN AGRICULTURE AND INDUSTRY

A. Utilisation in agriculture

1. Use of technology for conversion of agricultural products for export.
2. Use of packaging technology.
3. Use of technology for harvesting, and pre- and post-harvest technologies.
4. Use of genetic engineering and biotechnology for agriculture.
5. Use of agricultural machinery technology.
6. Use of technology for conservation of plants, animals and aquatic resources.
7. Use of technology for land development.

B. Utilisation in industry

1. Promotion of use of local raw materials and semi-finished products.
2. Improvement of industrial technology with emphasis on diagnosis of and solution to technical problems in production and management.
3. Development of products and product design, including system for legal protection of intellectual properties.
4. Development of quality of industrial products.

2 National Centers as Focus of Support for Specific Technologies

As Thailand moves towards industrialisation, there is increasing need to strengthen scientific and technological capability in the areas related to new industries and business. The strengthening can be achieved through various mechanisms. A major mechanism recently applied is the establishment of national centers for specific technologies already identified as of high priority (see 1.2). This approach is in contrast with that used in the early 1960s, when a broad-base Applied Scientific Research Corporation of Thailand (later named Thailand Institute of Scientific and Technological Research) was founded.

In 1983, the National Center for Genetic Engineering and Biotechnology was established. With its office in the Ministry of Science, Technology and Energy and the budget primarily from the government, the Center serves as the focus for support to designated research development and other projects in genetic engineering and biotechnology. Rather than expending valuable resources, both human and monetary, in trying to build a research institute in a single step, the Center employs a gradual approach of firstly building a network of centers of excellence, giving support to identified research teams drawn from various institutions, and building up "units of operation" within the collaborating institutions. This approach, novel to Thailand, is yielding interesting results and, after a full evaluation, can serve as a useful model for other national centers yet to be established. The rationale for establishment of the National Center for Genetic Engineering and Biotechnology has been presented[11-13],

and the results of its research and development work was recently presented[14]. Areas where progress has been rapid include embryo transfer technology, plant tissue culture technology, optimization of already existing industrial fermentation, and production of bioagents for genetic engineering.

Other identified areas, i.e., material science and metallurgy, microelectronics and computer technology, may require different approaches in strengthening. With a scarcity of manpower in material science and metallurgy, a primary emphasis may need to be placed on the training aspect. The Engineering Industry Development Institute, recently set up under the Ministry of Industry, is expected to contribute significantly to training in various vital areas of metal technology, especially at the skilled craftsmen level. The research and development capability is expected to be built up with the establishment of the National Center for Metal and Materials Technology by the Ministry of Science, Technology and Energy, recently endorsed by the Cabinet. The strategy for microelectronics and computer technology has to take into account the very advanced level of sophistication already achieved in developed countries and free competition in the Thai market. On the one hand, comparative advantages have to be identified and utilised, in for example, the relatively low cost ratio of personnel to hardware. On the other hand some areas such as semiconductor technology need to be strengthened, even though the impact of endogenous development may not be felt for a long period, because of their basic importance. These issues are being considered in forming the work agenda for the proposed Thailand Electronics and Computer Technology Center recently established by the Ministry of Science, Technology and Energy and endorsed by the Cabinet.

3 Other Important Institutional Mechanisms

In building up scientific and technological capability and applying it to development, in addition to formation of national centers and networking of centers of excellence, there have been some other important recent initiatives. A major initiative launched in 1985 was the establishment of the Science and Technology Development Board (STDB) with funding as soft loan from the US Agency for International Development to the Thai Government, within the framework of the US-Thai co-operation programme in science and technology[15]. The STDB is structured to work as a flexible organization, nominally under the umbrella of Thailand Institute for Scientific and Technological Research (TISTR), and managed with significant participation from the private sector in addition to various government agencies. This inter-agency management system for science and technology is novel to Thailand, and it remains to be seen how successful it can become. While the STDB has a function in reviewing science and technology policy and practice, the largest component of the budget ($30 million out of $49 million) will finance research, development and engineering in three priority areas : bioscience/biotechnology, material technology, and applied electronic technology. These same three priority areas were chosen since they were based on the same criteria and arguments as used for the formation of the national centers discussed in 2.2. Indeed, it is widely anticipated that the STDB during its scheduled operation (four years, extendable to seven years) will give

birth to a healthy infrastructure for self-propelling development of the three identified technologies. Three different types of research, development and engineering activities are to be funded by the STDB : designated, competitive and company directed. In addition, the STDB will provide industrial development support in the form of standards, testing, quality control, information, and diagnostic/research design services.

Another recent novel development took place in the science and technology policy area. The Thailand Development Research Institute (TDRI)[16] was established in 1984 as a private foundation closely linked with the National Economic and Social Development Board (NESDB). One of the major concerns for the TDRI is research in science and technology policy as related to development. It is expected that the research from TDRI will provide valuable input in policy formation over a broad range of subjects concerning science and technology.

CONCLUSION

Although a number of identified objectives in science and technology policy have not been achieved as targeted in the Fifth Plan which terminated in 1986, there are none the less encouraging trends for the future. The science and technology component of the Sixth Plan has been emphasized to a greater extent than that of the Fifth Plan, where it first appeared. Moreover, major institutional developments not foreseen took place in the past few years. These include establishment of the National Center for Genetic Engineering and Biotechnology, the STDB and the TDRI. However, a major institutional improvement, the establishment of the National Council for Science and Technology, still eludes the attempt of implementers of the Fifth Plan. It is to be hoped that the next few years will see more positive development in science and technology policy in Thailand, so that the country can fully utilise this powerful tool for advancement in various economic and social sectors.

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