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MONITOR - SAST ACTIVITY
STRATEGIC ANALYSIS IN SCIENCE AND TECHNOLOGY

THE NEEDS AND POSSIBILITIES FOR COOPERATION BETWEEN SELECTED ADVANCED DEVELOPING COUNTRIES AND THE COMMUNITY IN THE FIELD OF SCIENCE AND TECHNOLOGY

(Sast Project N° 1)

REPORT ON ASEAN

by
Dr. L. Cuyvers, Faculty of Applied Economics
University of Antwerp (RUCA), Belgium

Dr. K. Ramanathan, School of Management
Asian Institute of Technology, Bangkok

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FOREWORD

This report has been prepared for the Strategic Analysis in Science and Technology Unit (SAST) of the Directorate-General for Science, Research and Development of the Commission of the European Communities. SAST activities are part of the MONITOR Programme which aims to identify new directions and priorities for Community research and technological development (RTD) policy and to help show more clearly the relationship between RTD policy and other Community policies.

For questions already identified as of interest for the development of Community policy, SAST projects provide an investigation of the perspectives opened up by science and technology. SAST projects thus serve as an input to the process of policy formulation. In the case of the SAST project to which this report contributes, "The needs and possibilities for cooperation between selected advanced developing countries and the Community in the field of science and technology", the context of policy questions includes the evolving economic relations between the Community and these countries, the interest to the Community of promoting international cooperation in science and technology with various types of countries, and the Community's role in European science and technology.

This report is one of a set of country studies carried out for the project. The set comprises the Republic of Korea, Thailand, other ASEAN countries, the People's Republic of China, India, Brazil and Mexico. An overall strategic review will also be available in 1992.

It should be borne in mind in reading the country studies that the fieldwork on which they are based was carried out almost entirely in the country concerned. The points of view of European industrialists/researchers/policy makers were not explicitly sought for this part of the project. (They will be sought as part of the work for the overall strategic review.)

SAST presents this report as a stimulus to reflection and debate within the European Community on the best strategies to adopt towards a group of increasingly important countries. It must be stressed, however, that the orientation and content of reports prepared for SAST cannot be taken as indicating the considered opinion of policy advisors within the Commission services.

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PART II : DECISION BASE

INTRODUCTION AND READERS' GUIDE

The Strategic Analysis of Science and Technology (SAST) Project No. 1 initiated by the European Community (EC) is entitled, "The needs and possibilities for cooperation between selected advanced developing countries and the Community in the field of Science and Technology". The aim of this project is to provide a decision base for policy-makers in developing S&T cooperation between the European Community and a number of selected advanced developing countries. The ASEAN nations of Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand constitute such as a group.

The term decision base, as mentioned above is used to indicate that the SAST Project No 1 consists of an analysis of the many factors that could be considered or decision-making in the area, but is not by any means to be associated with the decision process itself. The decision base is expected to include a description and analysis of the S&T situation in the countries in question against the political and economic background and the signalling of the most relevant facts and developments.

This report on the ASEAN countries has been prepared with the objective of providing some basic inputs to this decision base. The fact that this report has been prepared without any field work in the ASEAN countries, except Thailand, has meant that the study had to depend on published materials for collecting relevant information. Thus some of the more recent S&T developments in the ASEAN region may not have been captured adequately in this report. This is a limitation of this report and it must therefore be viewed only as a brief overview of the salient facts relating to all countries of the ASEAN group. The country studies series of the Asian and Pacific Centre for Transfer of Technology of UN-ESCAP proved to be an invaluable source of information. Considerable information was obtained from these studies for use in this report.

The research associates at the School of Management (Asian Institute of Technology) who assisted in the preparation of this report are Mr. P. M. Nishantha Sanjeewa and Mr. Nipon Chatarwarathit. We are also much indebted to Prof. Anuwar Ali and Prof. Anuar Adnan, Faculty of Economics, Universiti Kebangsaan Malaysia, for their most useful overview of S&T developments in Malaysia. Country information on S&T developments were also drawn from the reports of the S&T key-persons at the EC-sponsored workshop "Science and Technology Development in ASEAN Countries: Problems, Prospects, Scope for Cooperation with the EC" that was organised by the country contractor at the Asian Institute of Technology, Bangkok, 7-8 June 1990.

Starting with the economic situation in the ASEAN countries and a number of observations on past cooperation in the field of S&T between ASEAN and the European Communities, Part I gives the main strategic views and recommendations on future S&T cooperation with the ASEAN countries. These views and recommendations are evidently based on the decision base of part II, which is presented as follows:

Section 1: Country Overviews

Section 2: Evaluation of Commitment in Using S&T for Development

Section 3: Organizational Infrastructure for Using S&T for Development

Section 4: S&T Human Resources Development

Section 5: Technology Support Facilities

Section 6: National Policies Influencing Technology Imports and Indigenous Technology Developments

Section 7: International Cooperation Programs in the ASEAN with Emphasis on S&T

Section 8: Scope for Cooperation between EC and ASEAN in the Field of S&T.

EXECUTIVE SUMMARY

A group of diverse countries ...

The Association of South East Asian Nations (ASEAN) consists of six countries namely Thailand, Malaysia, Singapore, Indonesia, Philippines and Brunei Darussalam. Singapore is one of the Asian Newly Industrialising Countries, while Malaysia is near to becoming a NIC. The other ASEAN countries are aspiring to NIC status in the future, with Thailand and Malaysia having the best prospects.

The real commitments of the ASEAN countries to using S&T for development differ greatly. Since 1979, the Government of Singapore has emphasised that it must keep abreast of the rapid advances in new technologies and move into the new high-tech industries. The Singaporean S&T policies have been successful and other countries in the region are willing to follow the same lines. Malaysia has set up a Technology Park in 1988, and in Thailand, the feasibility study for five such Parks is presently being carried out. In Malaysia an important Action Plan for Industrial Technology Development was adopted in May 1990. The Sixth National Economic and Social Development Plan (1987-1991) of Thailand has a companion S&T Plan and a long-term S&T Policy and Master Plan (1992-2011) is in preparation.

From the existing inequalities among ASEAN countries, it clearly follows for the EC that it would be a good policy to concentrate cooperation efforts on the one or two best performing ASEAN "Newly Exporting Countries", provided that the European Commission wants to develop economic links and foster mutually beneficial S&T cooperation with countries in South-East Asia.

Battlefields and springboards

To do so would be wise. Countries like Thailand and Malaysia are considered by the Japanese companies and the emerging multinational companies from the NICs as "battlefields" and "springboards" in their global competitive struggle. So European companies and the EC should do the same. Therefore, we think that from a global strategic point of view, it is better to combat Japan and the NICs (among which also Singapore) in Thailand and Malaysia than in their respective home bases.

However, the share of EC foreign investment in the ASEAN countries is lagging behind and declining steadily, posing a serious threat for the future position of the EC in this strategic and economic booming part of the world. It is high time for the European Community to turn the tide and stay present in the ASEAN region in a more than symbolic way. Thailand in particular could become a bridgehead for European business in the region, as we stress in our Thailand report. Therefore, the Commission of the EC and the EC countries should develop urgently coherent industrial, commercial and S&T cooperation policies with the ASEAN countries, particularly with Thailand (and Malaysia), thereby avoiding to fragment efforts and resources, and learning from Japanese and US experience and strategies.

Avoid the myopia of the past

Japan has been very successful in penetrating the ASEAN countries with imports and direct investment. This business penetration has usually been well prepared many years before by the Japanese government agencies like JETRO, JICA and others, using suitable S&T cooperation, particularly in the field of human resource development and training. One obvious lesson for Europe is therefore, that the EC should avoid the myopia of the past and that future mutually beneficial S&T cooperation projects need to be beneficial for general and long term trade and investment interests of the EC in the ASEAN region. Apart from a wider use of the so-called Cheysson Facilities, the establishment of a special ASEAN-EC Development Corporation (for co-financing EC-ASEAN joint ventures) is recommended.

The development cooperation strategies of Japan and the United States show concern to the competitive position of their companies in ASEAN. We have the feeling that some anti-colonial resentment vis-a-vis European countries is still present in ASEAN countries, and that consequently, the European Community and the Commission, are better placed than individual member countries to combine European business interest with S&T cooperation.

Mixed successes of EC-ASEAN S&T collaboration

The EC has to be aware of a number of important constraints in herited from the past. In the ASEAN countries the S&T institutional framework is rather complicated, with many ministries and institutions involved, and a considerable degree of duplication of activities. In addition, ASEAN as such has also worked out plans and to a certain degree coordinated regional and national S&T projects, with the ASEAN Committee on Science and Technology (COST) being the main actor.

Moreover, S&T cooperation between the EC and the ASEAN countries has been a mixed success. Although bilateral S&T cooperation can be said to be successful (particularly with Thailand, and to a somewhat lesser extent also with Indonesia and Malaysia), regional EC-ASEAN S&T cooperation has largely failed, mainly because of complicated procedures and institutional mismatches between the EC and ASEAN.

Bilateral cooperation is better suited

It would be unwise to abandon regional S&T cooperation with ASEAN. In many cases, however, and also because of the necessity to bring in the private sector from both sides in future mutually beneficial S&T cooperation, we think bilateral cooperation would be better suited than regional EC-ASEAN cooperation. Only bilateral S&T cooperation will enable the EC to reach a "critical mass" of intervention in Thailand and Malaysia.

S&T in the ASEAN countries, apart from Singapore, is seriously constrained by the development of scientific manpower. In this area, great scope for S&T cooperation certainly exists, by providing help and sponsoring training programs and workshops, as well as in the establishment of graduate engineering schools and vocational training institutes. In countries like Thailand and Malaysia, such EC sponsored actions will prepare the ground for European investors.

Another suggested area of future S&T cooperation is in the field of standardisation and quality assurance. The EC has been involved with ASEAN in regional S&T cooperation in this area, which could be further developed. Cooperation in this area could have considerable spinn-off effects e.g. on European MNCs and EC-ASEAN joint ventures, and therefore, should be considered as an important support service for EC-ASEAN industrial

and commercial cooperation. Also, the establishment of joint ventures in R&D and R&D consultancy could be stimulated and assisted.

Finally, because in many ASEAN countries, the government is engaged in the creation of a national S&T information system and databases, the EC could support these initiatives. This would enable the Commission of the EC to get access to invaluable information on the continuously changing S&T environment in these countries, and to combine this information with specific business information on opportunities for economic cooperation. It would also enable to influence the S&T information system in these countries and link it to European information systems and databases.

PART I : STRATEGIC REVIEW

I.1. - THE ECONOMIC SITUATION OF THE ASEAN COUNTRIES AND THE POSITION OF THE EC

I.2. - OBSERVATIONS ON PAST COOPERATION

I.3. - SOME GENERAL RECOMMENDATIONS FOR FUTURE S&T COOPERATION BETWEEN THE EC AND THE ASEAN COUNTRIES

I.4. - AREAS FOR FUTURE MUTUALLY BENEFICIAL S&T COOPERATION BETWEEN THE EC AND THE ASEAN COUNTRIES

I.1. THE ECONOMIC SITUATION OF THE ASEAN COUNTRIES AND THE POSITION OF THE EC

In the past few years, the ASEAN countries (Indonesia, Malaysia, Thailand, Philippines, Singapore, Brunei Darussalam) have experienced high growth rates of GDP. To a large extent, this booming economic situation is due to increasing exports and investment, both domestic and foreign. Factors which contributed to this are the general boom in the Pacific Rim, active government policies to promote exports and foreign direct investment, and the shift of labour-intensive activities from Japan and the Newly Industrialising Countries (NICs) of Asia to the ASEAN countries.

During the past decade, the ASEAN countries have gained competitive strength in producing and exporting technology-intensive goods. If we use the OECD definition of high and medium R&D intensive goods, of the six ASEAN countries only Singapore is a net exporter of these goods. High technology-intensive goods represented one third of Singapore's exports of 1986. This share was 23 % in Malaysia and about 8-10 % in Thailand and the Philippines. Unlike the case of Singapore, the technology-intensive exports of the other ASEAN countries are relatively more concentrated in a limited number of high tech goods (integrated circuits, switch boards, and other electrical machinery and parts). Our analysis of revealed comparative advantage indices also point to the importance of the category of electrical machinery in Malaysia, Singapore, Thailand and Indonesia, as well as telecom and sound equipment. Singapore and Indonesia have a comparative advantage in oil refining, Indonesia and the Philippines in the production of manufactured fertilisers. A future comparative advantage in the production of a number of chemicals is likely to appear in Singapore, and in oil refining in Malaysia. For more details, we refer to Part II.

Compared to Japan, the United States and the NICs, the European Community has not been able to capture much benefit from its economic relations with the ASEAN countries. Nevertheless the EC countries are still among the main suppliers. Japan supplies more than 20 %. of the imports of Singapore, the US about 15 % and the EC about 11 %. The share of Japan in Indonesian imports is 30 %, of the US 12 %, and of the EC 18 %. Imports of the Philippines are for 17 % coming from Japan, for 22 % from the United States, and for 11 % from the EC.

On the other hand, the relative low share of the EC in foreign direct investment in the ASEAN countries, is a serious threat for the future of our economic relations with the region. In Thailand, the % share of the EC in foreign direct investment is still hardly 9 %, against 50 % for Japan, and 14 % for the US. In 1987, the share of Japan in foreign direct investment in Indonesia was 37 %, in Malaysia 30 %, in the Philippines 18 % and in Singapore 42 %.

These figures clearly indicate the importance for Europe to step up its economic relations with the ASEAN countries. For being successful, this has to be backed by European Commission and member states initiatives in the field of economic and S&T cooperation as is rightly pointed out in the recent guidelines of the European Commission for cooperation with the developing countries of Latin America and Asia [22]. The EC can learn a lot from the Japanese and US cooperation strategies in the region. The following summary conclusions and recommendations on future S&T cooperation between the EC and the ASEAN countries are formulated with these considerations in mind.

Our report "The needs and possibilities for cooperation between selected advanced developing countries and the Community in the field of Science and Technology" is largely based on an assessment of S&T needs and capabilities. Apart from Thailand, however, the studies on S&T needs and capabilities in the other ASEAN countries are based on the existing literature and on a number of papers prepared by key-persons from Thailand, Indonesia, Malaysia and the Philippines for a EC sponsored workshop ("Science and Technology Development in ASEAN Countries : Problems, Prospects, Scope for Cooperation with the EC"), organised by the country contractor at the Asian Institute of Technology, Bangkok, 7-8 June 1990.

Consequently, since no field research and extensive interviewing of S&T key-persons in the ASEAN countries other than Thailand was conducted, it is hazardous to draw firm conclusions and recommendations from the research. Therefore, the observations and recommendations given below are of a more tentative nature. With respect to conclusions and recommendations on S&T cooperation with Thailand, we refer to our report "The S&T Situation in Thailand and the Scope for S&T Cooperation with the European Community".

I.2. OBSERVATIONS ON PAST COOPERATION

I.2.1. INSUFFICIENT FUNDS

S&T cooperation between the EC and ASEAN countries in the past has been seriously hampered by lack of funds, compared to the funds earmarked for S&T cooperation in the region by Japan and by the United States. This is illustrated by the fact that between 1976 and 1988 the EC granted 112.4 MECU for economic cooperation with Asia. On the other hand, the annual program for International Scientific Cooperation, which finances cooperation between universities and research institutes in EC countries and in Asian, Latin-American and Mediterranean countries disposes of max. 100,000 ECU.

These figures should be compared with Japanese and US S&T cooperation projects. We quote the new USAID project "ASEAN Private Investment and Trade Opportunities" (PITO) which alone will be good for about 2.5 million USD contribution of AID in 1990 and 1991. We particularly quote the Thai project for setting up a new TISTR-TISI testing and calibration facility, for which the Japanese government provides over 50 million USD.

This lack of funds has led DGI and DG XII to be niggardly and to use informal criteria for the funding of the participation of scientists of ASEAN countries in workshops, so that finally scientists from Brunei and Singapore were treated differently from scientists from the other ASEAN countries. In turn, this has caused irritation and mutual distrust, and has also seriously hampered the success of a number of S&T cooperation initiatives of the past.

We would recommend the Commission of the European Communities :

- EC funds earmarked for S&T cooperation with the ASEAN countries have to be increased if the European Community wants to be present in a more than symbolic way in the region.

- The private sector in Europe has to be more involved in S&T cooperation between the EC and the ASEAN countries. It should, however, be clear that cooperation projects which are beneficial to European business interests in the short or medium term will not come up easily and will not be the most promising ones from a long term point of view. We return to this.

- EC funds should be concentrated on one or two ASEAN countries. Because of the strategic position in the region, its booming economy and the fading presence of Europe as investor, economic and S&T cooperation with Thailand has to be stimulated and speeded up (see our Strategic review on S&T cooperation with Thailand). Also cooperation with Malaysia should be increased. This concentration has obvious consequences for the choice between bilateral and regional EC-ASEAN S&T cooperation (see below I.3.4)

II.2.2. COMPLICATED PROCEDURES AND INSTITUTIONAL MISMATCHES BETWEEN EC AND ASEAN

The cooperation in the past on a bilateral basis between the EC and ASEAN countries, though limited in scope, has been rather successful. Complaints were voiced by some interviewed key-persons in Thailand, about the lack of transparancy of the EC institutions (the various Directorates General of the European Commission) and, compared to bilateral cooperation with EC member countries, long, somewhat confusing and complicated procedures. Probably also some disappointment about the limited financial capacity of the EC, compared to Japan, the US, or even EC member countries, is present, and explains some of these complaints.

Regional cooperation between the EC and ASEAN has been much less a success (see above). There exist a number of important differences between the European Community and ASEAN. Unlike the European Community, ASEAN is an association of countries aiming at regional cooperation rather than integration. ASEAN has a weak institutional background, is very much decentralised and its decision-making processes are time-consuming because based on continuous consensus-building. Chairmanship and secretariat of ASEAN Committees are rotating between the member states, which more than once has created communication problems with the EC. Also the fact that in S&T cooperation with ASEAN, DG XII had to deal with more than one ASEAN Committee (Committee on Science and Technology COST, Committee on Social Development COSD, Committee on Food, Agriculture and Forestry COFAF, etc.) has hampered a speedy and smooth communication in the elaboration of regional S&T cooperation projects between the EC and ASEAN.

I.3. SOME GENERAL RECOMMENDATIONS FOR FUTURE S&T COOPERATION BETWEEN THE EC AND THE ASEAN COUNTRIES

I.3.1. THE EC PRESENCE IN THE ASEAN REGION

The general feeling we have got from our contacts with S&T key-persons in the ASEAN countries is that for the European Community it is high time to do more about its presence in the ASEAN region, if it wants to stay there at all. On the other hand, there is widespread concern among ASEAN S&T key-persons of becoming too dependent on Japan as supplier of capital goods, investment and technology. In a sense, Europe is invited together with other industrial countries, to speed up the development of its trade and investment links with the ASEAN countries. The European Commission can react to this invitation by new forms of mutually beneficial commercial, industrial and S&T cooperation. In doing this, the EC is better suited than the former European colonial powers, but it should be very much aware of some anti-colonial resentment in ASEAN countries like Malaysia and Indonesia, when applying too strictly short term mutual benefit and profit related criteria to S&T cooperation projects.

It will not be sufficient to copy either the US, or the Japanese initiatives. More importantly, lessons have to be drawn from the Japanese strategies of long term planning of mutually beneficial S&T cooperation, and "niches" have to be found where also the EC S&T cooperation with the ASEAN countries can be mutually beneficial from the long term perspective.

Comparing European (or US) with Japanese companies one is struck by the relative shortsightedness of the former. The same myopia equally appears on the side of the ASEAN companies. Financial incentives should be given to European companies to act along similar lines as Japanese companies. Apart from securing the position of European companies in the South-East Asian region, this would lead to lasting successful industrial cooperation and mutually beneficial technological cooperation.

The creation of the so-called Cheysson Facilities as a financial instrument of the European Community to stimulate the transfer of capital and technology through joint ventures with medium-sized companies in the Asian, Latin-American and Mediterranean countries marked an important step. More attention should be devoted to bring also the small and medium sized enterprises of the European Community and the ASEAN countries in contact. Both in the European Community and in the ASEAN countries these small and medium sized companies have large growth potentials. Since cooperation will be hampered by the lack of technological capability in the indigenous SME's of the ASEAN countries, EC financed or co-financed training facilities could alleviate these needs. We refer to section I.4.

Interesting lessons can also be drawn from the ASEAN-Japan Development Corporation (AJDC) established as a joint venture between the ASEAN Finance Corporation and the Japan ASEAN Investment Company. AJDC promotes and finances (or co-finances) Japan-ASEAN joint ventures, conducts feasibility studies, etc.

Comparing Japanese with European (or US) companies, one is equally struck by the importance of the general intelligence and business information system in the Japanese companies. Generally speaking and running the risk of some oversimplification, one can say that European companies are often badly informed, that their information system is

inefficient and that they react too late or are planning their future activities and developing their strategies under more uncertainty. This, no doubt, contributes to the abovementioned myopia of managment in Europe. The information disadvantage of European companies vis-a-vis the Japanese competitors has two aspects :

- Japanese companies dispose of excellent information and intelligence gathered by Japanese public services and agencies abroad like JETRO or JICA. In Thailand, we were e.g. struck by the results of a 1989 study by Siamerica Business Group Co.Ltd., prepared for the Office of the Board of Investment and JETRO Bangkok (!) on "Management and Technology Transfer. A Survey of American Firms in Thailand" [34] Special mention has also to be made of the wide diffusion of joint research results of Japanese universities and universities in ASEAN countries, on the general business and investment climate in the ASEAN countries (see e.g. [45]).

- Management of companies that are part of a grouping of Japanese companies (keiretsu) dispose of excellent information and intelligence gathered by the many branches abroad (particularly of the general trading companies). This information and intelligence is widely diffused within the company and used in the rounds of discussions and consensus building between and among the various layers of the Japanese management system (the so-called ringi-system).

The information available to the European companies on business opportunities should be structured and the development of business information systems stimulated by providing grants or conditional loans. The information and intelligence at the European Commission should be put into computerised databases, regularly updated and accessible to the EC business community. In this respect, we also refer to what will be said about the development of S&T information in section I.4.

I.3.2. THE PRINCIPLE OF MUTUAL BENEFIT

The principle of mutual benefit of future S&T cooperation is a very important one, by linking business interests in Europe with S&T development aid to the ASEAN countries.

The principle is also applied by Japan and the USA in its S&T cooperation projects. Japanese funding of training programs and institutes not only eases skilled labour shortages in the ASEAN countries, but also exactly suits the needs of Japanese investors in the region for Japanese minded and quality-aware staff, and by making the trainees acquainted with Japanese equipment.

During the Eighth US-ASEAN Dialogue Meeting in February 1988 much more emphasis was placed on mutual benefit and programs have been proposed in areas like trade and investment facilitation between the United States and ASEAN. In these programs, the private sector is playing a leading role, which is a clear departure of the USAID underlying philosophy and a redefinition of the role of USAID in the region.

The principle of mutual benefit is even more important for the European Commission's S&T cooperation policy towards advanced developing countries because of the need to supplement the EC aid with private means, and therefore to interest the private sector in the EC in industrial cooperation with the ASEAN countries.

However, if the European Commission wants to look at the mutual benefit of future S&T cooperation projects with the ASEAN countries (apart from Singapore) in this way, we fear that insufficient cooperation projects will emerge, and that the EC contribution will become marginal. On the contrary, we strongly recommend to view the criterium for S&T projects to be mutually beneficial from the angle of the need to counteract the overwhelming presence of Japan in the ASEAN countries (both the public and private sector) (see above I.3.1). Therefore, S&T projects need to be beneficial for general and long term trade and investment interests of the European Community in the ASEAN region.

Given the technological and competitive strengths of Singapore, however, the criterion of mutual benefit, can be applied there with more obvious and direct business benefits for the European Community. But even in Singapore we would advise the Commission of the European Communities against a too short term view on the mutual benefits and to carefully assess in its future S&T cooperation with Singapore the position of Japan and the United States.

I.3.3. CONTINUOUSLY FOLLOWING S&T DEVELOPMENT IN ASEAN COUNTRIES

The S&T situation in the ASEAN countries is changing continuously. The SAST project "Needs and Possibilities for Cooperation between Advanced Developing Countries and the Community in the Field of Science and Technology" was timely. During the research, we were confronted with important S&T plans that were either in process of development or under discussion within the Government (this was the case in Thailand and Malaysia). As far as we can judge from the scanty information at our disposal now, the adoption and implementation of these plans will bring about a tremendous change in the S&T institutional and incentive system in these countries. This creates important new opportunities for mutually beneficial S&T cooperation with the EC, which when timely seized, will give new impetus to the presence of the European Community in these countries and in the ASEAN region.

One way of staying informed and of closely monitoring these new developments is evidently by pursuing the present SAST research on Thailand and Malaysia, and by organising a follow-up workshop with the participants of the AIT workshop of 7-8 June 1990, if possible also with key-persons from Singapore. Of course, the personal element plays a dominant role in the organisation of such workshops. We are convinced that most of the key-persons which participated at the workshop at AIT did so because they were either acquaintances, or were visited once or twice before the workshop.

The country information we acquired from the workshop "S&T Development in ASEAN Countries : Problems, Prospects, Scope for Cooperation with the EC" was abundant. The personal contacts with the S&T key-persons which participated at this workshop has to be considered by the European Commission as a first, though important investment. This investment, if maintained, warrants a network of information and expertise on S&T developments and scope for mutually beneficial S&T cooperation between the EC and the ASEAN countries

In the longer run, we strongly advise for co-financing S&T information systems both at the regional level (ASEAN) and within the ASEAN countries (see below).

I.3.4. BILATERAL OR REGIONAL COOPERATION ?

In many cases bilateral cooperation between the EC and ASEAN countries is better suited than regional EC-ASEAN cooperation. The benefits for both parties are much easier to determine and assess in the course of project formulation and negotiation in bilateral than in regional/multilateral cooperation projects. Moreover, in areas where no clear consensus was reached within ASEAN, or in projects with commercial or industrial impact, several ASEAN Committees will want to have their say, which in turn will further complicate decision making and repulse potential business interests in these projects.

From the point of view of the EC presence in the ASEAN region, it also is advisable to develop more bilateral cooperation links, since this enables the European Commission to counteract, balance or supplement where necessary the changing presence and cooperation strategies of other industrial countries and EC member countries, respectively. Moreover, developing bilateral cooperation would enable the EC to concentrate its actions on a few countries, like Thailand and Malaysia, according to the recent EC guidelines [22].

A drawback of traditional bilateral cooperation is insufficient finance and specialists in the donor country. This, evidently, does not apply to the European Community, although funds are insufficient. On the contrary, bilateral cooperation between the EC and individual ASEAN countries can pool more expertise than bilateral cooperation between an EC member country and an ASEAN country.

The above does not imply that regional EC-ASEAN cooperation should be dismantled. The importance for the ASEAN countries of regional EC-ASEAN cooperation (or Japan-ASEAN, US-ASEAN, etc. for that matter) is that in this way the dialogue partners are involved in a supplementary way in intra-ASEAN cooperation. It appears, however, that intra-ASEAN S&T cooperation in the past was weak and dominated by projects which were not directly related to the improvement of export oriented productive sectors. This, at first sight, makes regional EC-ASEAN S&T cooperation less suited for projects were the private sector on both sides would be involved (although in the future, a success of USAID PITO might well prove the opposite). Exceptions are, we think, in the field of S&T information networking and institution building, or standardisation, where scope for mutually benefical regional S&T cooperation exists (see below). Also cooperation in the field of trade and investment information for EC and ASEAN countries' business partners, though operating in the ASEAN countries, could best be implemented and coordinated at the regional level.

I.4. AREAS FOR FUTURE MUTUALLY BENEFICIAL S&T COOPERATION BETWEEN THE EC AND THE ASEAN COUNTRIES

We have identified a number of areas for future mutually beneficial S&T cooperation starting from the S&T needs and capabilities in the ASEAN countries as evidenced by the literature consulted, and by the communications of the S&T key- persons from the ASEAN countries participating at the abovementioned workshop (AIT, Bangkok, 7-8 June 1990).

I.4.1. EC-ASEAN INDUSTRIAL AND COMMERCIAL COOPERATION SERVICES

Our research of revealed comparative advantage of the ASEAN countries, combined with the excellent information contained in a former EC financed study on EC-ASEAN industrial cooperation, has identified a number of industrial activities in the ASEAN countries which offer promising prospects for joint ventures with EC companies.

We strongly recommend to set up a number of EC-ASEAN industrial and commercial cooperation services to facilitate and assist the creation of EC-ASEAN joint ventures, such as :

- an ASEAN-EC Development Corporation along similar lines as the ASEAN-Japan Development Corporation (see above), in order to co-finance EC-ASEAN joint ventures (unlike the Cheysson Facilities this ASEAN-EC Development Corporation itself would be a joint venture between the Commission of the European Communities, EC and ASEAN countries, and EC and ASEAN financial institutions),
- EC-ASEAN investment promotion and support services, which would give support to ASEAN for the preparation of profiles or opportunity pieces for specific investment opportunities, sponsor investment and trade missions, identify joint ventures and act as broker in this respect, etc. A joint EC-ASEAN project could best be formulated along the same lines as the USAID-ASEAN Private Investment and Trade Opportunities Project (PITO), the purpose of which is to develop investment promotion activities (aimed at drawing US investment into the region) in close consultation with public and private sector key-persons. The proposed EC-ASEAN investment promotion and support services could also be used in some countries (e.g. Thailand) as "trouble-shooters" in the often difficult relations between European investors and the local authorities (customs, Ministry of Employment, etc.).

- a database on EC-ASEAN industrial cooperation opportunities. The prospects for industrial cooperation with the ASEAN countries have to be updated regularly, and combined with company information of interested partners both in the EC and ASEAN, as well as with detailed information on trade and investment developments and regulations. The database should contain also information on R&D, technology transfer, etc. The information of this database should be disseminated in the EC and ASEAN business community. In the EC, the Euro Info Centres and the Business Cooperation Net are obvious candidates for this dissemination. Infringements upon intellectual property rights (counterfeiting of watch brands, casual wear brands, automobile parts and acccessories, music and video tapes, etc.) are, however, very common in ASEAN countries like Thailand, Malaysia, Indonesia and other countries, and are hampering industrial and commercial cooperation.

Promising signs, however, are appearing in Malaysia where the 1987 Copyright Act came into effect on 1 October 1990, leading already to some spectacular seizures of pirated cassettes distributors [31].

I.4.2. EC-ASEAN COOPERATION IN THE FIELD OF STANDARDISATION AND QUALITY ASSURANCE

This cooperation is a support service for EC-ASEAN commercial and industrial cooperation, though of a somewhat different kind as the services mentioned I.3.1. It consists of co-financing of industrial standards development, testing and calibration in ASEAN countries according to the EC regulations, the accreditation of ASEAN standards testing and calibration institutes, the training of manpower in testing and quality assurance, etc. This cooperation obviously has important spin- off effects on EC-ASEAN joint ventures or ASEAN subcontractors supplying the European business partner, and will stimulate and promote EC-ASEAN industrial and commercial cooperation.

I.4.3. COOPERATION IN THE FIELD OF HUMAN RESOURCES DEVELOPMENT

There exists an accute shortage of specific skills in the ASEAN countries, which constrains the potential for industrial cooperation. The EC should not only provide help by sponsoring training programs and workshops, but establish in the main ASEAN countries graduate engineering schools and/or vocational training institutes (between European universities and universities or other organisations in these ASEAN countries). The EC could act as a broker in establishing such schools by identifying interested universities in Europe, by soliciting and screening applications from the potential partners in the ASEAN countries, by sponsoring meetings bringing potential partner institutes together, and by providing part of the funds to help the establishment of the abovementioned schools and institutes.

Likewise, the EC could sponsor the training of personnel of EC-ASEAN joint ventures in the European parent company, and set up exchange programs between technical and academic institutions in the EC and ASEAN, in fields like engineering, electronics, marketing and management, etc.

The successful examples of Japanese cooperation in the field of human resources development with the ASEAN countries show an important mutually beneficial impact.

I.4.4. SUPPORT OF R&D ACTIVITIES

A special category of mutually beneficial S&T cooperation between the EC and ASEAN is the establishment of joint ventures in R&D and R&D consultancy, which should be stimulated and supported by the EC in the same way as industrial or commercial joint ventures (participation/loan from Cheysson Facilities or from the proposed ASEAN-EC Development Corporation). These joint R&D ventures could be located in ASEAN countries as well as in EC countries. In the latter case, they should become eligible for support under an EC or other European (or national) R&D program.

Special mention in this respect should be made of needs in the ASEAN countries of S&T management skills, i.e. in formulating, preparing, implementing and monitoring S&T projects that fit into the national S&T plan, or "package" a number of these projects as proposals for international cooperation and negotiate with international agencies (UNDP, UNIDO, ESCAP and others), regional organisations or countries. There exist potentials for mutually beneficial cooperation with the EC in this field. The establishment of an EC-ASEAN S&T Institute (as a regional EC- ASEAN cooperation project) could be envisaged. Such an institute could manage S&T information (see I.4.5) and provide S&T management support services and consultancy to national governments, research institutes, universities, joint R&D ventures, etc.

I.4.5. EC-ASEAN S&T INFORMATION SYSTEM

In many ASEAN countries, the government is engaged in the creation of a national S&T information system and databases. By supporting these initiatives, the EC could get access to important information (such as on the nodal points in the S&T planning and decision making system in the respective ASEAN countries, on R&D activities in universities, research institutes and private companies, on S&T incentives, on scientific publications, unpublished reports and abstracts, patents, human resources development, education and training needs, etc.), influence the structure of the information system and link it to European S&T information systems. For setting up future nutually beneficial S&T cooperation, this information is of crucial importance, since it reveals strengths and weaknesses in the respective national S&T, and creates mutual confidence in the process of negotiating, implementing and monitoring future S&T cooperation projects. It also will enable the EC to enter more quickly and better informed into multilateral S&T cooperation schemes with international agencies like UNIDO, UNDP, the World Bank or UN/ESCAP, or react to "package deals" of S&T cooperation (given the limited funds available to the EC, this cooperation with international agencies in normal or "packaged" proposals is advisable).

In order to secure the most information on S&T in the ASEAN countries, this S&T information network should be established using both regional EC-ASEAN and bilateral EC-ASEAN country S&T cooperation.

PART II : DECISION BASE

II.1. - COUNTRY OVERVIEWS

II.2. - EVALUATION OF COMMITMENT IN USING S&T DEVELOPMENT

II.3. - ORGANIZATIONAL INFRASTRUCTURE FOR USING S&T FOR DEVELOPMENT

II.4. - S&T HUMAN RESOURCES DEVELOPMENT

II.5. - TECHNOLOGY SUPPORT FACILITIES

II.6. - NATIONAL POLICIES INFLUENCING TECHNOLOGY IMPORTS AND INDIGENOUS TECHNOLOGY DEVELOPMENT

II.7. - INTERNATIONAL COOPERATION PROGRAMS IN THE ASEAN WITH EMPHASIS ON S&T

II.8. - SCOPE FOR COOPERATION BETWEEN EC AND ASEAN IN THE FIELD OF SCIENCE AND TECHNOLOGY

II.1. COUNTRY OVERVIEWS

It is often not possible to view the Science and Technology (S&T) development of a nation independently of historical and socioeconomic factors. The purpose of this chapter is to provide brief country overviews of the five ASEAN countries being studied so that the subsequent sections which deal explicitly with S&T issues could be reviewed against this background.

II.1.1. INDONESIA

II.1.1.1. Historical and geographical background

Known as one of the largest archipelagoes, lying between Asia and Australia, Indonesia has an area of 11,912,040 square kilometers comprising of 13,700 islands having a distance of 5,150 km from east to west and 1,770 km from north to south.

Indonesia has a population of about 170 million people concentrated on six main islands: Sumatra, Java, Bali, major part of Kalimantan (island formerly known as Borneo), Sulawesi and Irian Jaya (western part of Papua New Guinea). Java is the most important island for Indonesia in terms of population and other economic activities. The Indonesian capital, Jakarta is also located in Java. Indonesia, whose many parts lie just below the equator, has a tropical climate. The special feature of the archipelago is its many volcanoes, significant number of forests and mountains.

Indonesia could not avoid colonialism and was under Dutch rule for more than 350 years, followed by a Japanese invasion from 1942 to 1945. As a result of heavy pressure from nationalist organizations and world opinion, subsequently the country was able to emerge as an independent nation under the name of 'United States of Indonesia' which later became a unitary state called Republic of Indonesia in July 1976.

After a period of instability in 1966 an acting President was elected in 1967 by the then provisional People's Consultative Assembly. Later the post 'acting president' became President in 1968 and the first general election was held in 1971.

II.1.1.2. Description of government

The form of government in Indonesia is based on a 1945 constitution which vests the highest authority with the People's Consultative Assembly. The President, the House of People's Representatives, the Supreme Audit Board and the Supreme Court are provided for by the constitution.

Indonesia, being a unitary state has vested power in the People's Consultative Assembly which elects the President and the Vice-President and determines the "Guidelines of the State Policy" (GBHN). The assembly has 460 members representing functional groups and political parties elected for a period of five years.

The President who is also the Supreme Commander of the Armed Forces is in charge of administration of the state and is assisted by various ministers responsible for various functions. The decisions of the President has to be ratified by the Assembly.

II.1.1.3. Socioeconomic setting

The present population of 175.9 m people (1988) is expected to rise to 250 m by the year 2000, with the present growth rate of 2.3% per year. The population which is mostly young has a life expectancy of approximately 54 years for males and 55 years for females.

The Indonesian people can be divided into 300 ethnic groups with about 365 languages and dialects. While Bhasa Indonesia is the national language, English is used as a second language. Other languages such as Arabic, Chinese, Dutch and many other dialects are also used by the people belonging to the Chinese, Arab, Eurasian and Indian as well as Pakistani groups living in the country. Islam has been the main religion in the country for about 90% of the people with the rest belonging to the Christian, Hindu and Buddhist faiths.

Indonesia has taken several measures to try to develop a robust and well balanced economy using her five-year development plans known as PELITA's.

II.1.1.4. Brief description of resource endowments

Indonesia is endowed with many kinds of minerals. Petroleum, natural gas, asphalt, coal, bauxite, gold and silver, manganese, nickel, ironsands, copper-ore and tin contribute to about 57% of the foreign exchange earnings followed by about 10% from the export of forest products. The desire for the diversification of mineral exports has led to efforts in prospecting for and locating other mineral resources of commercial value.

Agriculture has been a very important sector in the country even though only 8% of the total land area is used for this. However, the importance of the agricultural sector differs from region to region. On the other hand, the country has a coast line of about 54,700 kilometers which indicates that there exists a great potential for exploiting aquatic resources.

The Indonesian National Plan (PELITA IV) planned many activities for implementation in the area of development of natural resources and environment. Now the present plan (PELITA V, 1989-1994) emphasizes the need to meet basic needs, increasing the role of the industrial sector, improvement in efficiency and the mobilization of financial resources, and the improvement of the export sector.

II.1.1.5. History of science and technology and research and development

The first known reference to formal science and technology planning dates back to 1778 in Indonesia with the founding of the "Batavia Society of Arts and Sciences" - a private organization - which was involved in promoting research in trade and agricultural development. However, this organization later began to focus more on the subject of

sociology. Based on considerations of location and endowments of Indonesia, initially the Government placed emphasis on biological and geological research. The establishment of the famous Botanical Gardens in Bogor in 1817 was a result of this emphasis.

As research work progressed, the need for an organization for the promotion of and coordination of scientific research was fulfilled by the National Science Council for the Netherlands Indies in 1928. This was followed by the establishment of the Organization for Scientific Research in 1948. However from the point of view of S&T development, Indonesia had to face several problems after the transfer of sovereignity in 1949 because of the leaving of Dutch scientists and hence Indonesia had to find ways to overcome these difficulties. Although ambitious Five-Year-Plans were drawn up to cope up with the situation it was only during the Third Five Year Plan that science and technology development was considered in detail. This plan emphasized science and technology, giving priority to their application in the agricultural, industrial and mining sectors. Also the enhancement of S&T educational programs were focused here. After this, PELITA IV, and V have given considerable emphasis for S&T development.

Universities and various other R&D institutions in both private and public sectors, are conducting R&D work enhanced by the reorganization of the work in various ministries most of which have their own R&D agency or center. Also, non-ministerial agencies are involved in R&D work.

To cope up with the increasing need for R&D, a research center for science and technology equipped with all the laboratory and other facilities is being constructed in Serpong in the vicinity of Jakarta, with the intention of naming it a 'Science Town'.

In promoting R&D work, the Minister of State for Research and Technology has special functions in preparing, coordinating and operating activities with all the agencies involved in such work. The ministry has an advisory body consisting of professionals in science and technology from universities and R&D agencies. Considering the major role that it has to play in S&T development a Presidential Decree promoted it to be the National Research Council in July, 1984.

II.1.2. MALAYSIA

II.1.2.1. Historical and geographical background

Recorded history shows the evidence of the existence of Peninsular Malaysia from the 14th century onwards. The country by the name of Malacca which was an important port was captured by the Portuguese in 1511 thus marking the beginning of the European invasion into Peninsula Malaya. They were followed by the Dutch in 1641, the British in 1824 and the Japanese in 1941. As a result of nationalist movements, Peninsular Malaya gained independence on 31st August 1957.

Malaysia was formed on 16th September 1963 with the inclusion of Sabah, Sarawak and Singapore. Singapore later withdrew itself from this federation in 1965.

Bordered by Thailand to the North and across the Straits of Johore by Singapore to the south, the narrow straits of Malacca to the east and the China sea to the east, the country

consists of 13 states and has an area of 330,424 square kilometers with Peninsular Malaysia covering 131,577, Sarawak 124,449 and Sabah 74,398 sq.km, respectively. Malaysia is a multiracial country with a population of 17 million people (1988) belonging to all races.

II.1.2.2. Description of government system

Malaysia has two distinct houses of Parliament known as the Senate and the House of Representatives. The Senate consists of 68 members who hold office for 6 years while the House of Representatives has 154 members elected by the people.

The supreme Head-of-State is a constitutional monarch who is elected for a period of 5 years. He is in charge of appointing judges of the Federal Court and High Courts and is also the Head of Religion.

Various ministries implement government policies and are manned by officers who are recruited largely by the Public Service Commission - an independent body.

II.1.2.3. Socioeconomic setting

Malaysia is currently implementing an Economic Plan with a five-year-planning horizon and has objectives based on better distribution of income, wealth and employment.

After Malaysia gained independence, she has shown 3 distinct phases of development;

Phase 1: 1960-1970
During this phase, development was based mainly on the export of rubber and tin while encouraging economic diversification resulting in an annual growth rate of about 5.2%.

Phase 2: 1970-1980
This phase witnessed a high growth rate of 8% and a trade surplus which was created through high commodity prices, increase in export of petroleum and manufactured goods.

Phase 3: 1980-1990
During this phase, world recession affected Malaysia and forced her to face unfavourable conditions in the trading of primary products. The growth rate fell down to 6.4%, and Malaysia had to take important steps to make the management of economic resources efficient through the introduction of various policies and encouragement of exports. Several measures to curb increasing government expenditure were also taken. Increased involvement of the private sector in economic activities was actively coordinated and facilitated by the government. As a result, Malaysia has shown a real GDP growth rate of 8.7% in 1988.

II.1.2.4. Brief description of resource endowments

The abundance of rainfall in Malaysia has facilitated forest based activities which provides her with timber as an important export item. Also, abundant rain has resulted in the generation of electricity based on hydropower.

The fisheries industry of Malaysia has access to 1,122,300 sq. km of coastal waters which is expected to provide about 1.18 m tones annually through the establishment of various aquaculture projects.

Malaysia's major minerals are tin, petroleum, bauxite, iron ore and copper concentrates. Being the largest tin producer of the world, Malaysia earns a substantial amount of foreign currency by exporting this mineral. In addition, China clay, gold, tungsten, manganese, ferromanganese, barites as well as a few other by-product beach minerals are also available in the country.

Malaysia had as at 1982, gas reserves amounting to 39 trillion cubic feet and has thus become a very important source of world gas reserves. Research indicates a future potential of another 25 trillion cubic feet on a 50% probability basis.

Besides these resources, Malaysia has traditionally been an agricultural producer, mainly in rubber and palm oil. Coconut, rice, tobacco, and pepper are also agricultural products produced by Malaysia.

II.1.2.5. History of science and technology and research and development

Malaysia recognizes education as a key factor for facilitating S&T development and has thus given emphasis to the training of people in science and technology.

The establishment of the Ministry of Science, Technology and Environment was a positive move made by the government a direct result of which was the establishment of the National Council for Scientific Research and Development. Other agencies such as the National Institute of Scientific and Industrial Research, the Standards Institute of Malaysia and the Chemistry Department were set up under the ministry. To accelerate industrial development and facilitate the production of quality goods, the Standard Institute of Malaysia and the National Institute of Scientific and Industrial Research were merged by the government in 1975.

The Tun Dr. Ismail Atomic Research Center is functioning under the Prime Minister's Department and is looking into the possibilities of the development of the full potential of nuclear science.

The history of R&D in Malaysia views the establishment of the Forest Research Institute as far back as 1879 as an early commitment to R&D. Institutes such as the Institute of Medical Research and the Rubber Research Institute were established in 1901 and 1925 respectively. Research which examined the possibilities of the efficient utilization of and exploration of resources gained gradual importance due to the fact that the Malaysian economy was heavily dependent on the export of rubber and tin. This situation forced the

country to think in terms of the diversification of the economy. The Malaysian Agricultural Research and Development Institute (MARDI) started conducting research especially in palm oil which resulted in the establishment of the Palm Oil Research Institute of Malaysia (PORIM). In the 1970s, with the new Economic Policy, more scientific and technological research activities were commenced covering many diverse fields in industry and agriculture.

II.1.3. PHILIPPINES

II.1.3.1. Historical and geographical background

The country is situated southeast of the Asian mainland almost to the south of the Japanese Islands and to the north of Borneo and Celebes, and consists of more than 7,000 islands and islets.

The Philippines was colonized by Spain for 333 years (1565-1898) which contributed a great deal to the development of the country in many ways. Until the Spanish-American War in 1898-1899, Spain influenced the Philippines in all its activities. The American triumph in this war led to American rule in the country. After a period of Japanese occupation as a result of the Pacific War in 1941, the Philippines gained independence on 4th July 1946. The country has an area of 299,998 square kilometers in size and a population of 58.7 million people.

II.1.3.2. Description of government

In 1973 when the old constitution lapsed into history, the present system of government based on the Presidential system came into practice. The President who is the Chief of State as well as the Head of the Government is elected by the people at a national election. However, in April 1981, constitutional amendments were brought forward for a French-Style parliamentary government in which a president is elected for a period of 6 years.

II.1.3.3. Socioeconomic setting

Philippines's population of 58.7 million people (1988) fall mostly in the age range of 15 to 16 years. Its labor force in 1988 was estimated to be 23.5 million people, which is growing at the rate of 2.5 % per annum. The country's economy is mainly based on agriculture. At present the country is undergoing several problems based on unemployment, high external debt and high internal debt. As a result of efforts taken to boost the economic situation of the country, the Philippines experienced a growth rate of 5% in 1987 and 4.6% in 1988.

Policies such as maintenance of price subsidies and land reform have contributed to the development of agricultural sector, while encouragement of foreign investment and industrial promotion through incentives have enhanced the development of the industrial sector.

II.1.3.4. Brief description of resource endowments

The Philippines is richly endowed with several types of mineral and other resources. The country has minerals such as gold, iron, and copper in varied quantity and quality spread out over the islands in the archipelago. The iron ore found in the central part is comparable to the best of its kind in the world, and is abundantly available. Deposits of copper, which are mainly concentrated in the mountain province and Camarines Norte areas, are considered to be extensive. Chrome deposits found in Zambales are regarded to be among the largest in the world. In addition, silver, lead, zinc, natural asphalt, bitumens, sulphur, marble and large deposits of nickel have been found in the country in several places in varying quantities and qualities.

II.1.3.5. History of science and technology (S&T) and research and development

There has been a concern in this regard from very early periods in the country dating back to the 1900s. The 1935 Constitution had indicated the need for policy initiatives to promote scientific research and invention. However, until recent years, S&T efforts were largely concentrated only on R&D and that too with limited success. More specific S&T promotion activities were later taken by the country through initiatives such as the Republic Act No 2067 "Science Act" which ultimately led to the establishment of the National Science Development Board to facilitate the intensification of scientific and technological activities.

From 1960 onwards, the government started giving greater impetus to S&T by establishing research institutes, science foundations and initiating programs for training scientists and engineers. More funding mechanisms and related efforts were also initiated in the seventies to facilitate effective use of S&T in national development.

II.1.4. SINGAPORE

II.1.4.1. Historical and geographical background

Located between Indonesia and the southern most part of the Malaysian Peninsula, Singapore has been a center of attraction for many years. The island's length and breadth is only 42 km from west to east and 23 km from north to south respectively. Singapore covers a total land area of 636 sq.km which includes the area of approximately 60 islets.

The country is a multiracial one. 75.9% of its 2.6 million (1988) population are Chinese while Malays, Indians and other ethnic groups account for 15.2, 6.5 and 2.4 percent respectively. English is the most widely used language although there are four official languages in the country namely, Malay, Chinese, Tamil and English.

Singapore was part of the British Strait Settlements and later became a crown colony in 1867. After a period of British and Japanese administration, Singapore became a separate Crown Colony on April 1, 1946. A merger of Malaya, Singapore, Sabah and Sarawak in

1963 resulted in the formation of Malaysia. However, Singapore opted out of this merger in 1965 to become a separate nation known as the Republic of Singapore.

II.1.4.2. Brief description of the government

Singapore, a republic, follows a parliamentary system of government having a President as Head of State. The President is elected by parliament for a term of four years. The President appoints a Prime Minister who has political power and also advises the President in appointing the cabinet. Parliament which has 81 members elected by the people is the highest legislative authority which can enact and amend laws as necessary in accordance with the provisions in the constitution.

A system of group representation constituency with an intention of catering to the multi-racial community is in practice for the selection of MPs to parliament.

II.1.4.3. Socioeconomic setting

After successfully reducing the high unemployment rate which prevailed in the country after 1959 through an industrialization program, Singapore started an export oriented manufacturing industry in 1960s which proved to be successful in attracting foreign investment. In the 1970's and 1980's, the country adapted an economic restructuring program to avoid problems such as labor shortages, increasing competition and protectionism. Knowledge intensive industries were given priority to labour intensive ones. As a result of these measures during 1960-1984 Singapore experienced sustained economic growth with an average GDP growth rate of 9% during this period. After successfully tackling the recession in 1985-1986, Singapore was able to achieve a growth rate of 11% in 1988.

The island is regarded as a free port and as a point of free trade. This has contributed substantially to the Singaporean economy thereby making the country one of the 20 richest countries in the world. Singapore had a per capita income of S$ 16,000 in 1988. The four main sectors on which the Singapore economy is based are manufacturing, financial services, commerce, transport and communications. The manufacturing sector contributed to approximately 4.5% of her overall growth in 1988. This was followed by contributions of 2.6% and 2.2% by commerce and finance respectively. Singapore is also an important tourist destination and one of the world's largest petroleum centers. In addition Singapore is regarded as one of the world's busiest ports.

II.1.4.4. Brief description of resource endowment

Singapore's location connecting the East-West trading routes, its political stability, high quality infrastructure, and dedicated work force are the resources she has got. Other than these, she has no natural resources and hence depends heavily on the global market for her own resource requirements.

II.1.4.5. History of science and technology and research and development

A Ministry that was created in 1960s for science and technology was dissolved in 1981 and subsequently the creation of the Science Council took over the task of promoting national science and technological capabilities. The Council is under the Ministry of Trade and Industry.

Singapore's limited resource base constrained the carrying out of basic research except some in the universities. However, after her program on economic restructuring in 1979, industries requiring an S&T research base especially in areas such as microelectronics, automation and robotics, information and computer technology, and biotechnology are being actively encouraged.

II.1.5. THAILAND

II.1.5.1. Historical and geographical background

Thailand has an area of 514,000 square kilometers in size, approximately the same size as France. The country is situated in the Indo-Chinese Peninsula bordered by Burma, Laos, Cambodia, Malaysia, the Gulf of Thailand and Andaman sea. The country has a population of about 54.6 million people (1988) out of which about 7 million are concentrated in the capital city, Bangkok.

II.1.5.2. Description of government

Unlike many other Asian countries, Thailand did not experience colonialism. The country is governed by a constitutional monarchy.

The idea of democracy was introduced to the country through various education and communication activities. The popularization of this concept resulted in a peaceful change of the political system in 1932 from the traditional absolute to a constitutional monarchy.

Thailand has had several kings who were involved in the development of the country in all its spheres. The present monarch, His Majesty the King (Bhumibol Adulyadej) Rama IX is a leader whom the people accept with great regard and respect. The sovereignity derived from the people is exercised by the King through the National Assembly which represents the ministers and courts. The cabinet in which all the ministers are represented and chaired by the Prime Minister administers and legislates the executive power at the national level.

II.1.5.3. Socioeconomic setting

The economy of Thailand is still based on agriculture. About 80 percent of the country's 29.7 million (1988) labour force is engaged in agriculture and rice is a major export crop. When the country started emphasizing industrialization in the 1970s, the share of agriculture in Gross Domestic Product (GDP) started to decline even though its absolute magnitude has continued to rise.

According to the International Monetary Fund Plan (under the Sixth National Economic and Social Development Plan) the GDP growth rate of the country is expected to rise to 9 percent in 1992, up from 7.1 percent in 1987.

The country's GDP per capita has continued to rise as the average national income reached US$ 1,000 level in 1988, up from US$ 900 in 1987 and US$790 in 1986. The average real GDP growth rate on 1988 showed a rate of 5.4%. The labor force has also increased over the years to 29.7 million in 1988, up from 29.1 and 28 million in 1987 and 1986 respectively.

II.1.5.4. Brief description of resource endowments

Of Thailand's total area of 514,000 km^2, about 159,340 km^2 (31%) is under forest land while 195,320 km^2 (38%) go as farm holdings. Paddy land accounts for a major portion of farm land with its share being over 60 percent or about 117,192 km^2. The most fertile land is in the Chao Phraya River basin. The average annual rainfall is over 1,000 mm.
The important mineral resources of Thailand are tin, tungsten, rock salt, lignite, fluorite and gemstones. Thailand has one of the world's largest deposits of potash. Natural gas has also been discovered in the Gulf of Thailand. One of the greatest potential sources of energy is sunlight which Thailand has all the year round.

II.1.5.5. History of science and technology and research and development

Thailand is regarded as the first country in Southeast Asia to apply S&T for commercial purposes though its development was limited. This is possibly because Thailand did not see the importance of having scientific excellence or the need did not arise for S&T for the survival of the production system. On the other hand, the pattern of the establishment of production activities is widely regarded as having ignored local S&T.

A gradual realization of the importance of S&T to economic growth led to several S&T related initiatives during the last two decades. For instance in 1974, the National Economic and Social Development Board (NESDB) set up a sub-committee comprising of 22 members selected from various government agencies and the private sector to develop a plan for development and utilization of science and technology. While the attempt of this committee to implement this plan, through the Fourth Five Year National Economic and Social Development Plan, did not succeed, it nevertheless led to the establishment of a Technology and Environment Planning Division, in 1975, in the NESDB.

This was followed by the establishment of the Ministry of Science, Technology and Energy (MOSTE) in 1979. The Ministry is responsible for developing policies and plans to effectively use S&T for economic development and growth. The Fifth Five Year Plan (1982-1986) and the Sixth Five Year Plan (1987-1991) have increasingly emphasized the importance of S&T and the Sixth Plan has as one of its components an S&T plan. At present the NESDB is working on the Seventh Five Year Plan for the period 1992-1996. To facilitate the incorporation of pragmatic and effective measures to use S&T for development in this plan, the MOSTE is currently working on the development of a long-term S&T policy and a 20 year (1992-2011) S&T master plan. This exercise is being carried out by MOSTE in close consultation with both public and private sectors.

II.1.6. EVOLUTION OF THE ASEAN ECONOMIES

The Association of South East Asian Nations (ASEAN) came into being on August 8, 1967. The ASEAN consists of six countries namely Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand. Of these Singapore has already reached Newly Industrialising Country (NIC) status. Table 1. gives some relevant socioeconomic statistics of these countries.

The functions and powers of ASEAN as an institution are rather limited in scope and subject to the principle of consensus with regard to decision-making. This implies that the powers of the Association tend to be confined to the promotion of voluntary coordination of efforts.

In this sub-section it is proposed to examine important aspects of the ASEAN economy in two areas namely trade patterns and foreign direct investment.

II.1.6.1. Trade Patterns in ASEAN

Table 2 presents the trading performance of five of the six ASEAN countries. Table 3 presents some of the major exports and imports of these countries. Table 4 presents a summary of the import/export ratios of these countries in items categorized as follows:

Food Items	(SITC 0,1,4)
Raw Materials	(SITC 2,3)
Processed Materials	(SITC 5,6)
Machinery & Equipment	(SITC 7)
Other Manufactured Goods	(SITC 8)

An examination of the figures in Table 4 shows that the ASEAN countries are heavily dependent on imports for capital goods and processed materials which are likely to be technology intensive. They are however net exporters of low and medium technology content goods such as food items and raw materials and more recently other manufactured goods. Table 5 shows the major trading partners of the ASEAN countries.

In a recent study, Cuyvers [24] has looked at the technology intensity of ASEAN exports and imports. Based on an OECD classification using the SITC (rev. 2) he categorizes technology intensive products into two groups as follows:
High R&D intensive goods:

SITC	54:	Medicinal and pharmaceutical products
	75:	Office machines and ADP equipment
	76:	Telecommunication, sound recording and reproducing equipment
	77:	Electrical machinery, appliances and parts
	792:	Aircraft and associated equipment, and parts
	87:	Professional, scientific and controlling instruments
	88:	Photographic apparatus, optical goods, watches etc.

Medium R&D intensive goods:

SITC	334:	Petroleum products, refined
	51:	Organic chemicals
	52:	Inorganic chemicals
	56:	Fertilisers, manufactured
	58:	Artificial resins and plastic materials etc.
	59:	Chemical materials and products n.e.s
	62:	Rubber manufactures n.e.s
	69:	Manufactures of metal n.e.s
	7:	Machinery and transport equipment (except 75, 76, 77, 792).

Based on this classification he has shown that in 1986, the trade of ASEAN countries in technology intensive goods (in millions of US$) is as shown in Table 6.

TABLE 6 : Exports and imports of technology-intensive goods of Asean countries, 1986 (million US $)

	Exports	Imports	Balance
High R&D intensive goods			
- Thailand	850.5	1,739.6	-889.1
- Malaysia	3,187.7	3,461.3	-273.6
- Singapore	7,417.3	7,289.1	+128.3
- Indonesia	48.7	1,243.6	-1,194.9
- Philippines	394.4	529.0	-134.6
High and medium R&D intensive goods			
- Thailand	1,273.3	4,802.3	-3,529.0
- Malaysia	4,200.9	6,930.7	-2,729.8
- Singapore	15,069.3	13,433.8	+1,635.5
- Indonesia	941.7	6,867.3	-5,925.6
- Philippines	731.1	1,774.4	-1,043.4

From these figures it appears that only Singapore is a net exporter of technology-intensive goods. If the balance of trade in technology intensive goods can be used as an indicator of technological development then Singapore appears to be the most technologically advanced nation in the ASEAN. However, it must be noted that negative trade balances in technology-intensive goods could also be due to a national strategy which relies on imports of technology-intensive goods in the short-term.

Some of the important high R&D intensive products exported by Malaysia, Philippines, Singapore and Thailand are as follows:

Malaysia	-	electrical machinery, telecommunication and sound equipment
Philippines	-	electrical machinery
Singapore	-	electrical machinery, office machines, ADP equipment, telecommunication and sound equipment
Thailand	-	electrical machinery

Some of the important medium R&D intensive products exported by these countries are as follows:

Malaysia	-	refined petroleum products
Philippines	-	manufactured fertilisers, organic chemicals, refined petroleum products, power generating equipment
Singapore	-	refined petroleum products
Thailand	-	rubber manufactures, plastic materials

When the share of technology-intensive goods in the imports of ASEAN countries are examined, the study by Cuyvers shows the following pattern (Table 7).

TABLE 7 : Share of technology-intensive imports of Asean countries, 1983-1986 (percentage)

	1983	1986
High R&D intensive goods		
- Thailand	12.8	19.0
- Malaysia	23.1	32.0
- Singapore	19.9	28.6
- Indonesia	9.9	11.6
- Philippines	8.7	9.8
High and medium R&D intensive goods		
- Thailand	50.5	52.6
- Malaysia	62.9	64.1
- Singapore	46.7	52.7
- Indonesia	69.9	64.1
- Philippines	38.9	32.9

These figures indicate that Indonesia ranks highest as dependent on technology-intensive goods followed by Malaysia and Singapore. Thailand and the Philippines come next. The main technology-intensive imports of these countries are as follows:

Indonesia: electrical machinery, machines for special industries, road vehicles, power generating equipment, organic chemicals, plastic materials, refined petroleum products

Malaysia: electrical machinery, telecommunication and sound equipment, refined petroleum products

Philippines: electrical machinery

Singapore: electrical machinery, telecommunication and sound equipment, refined petroleum products

Thailand: electrical machinery, organic chemicals, machines for special industries, road vehicles, refined petroleum products

It is interesting to note that these countries while exporting technology-intensive products in a certain category are also dependent on imports for specific products in the same category. However it would be unwise to draw conclusions on this phenomenon without examining the trends of this dependency pattern over time and national policies governing such imports.

Cuyvers has also, in his study, examined the revealed comparative advantage (RCA) of ASEAN countries in the production of technology intensive goods. The RCA index in a measure which illustrates in what way and to what extent, the share of a product in the total exports of a specific country is higher than the share of this product in total world exports. Thus, for a particular item if the RCA index is above 100% then the country has a comparative advantage towards the rest of the world in this particular item. An RCA index less than 100 indicates lack of comparative advantage. However an RCA index less than 100 but increasing rapidly with time can indicate improving comparative advantage.

The study indicates the following with respect to the comparative advantage of the ASEAN countries in technology-intensive products.

- In general ASEAN countries have a comparative advantage only in some specific technology-intensive goods.

- A number of ASEAN countries have a revealed comparative advantage in similar technology intensive goods such as office machines, computers, telecommunication and sound equipment, electrical machines (Thailand, Singapore, Philippines and Malaysia). Singapore and Indonesia have comparative advantages in oil refining, Indonesia and Philippines in manufactured fertilizers and Malaysia and Singapore in ship-building.

- Only Thailand seems to have a comparative advantage in the production of rubber manufactures.

- The comparative advantage of ASEAN countries is increasing in some goods such as chemicals (Singapore, Malaysia, Thailand), oil refining and manufactured fertilizers (Malaysia) and ship and boat building (Thailand).

- Some of the ASEAN countries have also lost comparative advantage in certain categories of products. For instance Thailand and Singapore have lost comparative advantage in medical and pharmaceutical products.

The major conclusions that can be drawn regarding the trade patterns of ASEAN countries is that they are still dependent on imports for high technology content products. However, over recent years they appear to have gained comparative advantage in the production and export of some technology-intensive products. This may be due to the dominance of multinational companies in the ASEAN region in the production and export of technology-intensive goods. For instance all of these countries have a comparative advantage in electrical machinery exports. This includes integrated circuits, switch boards etc. which are being produced mainly by multinationals.

Potential areas for EC-ASEAN cooperation in industry could be the areas where the ASEAN countries are having a revealed comparative advantage or in areas where the comparative advantage is improving with time. In this context it may be useful to note the powerful trading alliance (Table 5) that Japan and the USA have formed with the ASEAN countries.

II.1.6.2. Foreign Direct Investment in the ASEAN Region

Table 8 shows the pattern of foreign investment in ASEAN. Tables 9-13 indicate the investment commitments made in the ASEAN countries in 1986. While this data is not current it nevertheless indicates the range of countries involved in the ASEAN investment scene.

It can be seen from Table 8 that from 1984 Japan's share of investment in ASEAN continued to increase steadily until 1988 when there was a drop. However, as indicated in the separate detailed study on Thailand, Japanese investment in Thailand increased substantially in 1988. It can also be seen that the US presence in the ASEAN investment scene has been steadily deteriorating while the NIC's (Taiwan, Hong Kong and Republic of Korea) are increasing their investments in ASEAN. Thus the EC will have to compete with Japan and the NIC's to invest in the ASEAN region. Japanese investment in ASEAN may also be facilitated by the entry of Japanese venture-capital industry into the ASEAN scene. One such organization is the Japan ASEAN Investment Co. (JAIC) which aims at helping to recycle Japan's current-account surplus by encouraging portfolio investment in unquoted stocks of small companies in ASEAN countries. For this purpose JAIC has raised US$270 million.

A further entrant in the ASEAN investment scene may be the USSR which is inviting ASEAN private sector firms to invest in the USSR while at the same time showing interest in investing in ASEAN. For instance the USSR has expressed interest in joint ventures in Thailand's eastern seaboard development projects [7].

II.2. EVALUATION OF COMMITMENT IN USING S&T FOR DEVELOPMENT

It is generally accepted that unless there is strong political commitment at the national level in using S&T for economic development, it would be very difficult to embark on a program of sustained upgradation of national S&T capabilities. The purpose of this section is to indicate the level and type commitment that can be perceived in each of the ASEAN countries.

II.2.1. INDONESIA

The basic framework of the overall development efforts of Indonesia is laid down in the "Guidelines of the State Policy (GBHN)" which is formulated by the Peoples Consultative Assembly (MPR). The GBHN is reviewed every five years and is used as the guidance for the five year development plans (PELITA).

GBHN is thus considered to be the highest level of legal devices in the development policy of Indonesia. The importance of science and technology is well recognized within the framework of the national development of Indonesia and it has a dual status. On the one hand, it is viewed as the means to accelerate national development while on the other, science and technology development is one of the objectives of national development programmes.

Other legal devices in the form of national laws, Presidential Decrees, and government regulations at ministerial level have been issued to direct the implementation of science and technology as well as the development of the science and technology capability of the nation. The establishment of the Office of the Minister of State for Research in 1973 (which later became Minister of State for Research and Technology in 1978) was intended to coordinate and promote further the role of S&T in national development. Other commitments have been made through the establishment of R&D institutions under non-ministerial agencies, ministerial institutes and also universities.

The recognition of the role of scientists and technologists in all aspects of development activities have become more explicit since the beginning of PELITA I. At the highest level it is reflected by the involvement of scientists and technologists in the executive government body as ministers and other high ranking officials. Think-tank groups, comprising of interdisciplinary scholars have been set up to help the government in making and implementing policies for national development.

Indonesia still finds it difficult to meet the demand for highly qualified capable scientists and technologists. This has led to a situation where capable scientists and technologists in the government sector are becoming overburdened with various administrative tasks. In R&D centers, which are mostly government institutes, it is rather difficult to recruit young bright university graduates. However, the government has taken steps to encourage more young scientists and technologists to join the R&D and education sectors.

Some of the steps which have been taken in this regard are as follows:

(a) Implementation of a career development scheme in the structure of the government official system. The government introduces career development through the measurement of achievement within the functional ladder system. In this scheme, it is possible for scientists/technologists to achieve higher ranking exceeding the rank of the top manager of the organization where he/she works. In parallel with the functional ladder system, additional incentives on top of the regular salary as a government official are also given.

(b) Providing opportunities for further studies at in post-graduate level. Facilities have been provided to send young scientists and technologists who are working in R&D institutions or universities to develop their skill and knowledge through training or post-graduate study in local or foreign universities.

The important role of the mass media in promoting and popularizing a technology culture in Indonesia is well recognized. The wide range of technologies being used in Indonesia is a reflection of the large differences in the technology culture of Indonesia . Therefore, in promoting and popularizing a technology culture the mass media is trying to develop a range of appropriate materials to be communicated most effectively to selected target audiences. Issues such as efficiency, productivity, conservation, added value, new techniques etc., are among the messages being covered in these communication materials. The electronic media has been growing very fast since the mid-seventies. The introduction of the communication satellite PALAPA has made all parts of Indonesia open to television broadcast. The establishment of TV broadcast stations in several regions has improved the effectiveness of this task since those stations can be more specific in broadcasting programs appropriate to the local needs. Radio broadcasting systems are also used extensively for similar purposes.

Printed material is the other mass medium being used extensively to promote and popularize a technology culture. A movement called "newspaper going to village" is a policy that has been introduced by the government to promote modernization at village level. This material that is published regularly contains information for practical mass education as well as other information. The involvement of publishers to publish more books in science and technology is another step that has been taken by the Government.

II.2.2. MALAYSIA

At a policy level, the Ministry of Science, Technology and Environment stresses the need to achieve self-reliance in technology. It is however emphasized that this does not mean shutting Malaysia's doors to imported technology but it implies that the technological capability in identifying, selecting, transferring and absorbing imported technology, and local R&D efforts be viewed against this guiding principle.

To facilitate inflow of technology and to upgrade the technology capability of local entrepreneurs, the following measures have been taken:

(i) The enactment of the Patents Act of 1983 to protect intellectual property ;

(ii) The establishment of the Standards and Industrial Research Institute of Malaysia (SIRIM) to assist local industry in upgrading their technical expertise ;

(iii) The establishment of a Technology Information Center to keep industry informed of the latest production technologies and alternative technologies available ;

(iv) The formation of the government-owned Heavy Industries Corporation of Malaysia Ltd. (HIKUM) to act as a catalyst to stimulate heavy capital-based industries in the country and as a channel to encourage the inflow of high technology into the country. The national car industry called Automobile National Sdn. Bhd. (the Proton Saga) was set up by HIKUM. It is envisaged that the spin-off effects due to such large scale high-tech ventures will be the establishment of a group of small and medium scale industries that will supply high-tech precision products and auxiliary services to these large scale ventures.

(v) The establishment of the Malaysia Institute of Microelectronic Systems (MIMOS) in 1985 to facilitate software design and computer applications.

(vi) The establishment of the coordinating Council for Technology Transfer at the end of 1986.

(vii) The establishment of a Technology Transfer Center in SIRIM to provide information extension services and assistance in foreign technology patent evaluation.

(viii) Preparation of plans to set up a national center for computer aided design (CAD) and computer aided manufacturing (CAM).

(ix) The establishment of a Technology Park in 1988. This is expected to help build the mechanisms for the growth of high-tech industries in the country.

(x) The formulation of an Action Plan for Industrial Technology Development in May 1990 to facilitate the development of indigenous technological capabilities with a view towards making effective use of existing and new technologies both imported and domestic, in support of industrialisation in particular, and economic growth and development in general, for Malaysia.

The organization that provides for the participation of scientists and technologists in the governmental decision making process is the National Council for Scientific Research and Development, the Secretariat of which is located within the Ministry of Science, Technology and the Environment. The Chairman of the Council is the Chief Secretary to the government who is directly responsible to the Prime Minister and the Cabinet. The members of the Council are appointed from various scientific disciplines by the Minister of Science, Technology and the Environment for a period of 2 years to provide adequate representation of all sciences. Broadly, its objectives are to ensure that scientific research activities are geared to national development needs and the achievement of established goals. Its function is to advise the government on all scientific and technological matters and to coordinate all scientific and research activities within the country.

There is also a strong commitment by the government to invite scientists and technologists to contribute their ideas and views related to technology based development programs. The involvement of a large number of scientists and technologists in the formulation of the Industrial Master Plan and Technology Development Plan is perhaps the most striking example in this regard.

Apart from formal organizations such as research councils and research committees in research institutions, the opinion of scientific and technological personnel from within and

outside the government sector are always sought by the government where a decision on a subject involving technical aspects has to be made. Usually these consultations are done by calling the relevant scientific and technological experts for a meeting or by writing to them for comments and observations. The Ministry of Science, Technology and Environment coordinates meetings of scientists to discuss bilateral scientific and technological cooperation, international cooperation in science and technology including regional cooperation in science and technology such as ASEAN - COST and also discussions on the establishment of necessary science and technology infrastructure.

The role played by the mass media in the dissemination of technology information is not clearcut and is determined by the policy of the individual newspapers and magazines. The radio and television stations which are owned and operated by the government to a certain extent do feature programmes on technology, especially programmes geared towards supplying information on the use of modern technology in the agriculture sector. Though newspapers do carry articles on technology from time to time, there appears to be no sustained effort to promote or popularize a technological culture.

The above mentioned strategies and activities are likely to be strengthened as a result of the Action Plan for Industrial Technology Development. The major areas of thrust as envisaged by this Action Plan are indicated below in summary form.

- Provide leadership to strengthen the institutional and support infrastructure for rapid and realistic industrial technology development

  - establish a cabinet committee on science and technology
  - strengthen the ministry of science, technology and the environment
  - coordinate R&D programmes in science and technology
  - establish an advisory council on science and technology
  - establish a national science and technology intelligence and information system
  - target gross national R&D expenditure levels of 1.5 percent of GDP by 1995, 2 percent of GDP by 2000, with at least 60 percent from the private sector
  - increase R&D expenditure levels in industrial technology
  - institute five-year budgeting procedures for R&D programmes
  - implement a system of contract research for R&D
  - target self-financing for all industrial R&D institutes of 30 percent by 1995, 60 percent by 2000
  - launch a commercialisation of technology (COT) initiative

- Ensure widespread diffusion and application of technology, leading to enhanced market-driven R&D to adapt and improve technologies

  - promote private sector industry research consortia
  - embark on National Awareness Programmes to institutionalise quality and design in Malaysian industrial culture
  - set up regional quality centres, and a national centre for product design and development
  - establish a technical committee to enhance capabilities of the engineering and technical services sector
  - enhance the Industrial Technical Assistance Fund
  - judicious use of public procurement policy to stimulate innovation and product development
  - consolidate vendor/purchaser procurement linkages
  - enhance industrial R&D incentives

  - improve access to the system of R&D incentives
  - implement the 67 product group action profiles in the nine key industry sectors

- Build competence for specialisation in the key emerging technologies

  - designate key emerging technologies as priority areas for new R&D
  - priorities research to ensure focus and maximum pay-off
  - encourage formation of New Technology-Based firms
  - set up national focal points for the key emerging technologies
  - ensure exposure to international developments and cross-fertilisation of ideas and techniques

- Strengthen institutions and mechanisms for continual development and elevation of the technological proficiency of the ultimate resource

  - establish a skills development fund
  - enhance the system of certification and classification of technical skills
  - upgrade skills base in technical subjects through adult and continuing education programmes
  - improve industries' involvement in course design and curriculum review
  - ensure that graduates acquire skills relevant to needs
  - institutionalise linkages for industrial training between industry and universities/training institutes
  - enhance role of tertiary institutions in advanced technology research and innovation
  - tertiary institutions to participate fully in all proposed technology parks and innovation centres

- Increase S&T awareness and appreciation of society to provide the most conductive climate possible for invention, innovation, and technological advancement

  - elevate S&T awareness and appreciation at all levels of government
  - inculcate S&T culture in the education system
  - use mass media to heighten S&T awareness and appreciation
  - expand the "S&T week"; create a science centre of international standard
  - encourage professional and science-oriented societies
  - encourage guilds for technical sub-professionals
  - support Yayasan Rekacipta Malaysia
  - strengthen the system for management of intellectual property rights, patents advice and similar services

II.2.3. PHILIPPINES

In the Philippines, recognition of the role of S&T in national development is embodied in a Constitutional provision. In addition, an entire chapter (Chapter 8) of the Five-Year (1983-1987) Philippine Development Plan (PDP) is devoted to science and technology. The statement of basic policy reads: "As a general policy, science and technological development programs shall be integrated into the overall national development effort". Towards the attainment of the country's twin objectives of increasing national productivity and world competitiveness and improving the quality of life of the Filipino people:

> "..... efforts shall be directed at the efficient and effective application and utilization of available technologies".

"The concern for self-reliance and countrywide development in support of balanced agro-industrial development will permeate all S&T efforts in every sector. The philosophy that science and technology shall be one of the major tools in bringing about economic recovery and progress shall be a guiding principle in every S&T effort."

The PDP's chapter 8 discusses the objectives and the major programs of science and technology for each identified area/sector (e.g., agriculture and natural resources, industry and energy), the policies and strategies involved, and the functional structures and linkages for implementing the plans and programs.

To ensure that proper attention is given to S&T development, the national planning development arm of the government for S&T, the National Science Development Board (NSDB), was reorganized into the National Science and Technology Authority (NSTA) in 1982. The NSTA has much broader powers that the NSDB, and in pursuit of its mission it has formulated a comprehensive National Science and Technology Plan in 1983. This plan places emphasis on mission-oriented technology development which would be guided by the following principles:

- full-cycle - starting from identification of requirements up to utilization of the technology that has been developed;

- main thrust toward applied research and development-oriented programs balanced with adequate levels of support to basic research;

- emphasis on locally-developed technology, with sufficient provisions for the verification and adaptation of appropriate foreign technology which are vital to national interest;

- proper consideration given to available resources and potential as well as opportunities on both domestic and international fronts; and

- strengthened interface of science and industry, i.e., between government R&D groups (technology suppliers) and private industry (technology users).

Scientists and technologists, while accorded respect and recognition, do not, in general, enjoy a favorable standing in the Philippines. Recognition of this fact is discernible from explicit provisions in existing S&T development plans to develop "a more hospitable environment for science and science workers". Studies carried out have shown that Ph.D. holders do not devote a major portion of their time to their areas of specialization. Also, the brain-drain problem has persisted in the Philippines for decades. These occurrences point to the relative unattractiveness of the science profession in the Philippines, and while no figures are readily available, it is often and assumed the decisive factor is financial remuneration in most cases.

As to the status of scientists and technologists in governmental decision-making, science has been allotted a cabinet seat in the Philippines. This cabinet post, in combination with the NSTA's system of sectoral councils, wherein deputy ministries of concerned ministries (e.g., agriculture, natural resources, health) sit on R&D policy-making bodies together with scientists and private-sector representatives, provides a means for R&D interests to be represented in governmental decision-making.

In the 1980's the government began to utilize the mass media for propagating science consciousness among the populace. Examples are NSTA's radio and TV spots on the

importance of science and technology and on appropriate technologies as well as an hour-long, weekly program highlighting specific technological innovations/improvements, usually in small community-based or village-level types of technologies which emphasize increased-income opportunities.

II.2.4. SINGAPORE

Since 1979, the Government of Singapore has placed emphasis on technology as a tool to support and enhance economic and industrial growth. It recognizes the fact that Singapore must keep abreast of the rapid advances in new technologies and move into the new high-tech industries as they are the growth areas of the future. It is recognized that to continue depending solely on traditional industries, such as oil-refining and, shipbuilding and repair, which had been the growth industries of the late 1960's and 1970's, would undermine the economic advances achieved so far.

To succeed through the effective deployment of high technology, Singapore has formulated an R&D policy to upgrade technological competence. The goals of its high-technology policy are to :

- encourage all industries both local and foreign owned, to exploit and apply new advances in technology as widely as possible;

- develop competence in selected new technologies whose future importance is clear, and where it has a comparative advantage; and

- move into high technology industries as one area of growth.

The goals of Singapore's R&D policy as spelt out in the 1986 'Report of the Economic Committee' are:

- to improve product design and development capabilities: These cover mainly established industries, e.g. consumer electronics and automation equipment; and

- to develop competence in technologies relevant to economic growth: These include both established industries, e.g. electronics and chemicals, as well as targeted new industries such as biotechnology and electro-optics.

The Singapore Science Park is expected to prove an ideal environment for R&D activities and its proximity to the National University of Singapore is expected to foster greater university- industry interaction which could facilitate the achievement of the above goals.

The government has several promotional and publicity programs aimed at increasing public and industry awareness of S&T as a means for enhancing economic development. The "Technology Month" organized by the Science Council of Singapore is such an effort. In addition it is intended to inculcate an interest in and stimulate development of relevant emerging technologies. During the Technology Month, activities such as open houses, conferences and exhibitions are held to enable the public and industry obtain better insights into selected technologies. Such activities are also carried out by the Singapore Science Center (SSC), the National Computer Board (NCB) and Singapore Telecom in areas of technology coming under their purview.

II.2.5. THAILAND

The recognition of the role of technology for national development can be traced back to the reign of King Rama IV, 120 years ago. During the reigns of King Rama V and King Rama VI, new inventions were brought in from western countries, Moreover, more people who graduated from abroad worked for the government, the result of which was that the importance of technology became more widely recognized. When foreign trade was interrupted during World War II and imported goods became scarce, attempts were made to manufacture products for which there was a demand. The importance of technology became evident at this stage.

The role of the government in the promotion of science and technology was first mentioned in the 1984 Constitution, Article 65, which stated that "the state should encourage research in arts and sciences". The same statement was repeated in Article 61 of the 1968 Constitution which stated that "...the state should encourage research in arts and sciences and promote the application of science and technology for national development...". The Second National Economic and Social Development Plan and the subsequent plans stressed the need for promotion of science and technology. In the Fifth Plan (1982-1986), a whole chapter was devoted to the utilization and development of science and technology while the Sixth Plan (1987-1991) has a companion S&T plan. Also at present the Ministry of Science, Technology and Energy is working on the development of a long-term S&T Policy and Master Plan (1992-2011).

In Thailand two styles of technology development are seen as appropriate. These are: (1) the development of cost-effective, market-oriented local technology; and (2) the importation and assimilation of technology developed elsewhere - especially from the developed world - to facilitate rapid industrial development. These considerations are expected to guide the formulation of Thailand's science and technology policies.

In the past, as in many other Asian countries, scientists and technologists in Thailand had a very limited voice in government decision-making. However over the last decade several scientists and technologists, with outstanding records, have been appointed to key positions in government as technocrats, advisors and even as ministers. The Ministry of Science, Technology and Energy utilizes the S&T community to formulate policies and also to formulate S&T development plans for incorporation into the National Economic and Social Development Plans.

However, the status of scientists and technologists in the civil services is still vague because they are placed under rigid regulations of bureaucracy with low pay. Thus, they are lured into the private sector or multinational corporations where salaries are much higher. Besides, there is a great disparity in advancement between scientists and government officials in other fields. Therefore, scientists transfer to administrative positions in order to seek advancement. This deprives the nation of scarce S&T manpower which could be put to more effective use in S&T development.

Although the mass media in Thailand covers the whole country it still devotes most of its time and space to entertainment and state news propagation. While S&T oriented programs and news are propagated occasionally, the use of the mass media in popularizing a technology culture has still not received the attention that it should. Lack of adequate and well trained personnel to develop S&T information for laymen is considered to be one of the biggest barriers that will have to be overcome if the mass media is to launch a concerted effort to propagate a technology culture.

II.3. ORGANIZATIONAL INFRASTRUCTURE FOR USING S&T FOR DEVELOPMENT

The purpose of this section is to briefly outline the organizational infrastructure currently existing in the ASEAN countries to facilitate the effective use of S&T for development. The activities of some of the specialized agencies involved in such endeavours are also described briefly.

II.3.1. INDONESIA

In 1973, the Office of the Minister of State for Research was established to assist the President in the formulation of policies, and in the direction and coordination of research activities. The Minister also assisted the President in the implementation of policies on Science and Technology. In 1978, the status and name of the office of this Minister, were upgraded, and it became known as the Office of the Minister of State for Research and Technology. The Minister has been given the task of coordinating all science and technology activities in Indonesia conducted by the government institutions as well as by the private sector.

Presidential Decree No. 28 of 1978 further clarifies the functions of the Minister of State for Research and Technology: These include the following:

a. To formulate all government policies on research and in the development and application of research and technology to support the planning and implementation of national development plans and programme;

b. To coordinate and secure the cooperation of all research and technology activities of different government agencies;

c. To coordinate the operational activities of LIPI, BATAN, BAKOSURTANAL, LAPAN, and BPS in the field of research and technology according to the procedures set by the Minister of State for Research and Technology;

d. To submit reports, information and advice on his responsibility to the President.

The Minister was also assisted by a team of experts, formerly called PEPUNAS RISTEK. The team carried out the following major tasks:

a. Formulating important national programmes on R&D;

b. Evaluating ongoing R&D programmes;

c. Identifying priority areas in research and development.

On 7 January 1984, the "PEPUNAS RISTEK" was promoted by Presidential Decrees to become the "National Research Council" (DRN), to assist the Minister of State for Research and Technology in the execution of his tasks. The Minister himself acts as the Chairman of the Council, and is assisted by the Chairman of LIPI as Vice-Chairman, while one of the Assistants to the Minister acts as the Secretary-General of the Council. It is hoped that by

the establishment of DRN, the coordination and integration of activities among the various institutions could be carried out more effectively.

A step forward in the creation of a more conducive atmosphere for coordination and integration, and at the same time also for sharing the existing resources between the most important laboratories, is considered to be the establishment of the Science and Technology Centre (PUSPITEK) in Serpong, near Jakarta. PUSPITEK is intended to develop as a science city of Indonesia, for more effective coordination and integration of relevant R&D activities under different sectors.

To develop Science and Technology in pursuance of the national goals of development, Indonesia has been participating in international cooperation schemes through bilateral and multilateral agreements. Indonesia has bilateral cooperative arrangements in science and technology with, among others, USA, France, FRG, the Netherlands, Japan, Canada, Australia, Belgium, USSR and Yugoslavia. Multilateral Cooperation has been conducted through the United Nations agencies, or through other channels, such as ASEAN, EEC, International Finance Corporation, etc. International, inter-regional, regional and sub-regional types of cooperation have been developed not only to increase needed capital investment and transfer of know-how and technology but they are also aimed indirectly at enhancing export potential as well as general social-economic benefits. The latter is concerned with areas which would generally not benefit from cooperation such as rural and inter-island transportation improvement, etc.

Some of the specialized agencies which assist the Ministry of State for Research and Technology in carrying out technology-based activities are as follows.

(i) The National Development Planning Agency (BAPPENAS)

This organization is the major institute which is responsible for the preparation of Indonesia's Five-Year Development Plans-REPELITA. BAPPENAS acts as the central planning and coordinating agency with ministries, departments and other agencies in accomplishing this task.

(ii) Indonesian Institute of Sciences (LIPI)

LIPI is a Government body which provides guidance in the field of scientific and technological research. It reports directly to the President of the Republic of Indonesia. The creation of LIPI was to obtain higher efficiency and effectiveness in carrying out scientific and technological research for the welfare of mankind in general and for the welfare of the nation in particular.

(iii) The Investment Coordinating Board (BKPM)

BKPM is responsible for approval of foreign investment. All intended capital investment should go through this Board. In assisting the President to decide government policies with respect to investment, in processing investment approvals and licenses, and in supervising investment implementation, BKPM performs the following functions:

a. To formulate investment policy to be considered and approved by the President;

b. To coordinate investment planning both sectorally and regionally and to develop it into a master plan within the framework of Foreign Investment Law as well as other regulations;

c. To compile and to prepare an Investment Priority List on a regular basis jointly with the ministries/government agencies which shall serve the development of investment sectors;

d. To submit the Investment Priority List to the President for approval through a Presidential Decree;

e. To direct distribution of investment activities to provinces in accordance with development policy;

f. To provide information as widely as possible concerning investment projects;

g. To establish effective communications with investors in particular and business circles in general;

h. To provide guidance and counselling in the implementation of investment projects;

i. To screen and evaluate investment applications in accordance with applicable investment policies and regulations;

j. To submit the results of the evaluation of foreign investment applications to the President for approval;

k. To approve domestic investment applications, on behalf of the Government of the Republic of Indonesia;

l. To issue licenses and permits for investment implementation on behalf of and under the authority given by the ministry under which the investment is made;

m. To render services required to ensure the smooth implementation of investment projects;

n. To supervise the implementation of investment projects already approved by the government under collaboration with the Regional Investment Coordinating Board (BKPMD) and other concerned ministries/agencies.

(iv) Agency for the Assessment and Application of Technology (BPPM)

Established in 1978 by Presidential Decree Number 25 and then reorganized by Presidential Decree Number 31 of 1982, BPPT has the tasks of advising the President in matters relating to national policy with respect to the development and application of technology for national development; coordinating implementation of technology development programmes; and providing advisory and consulting services to government agencies and to the private sector. BPPT is also expected to identify technologies appropriate to Indonesian conditions and facilitate their possible application in industry.

(v) The Department of Industry

This is organized into four main branches namely basic metal industry, basic chemical industry, multifarious industry and small industry. In addition to these, an agency for Industrial Research and Development and a center for Industrial Education and Training are within the Department.

The Department provides assistance in the form of finance and operates nine major industries research institutes and nine small regional industrial research institutes.

(vi) National Agency for Export Development (NAFED)

This agency which was created in 1971 comes under the Ministry of Trade and performs the following functions:

a. Providing information and guidance to the business community about ways and possibilities of marketing Indonesian products abroad.

b. Providing information about Indonesian exports to importers from abroad.

c. Assisting and coordinating with the government in achieving export targets.

d. Upgrading the abilities of businessmen and exporters in handling and managing international trade opportunities.

II.3.2. MALAYSIA

The Ministry of Science, Technology and the Environment was established in 1976 and given the role of planning, coordination and development of all activities related to science and technology. It is also entrusted with the design and development of a National Science and Technology Policy. Essentially, the objectives of the Ministry are:

(i) to develop and to promote the expansion of science and technology with the aim of improving quality of life;

(ii) to formulate, plan, implement and ensure that the extensive application of science and technology does not give rise to adverse effects but will sustain a prosperous and peaceful nation;

(iii) to ensure that material development through science and technology does not pollute the environment and destroy wildlife and plants;

(iv) to integrate physical development, through science and technology, with human and individual development in order to reduce undesirable conflicts and stresses that may arise from environmental and technological changes.

The Ministry of Science. Technology and the Environment also functions as a centre for coordinating international relations in science and technology activities. It is the focal point for the United Nations Conference for Science and Technology for Development, the Asean Committee on Science and Technology and is a member of the National UNESCO Board and the Commonwealth Science Council. Though bilateral and international cooperation falls

under the jurisdiction of the Economic Planning Unit of the Prime Minister's Department and the Ministry of Foreign Affairs, any offers of training fellowships and scientific and technological cooperation are referred to the Ministry of Science, Technology and the Environment. Therefore, the Ministry acts as a focal point where such offers are coordinated and directed to relevant R&D institutions.

The Ministry is assisted by the National Council for Scientific Research and Development in planning for science and technology development. The Council advises the Ministry on matters relating to science and technology infrastructure development, research priorities, science and technology planning and currrent problems in science and technology activities in the country. Due to the diverse nature of science and technology which involves many ministries, current issues of science and technology development are brought by the Minister of Science, Technology and the Environment to the Cabinet for coordinated implementation. The Ministry is also represented on the Council for Coordinating Industrial Technology Transfer and is also on other technical committees which are established from time to time by other ministries.

Other specialized agencies which play a key role in technology-based activities are as follows.

(a) The National Council for Scientific Research and Development

The National Council for Scientific Research and Development was established in 1975. Its general objectives are to ensure that scientific research activities are geared to national development needs and goals and its function is to advise government on all scientific and technological matters and to coordinate scientific and research activities within the country.

The functions of the Council are as follows:

(i) to be responsible for the formulation of science policy of the nation and undertake an innovative role in relation to science for the progress and modernisation of society;

(ii) to serve as the national scientific consultative and advisory body of the government;

(iii) to identify R&D activities required to meet national development objectives;

(iv) to initiate and coordinate R&D activities of the nation and to ensure maximum utilisation of resources;

(v) to develop the country's manpower potential for R&D activities;

(vi) to collect and collate information on R&D, evaluate, publish and disseminate documents related to R&D

(vii) to promote interaction in R&D between the private and public sectors;

(viii) to recommend appropriate legislation for promoting R&D activities;

(ix) to undertake all other actions or measures that will provide speedy and effective scientific research and development in the country.

The members of the Council are appointed by the Minister of Science, Technology and the Environment and each serves a term of 2 years. Council members are scientists from various academic and research institutions. The committees are the:

(i) Agricultural Sciences Committee;

(ii) Industrial Sciences Committee;

(iii) Marine Sciences Committee; and

(iv) Medical Sciences Committee.

The Chairmen for the various committees are appointed from among members of the Council for a term of two years, subject to renewal for another two terms. The committees report to the Council which normally meets once in every two months.

The activities of the Council are coordinated by a Secretariat which also coordinates the activities of the various committees, subcommittes, working groups and expert groups that are established from time to time. The Secretariat to the Council comes under the jurisdiction of the Minister of Science, Technology and the Environment.

(b) The Technology Transfer Centre

In 1974, the Coordinating Council for the Development of Small Scale Industries proposed to the National Planning Council to set up an institutional mechanism for the development and promotion of technology transfer.

A feasibility study was then carried out with assistance from a group of experts from Germany. The recommendations of the study included merging the Malaysian Industrial Development Authority (MIDA) with the Standards Industrial Research Institute of Malaysia (SIRIM) to form the National Technology Transfer Centre.

However, it was found that the recommendations were not practical because it would involve major organisational changes. Also since the technology transfer function involves various ministries, it might involve the reallocation of responsibilites among the various agencies involved in technology transfer and some of these institutions would have had to be phased out.

Therefore, the Coordinating Council for Industrial Technology Transfer was created and SIRIM was appointed the Secretariat to the Council. Though SIRIM was not officially designated as the National Technology Transfer Centre, the facilities and infrastructure existing in SIRIM and various activities and programmes implemented by SIRIM are aimed to facilitate the transfer of technology from this institute to technology users.

SIRIM performs a dual function as follows:

(i) it is the guardian of Malaysian standards and certifies the quality of goods produced in Malaysia or imported goods which satisfy a Malaysian or a foreign standard adopted by Malaysia;

(ii) It is a centre for Technology Transfer supported by activities of its various divisions such as:

(a) the Industrial Research Division;
(b) the Industrial Consultancy and Industrial Liason Division;
(c) the Metal Industries Technology Transfer Centre and the Metal Research and Development Centre.

The technology transfer arm of the institute that links the technical services offered by SIRIM to industries is the Industrial Consultancy Division. This Division provides consultancy or extension services to individual entrepreneurs who require technical assistance from SIRIM in solving technical and other production problems. This unit also accepts orders to produce low-cost machinery and equipment which it specifically designs. The main target group of this unit is the small and medium scale entrepreneurs from whom it receives nearly 100 requests annually. Apart from direct consultations with the entrepreneurs, this unit also screens information on technology trends and publishes regular reports on new technologies and discoveries.

The unit also conducts state-of-the-art surveys of the technologies used in various industries in the country. The Metal Industry Technology Transfer Centre (MITEC) is a joint project between the Japanese International Cooperation Agency (JICA) and the Malaysian Government. This centre offers testing services and fabrication and design consultancy services to the metal industries, welding, electroplating, press die making and presswork. It also fabricates prototype jigs and dies and performs trial runs to determine durability. MITEC also conducts about 70 courses per year to upgrade the skills of metal workers. The Metal Industry Research Development Centre specialises in mould and die making and also in the fabrication and design of moulds and dies. It also conducts courses and training programmes for metal workers in the country.

As a result of increasing demand from the small and medium scale entrepreneurs for the services of the two centres, SIRIM is planning the establishment of a foundry centre, plastic centre, electro and electronic centre and ceramics and glass centres. There are also plans for a Industrial Design Centre and additional infrastructures to support its training facilities.

(c) Board of Investment

The Malaysian Industrial Development Authority (MIDA) is entrusted with the coordination of all industrial development activities in Malaysia. MIDA was established as the Federal Industrial Development Authority (FIDA). To project the Malaysian image at international levels, it was renamed MIDA in 1979. The main functions are to promote and coordinate industrial development in Malaysia and to advise the Minister of Trade and Industries on the formulation of policies relating to industrial development. For that purpose the Authority may:

(i) Undertake economic feasibility studies of industrial possibilities;

(ii) Undertake industrial promotion work in Malaysia or abroad;

(iii) Facilitate the exchange of information and coordination among institutions engaged in or connected with industrial development;

(iv) Recommend policy on industrial site development and where it deems fit, to undertake the development of such sites;

(v) Evaluate applications for project proposals;

(vi) Advise the government on measures for the protection and promotion of industries including tariff adjustments and import and export licencing;

(vii) Report annually to the Minister on problems of industrialisation in Malaysia and make recommendations on the manner in which such problems may be dealt with.

MIDA operates both within Malaysia and abroad with eight regional offices in Malaysia and 15 overseas centres in New York, Chicago, Los Angeles, Toronto, Sydney, Panama, London, Paris, Cologne, Bonn, Hong King, Tokyo, Osaka, Seoul and Singapore. The principal role of MIDA is to advice the Minister of Trade and Industry on the formulation and implementation of various industrial development policies and strategies, incentives for industry and other facilities required for accelerated industrial development. This agency also handles all enquiries from potential investors in the manufacturing sector. It advises entrepreneurs, both Malaysian and foreign, on the feasibility of and the technicalities involved in locating industrial projects in Malaysia and provides follow-up assistance where necessary. MIDA also evaluates applications for manufacturing licenses, incentives, tariff protection and import duty exemptions.

(d) Technology Transfer Unit in the Ministry of Trade

Prior to the establishment of the Investment Incentive Act in 1968, firms had to submit manufacturing agreements to the Bank Negara according to the Foreign Exchange Control Act to receive approval for any remittance of royalty payments abroad. No screening of agreements was done at that time as the prime concern of the bank was only the amount of money remitted.

In 1975 the Industrial Coordination Act was introduced and enforced in May 1976, requiring all enterprises employing 25 or more full-time workers and have a shareholder fund equal to or in excess of M $ 250,000 to apply for a manufacturing licence. One of the conditions for the granting of the licence was that firms must not enter into any subsequent agreement such as technical know-how agreements without prior written approval of Ministry of Trade and Industry. In May 1976, the Technology Transfer Unit was set up in the Ministry of Trade and Industry for the purpose of screening these agreements.

The TTU screens all agreements which have been signed by any company licensed under the Industrial Coordination Act which includes agreements for trademarks, marketing, technical assistance and agreements for joint ventures, restructuring, amalgamations and mergers, etc.

The rationale behind the setting up of TTU was that industrial development depends largely on foreign know-how and technology and that the government therefore has to encourage the inflow of foreign investment and expertise. Therefore, there is a need to regulate the transfer of technology to overcome the problem of Malaysia's possible over-dependence on foreign multinationals and take steps to increase the capability of the industrial sector to develop domestic technology. The strategy adopted by the government is aimed at balancing the efforts made to encourage foreign investment with the need to regulate imported technologies.

To maintain this balance and to assist technology users of the country, the TTU makes available a checklist to Malaysian industrialists for the purpose of negotiating technology licence agreements and provides information on the necessary basic steps involved in negotiating licence agreements. These steps are:

(i) Collection of economic data on the proposed project (details on required inputs and patents, etc.);

(ii) Evaluation of available alternate technologies;

(iii) Evaluation of licensor's position with respect to other possible licensors and an assessment of the licensor's experience.

(e) Export Promotion

The Malaysian Export Trade Centre or MEXPO of the International Trade Division of Ministry of Trade and Industry was established in January 1980. The essential objective of MEXPO is to boost the export of manufactured goods by providing services to Malaysian businessmen and exporters who wish to know more about market conditions, coverages and locating foreign buyers who are interested in exploring Malaysian market for supplies.

Services that are provided by MEXPO include:

(i) Providing trade information on overseas markets such as commercial and economics data, statistics and trends, pertinent legislation in the commercial fields, GSP rules, market studies on products, country information etc.;

(ii) Answering market enquiries on Malaysian made products received directly from importers or through Malaysian Trade Commissioners' Offices located in major cities overseas;

(iii) Maintaining an importers' register listing names and addresses of useful contacts overseas;

(iv) Providing space both at MEXPO and in some Trade Commissioners' Offices abroad where space is available for display of Malaysian products;

(v) Organising seminars on trade opportunities and other aspects of trade in the overseas market for the benefit of Malaysian exporters;

(vi) Publishing booklets, pamphlets and brochures on country surveys, market and product surveys, businessmen's guides and other trade literature on a regular basis for distribution to Malaysian exporters.

II.3.3. PHILIPPINES

The Executive Order No. 784, issued in March 1982, transformed the National Science Development Board (organized in 1958) into the National Science and Technology Authority (NSTA). The NSTA is required to:

(i) Formulate and submit to the President, for his approval, a comprehensive National Plan for Science and Technology, including specific goals, policies, plans, programmes and projects;

(ii) Promote, assist and where appropriate, undertake scientific and technological research and development and towards this end, provide direction to and promote cooperation in the scientific and technological activities of the public and private sectors;

(iii) Promote the development of indigenous technology and the adaptation of foreign technology for domestic use;

(iv) Prepare and submit to the Office of the Budget and Management, the annual national budgetary requirements of the Authority and its agencies and coordinate funding and implementation of the Comprehensive National Plan for Science and Technology;

(v) Develop and implement a national delivery system for the effective and efficient utilization of the results of scientific and technological R&D;

(vi) Encourage and facilitate the active participation of the private sector in scientific and technological activities;

(vii) In cooperation with other concerned agencies, develop and implement a national programme for strengthening scientific and technological capabilities through accelerated training and development of manpower and building up of appropriate infrastructure and institutions;

(viii) Develop and maintain a national information bank of science and technology for use by both public and private sectors; and

(ix) Promote public consciousness of science and technology.

Executive Order 784 also provided for a more extensive and coordinated network of sectoral S&T councils, implementing research institutions, and support agencies.

Other specialized agencies which are of importance to S&T development in the Philippines are as follows.

(a) Technology Transfer Board

The Technology Transfer Board is an interagency body composed of representatives, with a rank not lower than bureau director, from the following agencies:

- Ministry of Trade and Industry (Chairman)
- National Economic and Development Authority
- Board of Investment
- National Science and Technology Authority
- Philippine Patent Office
- Technology Resource Center
- Central Bank in the Philippines

The Board was established to regulate the flow of technology into the country and to regulate the outflow of foreign exchange related to the acquisition of technology. Its functions are:

(i) To formulate policies, including a system of priorities which will promote an integrated approach to the developmental and regulatory roles of the government in the field of technology transfer;

(ii) To issue rules and regulations for the effective, efficient, and economic implementation of policies and guidelines pertaining to technology transfer;

(iii) To establish a system for coordinating all government activities on technology transfer and ensure continuing and meaningful interaction among various government agencies, particularly with respect to the determination of the impact of technology transfer on national development;

(iv) To serve as a forum for the continuing interchange of ideas and information among the concerned government agencies, the private sector, and the general public on policy issues, problems, and alternative approaches relating to technology transfer; and

(v) To perform other functions as may be necessary for the accomplishment of its objectives.

(b) Board of Investment

The Board of Investment is composed of five full-time governors appointed by the President of the Philippines. The Minister of Industry is the Chairman of the Board. The Vice-Chairman of the Board, who is appointed by the President, is its Managing Head.

The Board is responsible for the regulation and promotion of investments in the Philippines. Its powers and duties are as follows:

(i) To prepare annually the Investment Priorities Plan which contains a listing of specific activities that can qualify for incentives under the Investments Code, duly supported by the studies of existing and prospective demands for such products and services in the light of the level and structure of income, production, trade, prices, and relevant economic and technical factors of the regions;

(ii) To promulgate such rules and regulations as may be necessary to implement the intent and provisions of the Investments Code;

(iii) After due hearing, to decide on controversies concerning the implementation of the Investments Code that may arise between registered enterprises or investors therein and government agencies;

(iv) To process and approve applications for registration under the Investments Code;

(v) To recommend to the Commissioner of Immigration and Deportation, the entry into the Philippines for employment of foreign nationals;

(vi) To periodically check and verify the proportion of participating Philippine nationals in a registered enterprise to ascertain compliance with requirements;

(vii) To periodically check and verify compliance by registered enterprises with the provisions of the Investments Code;

(viii) To formulate and implement nationalization programs for certain industries whose operations may result in dislocation, overcrowding, or inefficient use of resources, thus impeding economic growth;

(ix) To regulate the making of investments and the conduct of business within the Philippines by foreigners or business organizations owned in whole or in part by foreigners;

(x) In general, to exercise all the powers necessary or incidental to the attainment of the purposes of the Investments Code and other laws vesting additional functions on the board.

(c) Ministry of Trade and Industry (MTI)

The MTI is the chief planning, programming, administrative, and policy-making instrumentality of the government for the development, expansion, and diversification of industry and trade. Its main objectives are:

(i) To propel trade as an engine of growth that will link all sectors of economic activity;

(ii) To enhance the image of Philippine industry and entrepreneurship, both here and abroad, through the development of quality products and services;

(iii) To strengthen relationships with members of the international community of nations through mutually beneficial trading partnerships; and

(iv) To contribute significantly to the social and economic upliftment of the Filipino people by providing essential services as well as stimulating utilization of available resources in order to increase output and thereby improve economic well-being.

II.3.4. SINGAPORE

The Science Council of Singapore promotes science and technology, particularly the growth of the technology-based innovation process in Singapore from basic and applied research to product/process development and industrial applications. It achieves this mainly through the administration and promotion of the Singapore Science Park and the Research and Development Assistance Scheme (RDAS)

The Singapore Science Park was established as a focal point for industrial R&D-oriented activities. Since the Park's opening in 1984, a total of 50 R&D related organisations with a staff strength of more than 2,000 have been admitted. Although currently only in its first phase of development, the Park has succeeded in attracting firms engaged in a broad spectrum of technologies, including biotechnology/biomedical sciences; computer and information technology (IT), agrotechnology, microelectronics, marine technology and chemical/petrochemical technology.
The RDAS is a grant scheme for the support of R&D projects. Introduced in 1981, the first phase of the scheme which ended in 1988 has committed a sum of S$ 43 million for 35 biomedical, and 37 engineering and physical sciences projects. Another S$ 50 million has been allocated for the next five-years under the second phase of the scheme which commenced in 1989. To encourage greater private sector initiative, the second phase no

longer supports purely public sector projects but will continue to fund private-public sector collaborations and purely private-sector R&D projects.

The Council has continued through the years to maintain its formal as well as informal contacts with scientific and technological organisations of other countries around the world. This is achieved through its involvement in the various international and regional programmes, bilateral cooperation programmes and exchange schemes. Among some of programmes which are administered by the Council include the ASEAN Committee on Science and Technology (COST) and the International Atomic Energy Agency (IAEA). The Council's participation in these international and regional activities has over the years facilitated personal and institutional contacts with international scientific research establishments and R&D oriented organisations in countries such as USA, Sweden, UK, Japan, Australia and the EC countries. International cooperation with these countries has been recognised as vital in the provision of overseas expertise and technical assistance for the development of Singapore's scientific and technological resources.

Some of the specialized agencies whose functions and activities influence technological choice and development in Singapore are as follows.

(a) National University of Singapore (NUS)

NUS is committed to producing quality graduate manpower and fostering a strong research culture. As such, research is given top priority in the university. Staff research in the various disciplines is funded under the University's operating budget as well as through Government and other sources such as the Science Council's RDAS.

In response to the country's emphasis on high technology as a tool to achieve economic growth, the University has stepped up research in the Faculties of Engineering, Science and Medicine. Inter-disciplinary research is actively encouraged as it helps to bring the relevant disciplines together to enable pooling of expertise and resources. The NUS has also set up the Institute of Molecular and Cell Biology (IMCB) and the Institute of System Science

(i) Institute of Molecular and Cell Biology (IMCB)

The University's IMCB was set up to strengthen the infrastructure for basic biomedical and biotechnological research. The Institute undertakes basic and innovative research in molecular and cell biology. It also trains the necessary R&D manpower in molecular and cell biology as well as in relevant areas in the biological sciences. About 20 doctorate students are admitted each year to the Institute. Three broad areas have been identified for research namely, cell regulation, infectious and genetic diseases, and plant genetic engineering. In addition, it provides the necessary infrastructure to support and assist industries keen to set up biotechnology operations in Singapore.

(ii) Institute of Systems Science (ISS)

The ISS was set up in 1981 as a specialised institute of the NUS under a four-year partnership programme with IBM Singapore Pte Ltd to assist in training computer professionals at postgraduate level. It also conducts short courses and seminars to upgrade computer literacy. The Institute has become the focal point for advanced computer training and applications research. The Institute's Research Division aims to enhance the environment for applied research, develop the necessary skill base

and enable the transfer of R&D knowledge, tools and techniques to the information technology industry. The ISS focuses on areas such as multi-media systems, parallel processing and optical storage technology.

(b) Nanyang Technogical Institute (NTI)

The NTI provides higher training and conducts research in various branches of engineering and technology. The establishment of the Institute arose from the need of a larger enrolment in engineering courses at university level to meet the demands of economic restructuring. Emphasis is placed on the conduct of applied R&D projects which have direct relevance and application to industries.
To forge better institute-industry relations, an Innovation Centre was set up as a catalyst for innovative ideas from or for industry which could be developed and brought to commercial fruition by collaborative R&D between the Institute and industry.

In line with the Government's strategy to introduce high technology to remain competitive, the Institute identified Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) as a growth area. Within NTI a Centre to pursue R&D activities relating to CAM/CAD systems has been established. It provides a wide range of industrial consultancy, development and application services to both multinational corporations and small and medium sizes enterprises. The services include:

- Technical study and consultancy;
- Software development and system implementation;
- In-house training; and
- Bureau services.

This institute is gradually being recognised as a major CAD/CAM resource centre which can provide a wide range of industrial consultancy, development and application services to industry.

(c) National Computer Board (NCB)

The NCB is responsible for the promotion of national computerization and coordination of computer manpower planning and development. Its objective is to establish Singapore as a computer software and service centre. Specifically it:

- coordinates computer education and training of computer manpower to meet the needs of the industry;
- coordinates the Civil Service Computerization Programme; and
- creates the infrastructure to evolve the software industry in Singapore into an export-oriented one.

In 1986, after nurturing the development of the computer software sector, NCB together with other government agencies concerned with information technology, namely, Singapore Telecoms, the EDB and the NUS developed the National Information Technology Plan. NCB was given the task of leading the implementation of the plan. The objectives of the plan are to develop a strong export-oriented information technology industry and to exploit information technology to improve productivity and sharpen competitiveness in every sector of the economy. The Information Technology Institute (ITI) was established within the NCB in April 1986 to pursue applied R&D in Information Technology such as software engineering, artificial intelligence and office system technologies. The Institute also coordinates Information Technology manpower

development programmes in the tertiary institutions to cater to the needs of the industry. Technology Incubation Centres such as the Knowledge Engineering Resource Centre (KERC) were set up to help industry exploit expert system technology. Potential users of knowledge systems, vendors and local professionals use the KERC's hardware and software for prototyping activities of expert systems applications.

(d) Singapore Institute of Standards and Industrial Research (SISIR)

SISIR is a statutory body of the Ministry of Trade and Industry responsible for the promotion and upgrading of quality and technology in the manufacturing sector. It helps manufacturers, especially the smaller local companies, in industrial technology through consultancy, training, development work and technical support. Besides helping industry in quality-related areas, SISIR has in recent years substantially intensified its assistance to industry in technology upgrading. In the last ten years, it has shifted its focus in the technology area from mainly testing-oriented activities to technology transfer, industrial R&D and provision of specialised technical services.

In order to provide specialist expertise and facilities to industry in critical areas of technology, a number of "Technology Competence Centres" have been established within SISIR. These include the following:

i) Materials Technology Centre

The Centre helps in the selection, evaluation and industrial applications of materials in the areas of metals, plastics, chemical and surface technology. It also carries out R&D projects with industry, offers consultancy and training in process improvement, and helps to apply new technologies.

ii) Design and Development Centre

The Centre assists the industry in developing new products, and process development including electronics, process control, product design and development of special-purpose automation equipment.

iii) Food Technology Centre

The Centre helps local food manufacturers upgrade their operations by doing food technology R&D, food product and process improvement and technical consultancy services.

iv) Microprocessor Applications Centre

The Centre provides services on the industrial applications of microprocessors. The Centre carries out contract design and development for industry, and conducts training programmes for practicing engineers in industry. The Centre focuses on two main fields of automation technology-automated visual inspection and measurement, and factory floor communications. In addition, its Technology Transfer Department coordinates technology transfer programmes and monitor industrial technology trends.

(e) Singapore Science Centre (SSC)

The Singapore Science Centre, a statutory body of the Ministry of Education plays a key role in non-formal science education. The Centre provides a range of scientific educational programmes and activities, in particular exhibitions to enable the public to understand and appreciate the applications of scientific principles. Besides the exhibition galleries, the Centre also has an S$18 million Omniplanetarium complex which uses the most advanced audio-visual communication technology to present science and technology.

(f) Economic Development Board (EDB)

EDB is the main agency responsible for the industrial planning and promotion in the manufacturing and services industries. It also plays a key role in technological development and industrial manpower development. The Board administers several financial and tax incentives, and grant schemes to encourage manufacturing and service investments as well as R&D. One of the schemes administered is the Product Development Assistance Scheme (PDAS) which aims to encourage product/process design and development capabilities.

The Board identifies and promotes skill and technology-intensive companies which are export-oriented and which can widen Singapore's skill base. In addition to investments in manufacturing, it identifies new opportunities in the service sector. It also helps to develop and upgrade local small and medium enterprises through various assistance schemes.

(g) Trade Development Board (TDB)

TDB has been set up to develop the country's international trade. Its objective is to promote Singapore as a centre of trading activities such as third country trade, entrepot trade, countertrade, international warehousing and distribution, and global trading in commodities such as oils, metals and chemicals. The Board administers a number of incentive schemes to promote trade. They include the Market Development Assistance Scheme, the Design Ventures Programme and the Pioneer Status Incentive for Countertrade.

(h) Telecommunication Authority of Singapore (Singapore Telecom)

Singapore Telecom is responsible for the national and international telecommunication and postal services. While equipment and technology for the basic telecommunication infrastructure are imported, Singapore Telecoms carries out research into the efficiency and effectiveness of the operations once a particular system is installed. Where necessary, the systems including software are modified or developed internally to meet specific needs. In addition, it also conducts R&D to provide new services using the latest technology. It has entered into partnerships with tertiary institutions and manufacturers to conduct joint R&D projects such as the Teleview and office automation.

(i) Primary Production Department (PPD)

PPD is a department within the Ministry of National Development. Besides being responsible for the supply of meat, fish and vegetables for the local market, it also provides essential services to the primary and export oriented agro-related industries.

The Department conducts horticultural research such as varietal selection, pest and disease control, crop husbandry, hydroponics, protected cultivation and post-harvest technology. In animal husbandry, research is focused on more intensive forms of production, superior breeds and disease control. Aquacultural research, aimed at raising high-value fish involves areas such as breeding, feeds, hatchery, disease control, farming systems and farm-management.

The Department is now looking into the development of agrotechnology parks for high-tech farming and services in Singapore. Agrotechnology parks occupying a total of 2,000 hectares will be developed in the next few years.

II.3.5. THAILAND

At the national level, the Ministry of Science, Technology and Energy (MOSTE) and the National Economic and Social Development Board (NESDB) are the two major agencies that are responsible for science and technology policy. Other agencies such as the Ministry of University Affairs, the Ministry of Agriculture, the Ministry of Industry, the Ministry of Defence, etc. deal only with specific areas under each agency's jurisdiction.

MOSTE is the newest ministry in Thailand. It was set up in 1979 as a government mechanism concerning science, technology and energy of the country. The functions of MOSTE are as follows:

- To lay down policies, plans, schemes and projects related to science, technology and energy;
- To control, conduct, command and perform work related to science, technology, energy and environment;
- To formulate working plans, follow-up and evaluate work related to science, technology, energy and environment.
- To improve the plans, schemes and projects concerned so that they remain appropriate;
- To develop technology domestically which enhance productivity and are also commercially feasible;
- To provide services and promote both international and intranational technology transfer;
- To study, analyze, research and compile scientific and technological statistics; and
- To compile, collect and propagate information and research results related to science, technology and energy.

NESDB as the national planning agency has the following main duties and responsibilities:

- To draw up national economic and social development plans;
- To study and analyze the economic and social conditions of the country;
- To study the national income accounts;
- To analyze and evaluate development projects in relevant operating departments and public enterprises; and
- To perform such function as may be resolved or assigned to it by the cabinet.

One of its 12 divisions, Technology and Environment Planning Division, has the function of co-ordinating the science and technology plan with the National Economic and Social Development Plan.

Some of the key specialized agencies that play a key role in facilitating technology-based development in Thailand are as follows.

(a) Technology Transfer Centre

The National Centre of Technology Transfer in Thailand was set up in 1983 as a division of the Office of the Permanent Secretary, Ministry of Science, Technology and Energy. This centre acts as a promotional, advisory and training agency in the activities related to technology acquisition, development, adaptation, licencing, negotiation and transfer. The functions of the Technology Transfer Centre can be divided into 5 categories:

(i) Scanning, screening and introducing technologies;

(ii) Serving as a centre for technology transfer;

(iii) Evaluating the appropriateness of the technology to be transferred;

(iv) Co-operating with international organizations in matters concerning technology transfer; and

(v) Arranging seminars and handling extension work.

The functions of the technology transfer centre also include:

- location of alternate sources of technology;
- evaluation of technology offers;
- assistance to local organizations in evaluation of technology transfer offers;
- negotiation of conditions in the agreement with the supplier; and
- monitoring of progress in the adaptation, digestion and absorption of the technology transferred.

The National Centre for Technology Transfer in Thailand is divided into 4 sections, namely Technology Transfer Information Section, Technology Analysis and Evaluation Section, Technology Transfer Promotion and Dissemination Section and General Administration Section.

In addition to the Technology Transfer Center, which emphasizes industry, other research agencies such as the Agriculture Extension Department, research stations of the Technical Department and the Land Development Department of the Ministry of Agriculture, and the Industry Development Centre of the Industry Promotion Department have their functions in transferring technology to the private sector and the general public.

(b) Board of Investment

According to the Investment Promotion Act of 1977, "there shall be a Board of Investment consisting of the Prime Minister as Chairman, the Minister of Industry as Vice Chairman, not more than ten other competent persons appointed by the Prime Minister to act as members and Secretary General as member and Secretary to the Board". The Office of the Board of Investment has the following powers and duties:

(i) To perform such functions as may be resolved or assigned to it by the Board;

(ii) To undertake works to publicize investment potentials and induce investments in those activities which are important and beneficial to economic and social development, and security of the country;

(iii) To establish an Investment Services Centre to assist investors and prospective investors in obtaining permission and services related to investment which include facilities and assistance to prospective investors in the preparation of investment projects, in finding prospective partners and in the implementation of investment projects;

(iv) To appraise projects requesting promotion, and supervise, control, and evaluate promoted investment projects;

(v) To conduct studies and research in identifying investment opportunities, prepare feasibility reports, and formulate investment promotion programmes;

(vi) To study and compile data relating to investment in the Kingdom; and

(vii) To perform other duties in the furtherance of the objectives of this Act.

In the past, one of the conditions set out for the application of promotional privileges was that the machinery to be used had to be approved by BOI. This measure was employed mainly to prevent investment opportunists rather than to concentrate on the suitability of technology for the economic system. At present, interest in this respect appears to have switched to technology. Industries awarded with promotional privileges in the past were mostly capital intensive. Employment was thus limited. This was mainly because the promotional incentive in the form of the exemption of import tariff on machinery which was enjoyed by the investors prompted them to pick out capital intensive techniques. The new form of promotional privileges, which makes the number of employees a pre-condition, is expected to lessen the factor of price distortion to some extent.

(c) Export Service Centre (ESC)

The ESC is a unit coming under the Department of Commercial Relations, Ministry of Commerce. Its objective is to introduce Thai manufacturers to overseas channels of distribution which are appropriate to their products and the markets they are seeking to enter. The ESC attempts to mainly cater to the following needs of the Thai exporters:

- Market advisory services;
- Trade information services;
- Training;
- Product adaptation;
- Joint marketing by trading firms; and
- Export under licencing.

(d) The Thailand Industrial Standards Institute (TISI)

Another major institute of relevance to S&T development not within purview of MOSTE is TISI. TISI comes under the Ministry of Industries. It was established in 1968.

TISI is the national standards organization for Thailand. According to the Industrial Product Standards Act under which it was set up, TISI has as its governing body the

Industrial Product Standards Council which controls its policy, sets the priority of standards to be prepared, recommends qualified persons to be appointed to TISI technical committees, arbitrates and awards licenses under the certification scheme.

The primary functions of TISI are as follows:

- To prepare and publish national standards;
- To grant licenses to use TISI standards mark;
- To promote the implementation of standards;
- To represent Thailand in the international organization for standardization; and
- To assume responsibilities for food standards activities in Thailand and collaborate with the Joint FAO/WHO Food Standards Program.

(e) Thailand Institute of Scientific and Technological Research (TISTR)

The TISTR is a non-profit making state enterprise under MOSTE. It was originally set up by the Applied Scientific Research Corporation of Thailand Act of 1963 which was repealed and replaced by the Thailand Institute of Scientific and Technological Research Act of 1979 following the establishment of MOSTE.

The main functions of TISTR are as follows:

- To initiate and conduct research and to provide scientific and technological services to state agencies and private enterprises for economic and social development of the country;

- To conduct scientific and technological research in order to promote the utilization of natural resources appropriate to the economic conditions, environment, health and welfare of the people;

- To improve productivity in accordance with Government policies by propagating the results of scientific and technological research to benefit the country in agriculture, industry and commerce;

- To train scientific and technological researchers;

- To provide testing and measuring services and other scientific and technological services.

- To expedite the policies of the Ministry of Science, Technology and Energy dedicated to promoting the country's scientific and technological efficiency with the aim of self-reliance. This will be done by giving encouragement, incentive, assistance and support for the use of the results of research and development to tackle economic and social problems on all fronts.

- To mobilize the country's human resources to work for the development of scientific and technological research in order to effect practical operational results. This includes measures for screening, controlling and distributing technology systematically, and also for encouraging local inventions and high technology production in future.

- To operate as a "center of excellence" responsible for the provision of scientific and technological services, such as in testing and standards, supply of relevant information and consultation to the government and private sectors, both locally and regionally.

- To work in close cooperation with the private sector and with research and development units in order to build up an atmosphere in which science and technology are seen as means by which national problems may be solved.

(f) Department of Science Services (DSS)

The DSS was established several decades ago to provide testing and analysis services to the public and private sectors. Before the creation of MOSTE, DSS was part of the Department of Industry and was subsequently transferred to MOSTE. The main functions of DSS are:

- To act as the government's scientific and technological laboratories.

- To provide chemical, physical and biological analysis services to government and private sector organizations.

- To carry out research on the utilization of the nation's natural resources and industrial and agricultural wastes for economic benefit.

- To provide analysis and testing services in order to control and certify the quality of industrial products, food and beverages.

- To provide training for students of analytical chemistry of the various governmental and industrial laboratories.

- To provide scientific and technological information services.

(g) The National Research Council of Thailand (NRCT)

The main functions of NRCT are as follows:

- To formulate a national research policy by studying the present needs of research as directed by the Government, policies and plans of government agencies, the National Assembly's policy; in harmony with the National Economic and Social Development Plan, and public requirements; to ensure that these objectives for research will help the attainment of the same goal.

- To promote and stimulate research work by providing funds to both government and private sectors. These funds can be divided into research grants for junior researchers, senior researchers, experts and university lecturers. In addition, some grants are available to research workers to carry out certain projects that are considered to be of high priority. With a view to promoting new inventions and research works, prizes with high remuneration are also awarded to outstanding inventors and researchers.

- To coordinate research work with international organizations through the exchange of research information and researchers, in order to obtain knowledge which should be valuable for national development.

- To serve as a Research Documentary Center where research work both in natural science and social science will be compiled and made available to all researchers. The Center is also expected to serve as a Clearing House for researchers so as to avoid duplication of efforts.

- To promote and support the establishment of research institutes or professional societies as a means to bring professionals in each field together.

- To ensure that the research work of the country can be carried out in harmony with national development efforts as well as to optimize the national expenditures in this regard. NRCT has appointed an investigation unit to examine the project proposals submitted for government financial support.

- To provide support and to facilitate research opportunities for foreign researchers who carry out research work in Thailand. In providing this service NRCT acts as a center for research coordination.

- To organize training courses for social scientists at a post-graduate level to expand the research community in this area and associated manpower in various government agencies.

- To undertake large and important research projects or coordinate with other concerned agencies. Some current projects under the coordination of NRCT include the Aerospace Programme, Water Quality Assessment Project, Mangrove Project and the Narcotics Project.

- To continue the exchange programme of scientists and researchers and cooperation with other national organizations on projects such as Japan Society for the Promotion of Science, the National Institute of Health and the National Science Foundation of the United States.

- To disseminate research results and information to the public.

- To carry out translation of research documents and disseminate them to the public to increase knowledge and new technology in the community.

- To operate Thailand LANDSAT ground receiving station, situated 40 km east of Bangkok in the Lad Krabang District. The reception area of the station covers most countries in South and Southeast Asia including the Philippines, Indonesia, Malaysia, Sri Lanka, Nepal and Bangladesh. The ground facilities are equipped with data processing and reproducing systems to enable the production of LANDSAT data. These LANDSAT data products are then distributed to domestic and foreign users upon request. The application of LANDSAT data to natural resources survey in Thailand includes forestry, irrigation, land use, geology, water and mineral resources.

(h) The National Center for Genetic Engineering and Biotechnology (NCGEB)

The National Center for Genetic Engineering and Biotechnology (NCGEB) was established in September 1983 under the Ministry of Science, Technology and Energy to be the focal point for strengthening Thailand's capabilities in genetic engineering and biotechnology, and for applying these to national economic and social development. In performing these functions, the NCGEB promotes research in wide-ranging areas, from gene and cell manipulation through biomaterial processing and improvement to areas of biochemical engineering and technology with good potential for development in Thailand. The NCGEB also promotes industry-university links in relevant projects and activates selected programs by coordinating with the government, international sources and institutions active in the field of genetic engineering and biotechnology.

(i) The National Electronics and Computer Technology Center (NECTEC)

The NECTEC was established in September 1986 in accordance with the importance given to electronics and information technology as a "sunrise technology" by the Fifth and Sixth Social and Economic Development Plans. The NECTEC is expected to strengthen the technological capability of Thailand in the field of electronics and information technology and provide policy guidelines to the Government through MOSTE in assisting the electronics and computer industry to achieve both import substitution and export capability.

The major functions of NECTEC are as follows:

- To develop technological capabilities in electronics and computer areas to support the electronics and computer industry of the country;

- To accelerate computer applications in order to improve efficiency and productivity, and

- To promote research and development supporting industrial promotion and international competitiveness of Thai products.

(j) The National Center for Metal and Material Technology (NCMMT)

The NCMMT has been established for strengthening metal and material technology capabilities and for applying these to national social and economic development. NCMMT promotes research in metallurgy and materials science as well as in product design and processing for developing metal and material industries. Metal industries as defined by NCMMT include transformation of minerals to metals, production of iron sheets, iron pipes and other iron shapes, production of non-ferrous metal, production of machinery parts, machineries and machine tools. Material industries include ceramics, polymers, fiber and textiles, rubber and composite materials industries.

The main objectives of NCMMT are as follows:

- To supply useful data and know-how in metallurgy and materials science as well as in production engineering and mechanical engineering to local industries in order to strengthen their capabilities and to improve product quality to compete with those of other countries in the international market.

- To encourage and assist local industries to use local abundant minerals and resources, or to transform these minerals and resources to other more valuable forms.

- To provide and fund research and development projects done by institutions within the network with extensive collaboration with the private sector, to meet the technological needs of both local and export-oriented industries.

- To be a service center that would link approved and well equiped laboratories with the private sector in the provision of services such as testing, property analysis and quality control in accordance with international standards.

- To be an information center that would provide useful information in metallurgy and materials science for commercial utilization.

- To analyze the impact of using local minerals and resources, on the industrial structure and status of metal and material industries in Thailand and provide the government with guidelines to facilitate the growth of these industries.

(k) The Science and Technology Development Board (STDB)

The Science and Technology for Development Project is a cooperative project between the United States of America and Thailand, administered by the Science and Technology Development Board (established in 1985) which has an autonomous status, although it is formally under the Thailand Institute of Scientific and Technological Research. This project aims at increasing the efficiency and expanding the scope of science and technology application both in the public and private sectors for national development. The emphasis of this project is on solving problems related to three technological fields of high priority to Thailand namely bioscience and biotechnology, materials technology, and applied electronics technology. STDB is expected to strengthen the capability of related institutes; assist science and technology policy formulation; promote research, development and engineering; and extend appropriate support for industrial development. In this regard the mandate that has been set out in the five-year plan of STDB is as follows:

- To conduct and promote studies and research that support the formulation of policies, programs and approaches which facilitate the nation's scientific and technological development; and to promote policy dialogues concerning technology development and acquisition which will lead to an information and data base supportive of needed policy decisions.

- To promote the development of Thailand's infrastructure for science and technology.

- To support increases in the capacities for research, development and engineering in the private sector and in public science and technology (S&T) organizations including educational institutions.

- To support research, development and engineering activities aimed at meeting the requirements of the private sector; and to coordinate research in the private and public sectors that is directed toward achieving technological and commercial benefits in concerned industrial, agricultural and service sectors.

- To support increased S&T services, e.g. commodity quality analysis and testing, standards and calibration services, technological information services, and technical consulting services.

- To support increased capacities for selecting and acquiring imported technologies; including the ability to negotiate for the technologies and manage their acquisition such that the technologies can be efficiently used and absorbed, thus enhancing and strengthening the nation's technological capacity.

- To promote a strengthened S&T capacity to facilitate the application of technologies of increasing sophistication and in widening areas of application in the public and private sectors.

- To promote cooperation between the public and private sectors and between Thai and foreign organizations for enhancing the development of science and technology.

- To carry out other activities that are necessary for achieving the Board's objective, including raising funds to support the activities of the Board.

(I) Thailand Development Research Institute (TDRI)

The Thailand Development Research Institute (TDRI), founded in 1984, is a non-profit research foundation which fosters independent policy research on national development issues. TDRI strives to contribute to the search for solutions to long-term problems facing Thailand and to influence policy formulation for sustainable social and economic development.

TDRI has four main objectives:

- the conduct and promotion of policy research

- the establishment of an information center

- the creation of a research network linking institutions and individuals engaged in policy research issues

- the dissemination of the results of policy research

TDRI is committed to develop its own research agenda to ensure the coverage of all key policy issues and has initially defined seven research programs:

- Agriculture and rural development
- Industry, trade and international economic relations
- Macroeconomic policy
- Natural resources and environment
- Human resources and social development
- Urban development, infrastructure and energy
- Science and technology development

II.4. S&T HUMAN RESOURCES DEVELOPMENT

The purpose of this section is to review briefly the situation in the ASEAN countries with respect to S&T human resources development. Aspects such as national policies towards human resources development, technical education and managerial skill development will be examined briefly.

II.4.1. INDONESIA

Policies for human resources development in Indonesia as stipulated in the Guidelines of the State Policy (GBHN) cover the following aspects:

a. Establishment of an integrated method of manpower planning;
b. Development of a manpower information system;
c. Strengthening of programmes for the development of labour relations and worker's protection;
d. Continuation of the labour placement and allocation programme; and
e. Improvement of labour training, proficiency programme and manpower education programme.

Within this framework of integrated planning of manpower, the objectives of the policy are:

a. Expansion of employment opportunities at pragmatic rates;
b. Upgrading of the labour force, mainly through education and training;
c. Increasing labour productivity and improving labour relations based on the principles of Pancasila and UUD'45 (National Constitution);
d. Ensuring the efficient functioning of the labour market; and
e. Reduction of the growth rate of labour force and improvement of the quality of manpower.

The labour force was estimated to rise from 63.5 million in 1983 to 72.8 million by the last year of PELITA IV (1988-89).

During PELITA II and III (1978-79 to 1983-84), substructural and structural facilities in the field of science research and technology had been improved gradually. Improvement in the stock and quality of research scientists was achieved by taking advantage of opportunities made available by the various educational and research institutions in the field of science, both at home and abroad. During PELITA III more than 1000 researchers in various fields of science were recruited, and about 500 researchers underwent training at various local educational institutions. These training programmes included doctoral programmes, masters degree programmes, post-graduate courses in various disciplines and graduate study programmes. Meanwhile, the assignment of research personnel abroad was directed towards more specialized fields such as the utilization of biogas, nuclear energy, physical and chemical treatment of waste, rocketry, photography and interpretation of remote sensing, physics, chemistry, biology and oceanography.

Facilities have been established by BATAN in Yogyakarta and Bandung, PUSPITEK at Serpong, LAPAN at Pameungpeuk and Biak, BAKOSURTANAL Photographic Laboratory at Cibinong, and LIPI in Jakarta, Bogor, Bandung and Ambon. Joint projects in the field of research and technology development have been launched with the aim of improving

national capability in these areas, in order to support and expedite industrial development. Cooperation with foreign institutions and technological personnel, especially from developed countries has been directed towards gaining experience in mastering advanced technologies.

In PELITA IV, efforts to prepare educated and trained personnel with expertise covering a broad range of scientific and technological needs has been continued. State and private institutions of higher education were involved in this effort. The quality and quantity of research scientists is expected to be stepped up to levels required for the "take-off of national development" during REPELITA VI.

Training of skilled workers, both to increase their number and also to enable them to cope up with technological change, was the emphasis during PELITA IV. Public and private training institutions and also firms participating in the proficiency training program are responsible for this training.

Technical education at state universities and polytechnics is intended to train higher level technicians and supervisors. It is also intended to stress the link between theory in applied engineering and commerce with their practical uses in industry and other enterprises. There are six polytechnics built jointly with state universities, which are operational in addition to the Institute of Technology at Bandung.

The turnover of qualified technical personnel is relatively low in Indonesia especially of those who work in government institutions. Horizontal mobility, i.e. mobility of qualified technical personnel from one government institution to another, although possible, is considered to be not so easy. However, to compensate for the scarcity of qualified technical personnel, there is a scheme which enables secondment of a qualified person as a part-timer to other institutions.

Migration of qualified personnel to developed countries is relatively small. Technical personnel who go to developed countries for upgrading their skills return to Indonesia. There are some Indonesian technical personnel who are working in developed countries, but most of them appear to have started their careers there after undergraduate study in those countries.

Management development is carried out in Indonesia mainly through seminars, workshops and related programs in cooperation with specialized agencies and universities. A small number of managers are also sent abroad for higher studies in management.

II.4.2. MALAYSIA

The development of S&T in the country is essentially based on the requirements for a competent and viable research and development infrastructure, in optimal size for the national scientific community, widespread technical education and effective dissemination of scientific knowledge and adoption of S&T into the socio-cultural life of the people. In Malaysia, both the government and private sectors have played major roles in establishing new vocational-technical schools, agricultural and commercial institutes. The aim is to direct educational preferences away from arts and pure sciences and concentrate on applied arts and sciences.

The Economic Planning Unit in the Prime Minister's Department is the major manpower planning unit which studies the macro aspects of manpower projection including the development of supply and demand projections of sectoral, industrial and major occupational groups for the planned period.

The Public Services Department (PSD) undertakes manpower management for the public sector. Its key activities include the determination of salaries and career development paths, deployment of public sector personnel, demand monitoring, identification of manpower shortages, providing scholarships and training subsidies for individual and government offices.

The Educational Planning Research and Development Unit in the Ministry of Education is responsible for planning, research, evaluation and coordination of educational policy including technical and vocational education. This unit undertakes macro planning, research on factors affecting the implementation of education policy, collection, processing of educational and financial data and coordination of education projects financed by foreign agencies.

The Malaysian Administrative Modernisation and Manpower Planning Unit (MAMPU) in the Prime Minister's Department on the other hand coordinates manpower planning and development activities in the public and private sector. Some of the major organizations involved in training and manpower development are the Ministry of Labour, Ministry of Eduction, and MARA.

The Ministry of Labour runs Industrial Training Institutes (2 in 1982, 5 by 1990) which run several courses such as apprenticeship courses, preparatory trade courses, skill up-grading courses, instructional techniques courses, building trades and special building trade courses and training in mechanical, electrical construction and printing crafts. The expected output from these institutes is expected to reach 7,200 by 1990. The Ministry of Education runs secondary vocational schools which offer 2 year courses in commerce, agriculture, home science and seven engineering trades (25 schools in 1982, 38 by 1990). Also it has 9 Technical Schools offering courses to secondary level school students in mechanical and civil engineering, commerce and agriculture. The Ungku Omar Polytechnic and the Kuantan Polytechnic offer courses in mechanical, civil, electrical and electronics engineering, secretarial science and commerce. Five more polytechnics are expected to be in operation by 1990 producing about 4000 graduates per year. MARA is another well known institute in Malaysia which provides training in fields such as science, business and accountancy, engineering, computers, library science and catering. A notable feature is that with the introduction of Malaysia's "Look East Policy" in 1981, Japan is providing training for apprentices in various institutes in Japan for periods ranging from 6 months to one year. The Malaysian Government has also made it mandatory for large foreign construction companies to provide training for their staff.

The Malaysian government has proposed the setting up of a Skilled Manpower Development Fund with a view to producing skilled workers for the industrial sector. The fund is to be jointly managed by way of a cess collection from the manufacturing sector. The need for skilled manpower is very much evident in the fields of electrical, electronics, textiles, construction, metal and wood-based industries. And also it has been pointed out that by the year 2000 Malaysia's manufacturing sector alone will need 1.6 m skilled workers.

Malaysia has 7 major universities and colleges. During the period 1971-1980 out of the total output from these institutions, about 63% were arts graduates, 31% science

graduates and about 6% engineering graduates. This is expected to change to about 48%, 42% and 10% during 1981-1990. In 1986 it was estimated that about 52,000 Malaysians were studying overseas of which about 28% were estimated to be following S&T professional courses.

Management skill development follows a similar pattern to that of Indonesia.

II.4.3. PHILIPPINES

The basic policies pertaining to S&T human resource development in the Philippines were first outlined in the S&T Plan drafted in 1983. The key features of the policy are:

- top priority to be given to the requirements of manpower development programs and related facilities;
- creation of a more hospitable environment for S&T activities and S&T workers;
- programming of manpower development to meet the requirements of industry, government, and academe;
- conduct of manpower development at all levels (science degree courses, R&D and service technicians, S&T managers/administrators);
- S&T manpower to be primarily homegrown, with some foreign exposure for purpose of advanced training; and
- stimulation of standardization/accreditation of S&T degree programs and training courses.

These policies are being implemented with the NSTA, as the central government arm for S&T, playing a lead role in the implementation programs.

As at 1986, there were 83 schools offering baccalaureate degrees in the sciences and 18 colleges and universities offering masteral degrees. There were also 180 engineering schools.

Existing constraints in the development of scientific manpower are: the lack of qualified science and math teachers, inadequate and/or obsolete laboratories and facilities in universities for training local technicians, cultural bias against vocational training, inadequate curricula of technical courses to meet local industry requirements, outdated science and math textbooks in the secondary level, and insufficient facilities for widespread dissemination of S&T results. The large labour export demand tends to further deplete the skilled manpower available in the Philippines.

To meet the growing demand for trained industrial technicians, three technician institutes have been developed to serve the three major island groupings in the Philippines. The Manila Technician Institute serves the Luzon area, the Visayas Technician Institute serves the Visayan area and the Iligan Institute of Technology serves Mindanao. In addition, in 1982, an Asian Development Bank (ADB) assisted project was initiated to modernize 21 vocational/technical education institutes.

Postgraduate studies leading to masteral and doctoral degrees in the agricultural sciences, health sciences and the basic sciences are managed by the Philippine Council for Agriculture and Resources Research and Development (PCARRD), University of the Philippines and the National Research Council of the Philippines (NRCP) respectively. Interdisciplinary postgraduate programs in energy science and technology to be managed by Philippine Council for Industry and Energy Research and Development (PCIERD), have also been included by the NSTA in its manpower development program.

II.4.4. SINGAPORE

Given Singapore's lack of natural resources, great emphasis is placed on the training and development of its people. Singapore's early labour-intensive strategy meant that it was necessary to develop its human resources to its fullest. In the early 1960's, because of an expanding school population, emphasis was given to the development of primary and secondary education. It was only in the late 1960's, as industrialization took root that the Government steered its educational development towards vocational, technical and professional training.

When Singapore embarked on the promotion and growth of the knowledge-based industries, it recognised that there was a need to produce and upgrade the necessary manpower requirements. A statutory board, the Vocational and Industrial Training Board (VITB) was set up in 1979 to train skilled workers to meet the increased demands from the industry.

Some institutions involved in development of human capital are:

- The National Productivity Board;
- Vocational and Industrial Training Board;
- The Economic Development Board;
- The National University of Singapore;
- Nanyang Technological Institute;
- Singapore Polytechnic;
- Ngee Ann Polytechnic; and
- Joint Industry Training Centres and Institutes

The Singapore Polytechnic and the then Ngee Ann Technical College (now known as the Ngee Ann Polytechnic) were expanded to train more technicians. The student enrolment in the university professional courses such as engineering and business administration was stepped up to meet the projected demands of the industrial and business sectors. In addition, the EDB introduced new programmes to train highly skilled technicians in areas such as tool and component design and manufacturing, industrial automation, mechatronics and industrial electronics for skill-intensive firms. These programmes include joint government-industry training schemes, overseas training and industrial scholarship schemes, and grants for companies with approved training schemes.

Other than these the following institutions provide special training to the specific target groups.

(a) The German-Singapore Institute which provides training in production technology and advanced manufacturing processes.

(b) The French-Singapore Institute which provides training in electronic engineering with emphasis on microprocessor applications, control engineering, robotics, computer vision and industrial automation, instrumentation and electronic design and CAD/CAM/CAE.

(c) The Japanese-Singapore Technical Institute which provides training in the fields of mechatronics engineering at the level of Industrial Technician Certificate (ITC).

In addition to these, The Precision Engineering Institute and the Philips-Government Training Center train also skilled craftsmen.

Recent initiatives taken to enhance the scope of manpower development in the areas of science and technology include the Information Communications Institute which will provide postgraduate professional training in information communications technology in 1990, the Institute of Molecular and Cell Biology (IMCB) and the Information Technology Institute (ITI) of the National Computer Board (NCB).

The 1986 Economic Committee Report stated that the economy's growth is dependent on increased productivity through automation, mechanisation and improved business efficiency. This, however is only possible if Singapore has a better educated and trained workforce. Its manpower development strategies are therefore based on the following principles:

- Educate each individual to his maximum potential;
- Encourage the development of more creative and flexible skills through broad based education;
- Stress the need for continuous training and re-training;
- Provide skilled manpower at internationally competitive cost; and
- Ensure that skills match demand.

To encourage companies to provide and undertake training programmes the government provides incentives schemes; such as:

- Skill Development Fund Grants;
- Interest Grant for Mechanisation Scheme; and
- Initiatives in New Technologies Scheme.

On the whole, and from a long term perspective, Singapore's human resources development programs are aimed at enhancing creativity and continuous upgrading of relevant skills.

II.4.5. THAILAND

The Constitution of the Kingdom of Thailand holds that "The State shall promote and support education and professional training according to the suitability for and the demand of the country. The organization of the education system is the exclusive duty of the State. All educational establishments shall be under the control and supervision of the State".

The government budget for education has had the highest rank among all sectors for several years. The budget for education has been usually around 20% of the total budget.

The Thai Government has clearly defined the measures necessary for occupational preparation. Among the main measures are the following:

- Promote training programs for important occupations and for increasing workers' skills as well their quality.

- Promote the physical and intellectual development of the population through the provision of adequate public health and education services to produce individuals with good health and to equip them with the knowledge and skills for suitable employment.

- Promote short-term vocational training courses for farmers to provide them with an adequate knowledge for increasing productivity and marketing, thus enabling them to enjoy a better standard of living.

A program of action for developing Thai S&T human resources has been outlined in the Fifth National Economic and Social Development Plan (1982-1986) as follows:

1. Conduct a survey of the country's scientific and technological personnel at university and vocational levels according to each subject and occupational requirement. This will permit a correct evaluation of the manpower resources which could be fully mobilized.

2. Forecast the demand and supply for scientific and technological manpower which is consistent with the technological development in order to prepare for the expansion of production and economy in both the short and long terms.

3. Improve and formulate a scientific and technological educational system at all levels by upgrading the syllabus, teaching methods, quality of the teaching staff as well as the utilization of modern and technologically up-to-date equipment.

4. Set up a system and measures for mobilizing scientific and technological manpower as follows:

   (a) Provide incentives for scientists and technologists in order to attract capable persons, for example by issuing permits for people with scientific and technological occupations, by establishing appropriate salaries, and by requiring private business or industries of a certain size to employ scientists and technicians who hold these permits.

   (b) Improve the efficiency of those employment agencies engaged in employing technicians. These agencies are to more efficiently co-ordinate requirements between those seeking jobs, employers and training centres than at present.

   (c) Survey and formulate a mobilization plan for top Thai scientists and technicians who are working abroad to encourage them to return to Thailand to meet the country's research requirements. It is also necessary to have scientific and technological advisors stationed in developed countries in order to monitor the advances in science and technology, determine the most appropriate method for transferring technology and seek technological co-operation with these countries.

These aspects have been strengthened further in the Sixth Plan (1987-1991).

Since 1979, there have been improvements in technical/vocational education in terms of the number of students educated from Technical and Vocational Institutes (in natural sciences, agriculture and engineering) and the number of vocational trainees successfully completing training, classified into certificate level, higher certificate level and diploma.

Thailand too faces a problem of brain drain with many qualified professionals preferring to work in the developed countries. However, now Thailand also faces a problem of "brawn drain" with skilled workers seeking employment in the Middle East and ASEAN countries such as Singapore, Malaysia and Brunei where the remuneration they get is higher than what they would receive in Thailand. The shortage of skills is attributed as a major factor behind the poor R&D performance in the country.

II.5. TECHNOLOGY SUPPORT FACILITIES

Technology support facilities such as S&T documentation services, computing services, standardization and quality assurance services, testing and instrumentation services, and consultancy services (engineering and management) play a major role in facilitating technology-based development. The objective of this section is to outline the status of these facilities in the ASEAN countries.

II.5.1. INDONESIA

The most important S&T documentation centre in Indonesia is the National Scientific Documentation Centre (PDIN) at LIPI. This centre provides: (a) scientific literature for researchers; (b) information on science and technology; (c) information on scientific and documentation sources in Indonesia and abroad, particularly in South-east Asia, and (d) arrangements for subscriptions to domestic and foreign scientific periodicals particularly for research institutions of LIPI. It also carries out literature searches in science and technology subject areas, bibliographies on specific subjects, current awareness services and translation and reproduction of technological books and journals articles.

A national network of S&T information has also been established to enable information users to have access to available S&T information sources in Indonesia. The network includes: the information system on biology and agriculture handled by the Ministry of Agriculture; the information system on health and medical sciences handled by the Ministry of Health; the information system on social sciences and humanities handled by PDIN-LIPI; the information system on population and family planning handled by National Coordination Agency for Family Planning; the information system on food and post-harvest handled by the National Logistic Agency; and the information system on appropriate technology handled by PDIN-LIPI.

Computers have been used in Indonesia since PELITA I (1969-1974) and its scope and extent of application has increased during PELITA II and III. Public and private sector organizations in agriculture, communications, construction, transportation, manufacturing and energy were the major users during this period. During PELITA IV educational institutions have started using computers extensively. Domestic users are also increasing. The computer industry in Indonesia is restricted mostly to the assembling function. There are also several private and public institutions involved in computer education and training.

In 1978 a Committee for the Preparation of a National Standardization System (PPSNS) was set up under the purview of LIPI to propose a blueprint for setting up a national system for standardization in Indonesia. In 1984 the Presidential Decree for the establishment of the National Standardization Council (NSC) was promulgated. The NSC is a non-structural body which coordinates an implements, through other agencies, standardization activities in Indonesia. The NSC reports directly to the President. Its main functions are:

- to coordinate, synchronize and ensure cooperation among the institutions concerned with standardization activities;

- to advise the President on national policy on standardization and submit issues of importance on this subject for his consideration;

- to formulate and determine national policy on standardization;

- to coordinate and synchronize the standardization progamme;

- to collect data on the implementation of standardization;

- to facilitate standardization activities and cooperation among the institutions concerned;

- to coordinate standardization activities, monitor and evaluate their progress;

- to promote and foster international cooperation in standardization and to coordinate the activities of the participating institutions;

- to assist national organizations in cooperation (bilateral, regional and international technical cooperation) with respect to standardization activities;

- to prepare national standards and approve them through consensus of the members of the drafting committee;

- to play an active role in solving problems, if any, among the institutions concerned and to be the information centre for standardization;

- formulate and approve the national standards formulation procedures, implementation criteria and other standardization activities.

In the area of instrumentation and testing, Indonesia has the capabilities for:

- metrology and calibration covering the areas related to mechanical, electrical, thermal, optical, acoustics and materials engineering;
- instrumentation technology in the line of instrumentation development, calibration, metrology services, technical services, technical information and technical assistance.

In the field of consultancy services, the Government, through a Presidential Decree in 1984, instructed all ministries and institutes to use national consultancy services as far as possible. Consultancy expertise is available in the following areas:

- survey services,
- design and engineering services,
- project management services,
- production and industrial services,
- operational maintenance and rehabilitation services,
- information services and
- management services.

II.5.2. MALAYSIA

Malaysia has recognized the need for establishing a national network for S&T information and the National Council for Scientific Research and Development (NCSRD) has been entrusted with this responsibility. However a Technological Information Centre (TIC) has

already been set up at SIRIM based on the information already available at its Patent Information and Documentation Centre (PIDC).

Other than these developments, various research institutions have their own documentation sections and their own libraries where scientific and technological information are stored and dissemination of information on current activities of the institutes are incorporated into the annual report. Apart from this, the various institutes publish research findings and bulletins which are disseminated to their various target groups.

There have been efforts made by the Ministry of Science, Technology and the Environment and the NCSRD to gather statistics on various aspects of science and technology to assess the scientific and technological development in the country. There appears to be no comprehensive statistical compilation as to the status of scientific and technological development in the country.

In November 1984, Malaysia's Own Packet Switch Public Data Network (MAYPAC) was introduced by the Telecommunications Department to facilitate a more speedy, efficient, accurate and economical system for the exchange of data by computers and terminals both within and outside Malaysia. Formerly information and data exchanges were conducted through the normal telephone system which is both costly and inefficient. Although initially access to the database was only limited to those in the United States of America it has been extended to databases in other countries as well.

The rapid spread of computers and computer usage in Malaysia has led to the development of a National Computer Policy the main aim of which is to provide Malaysia with a fair degree of self-reliance in a critical technology such as computer technology. The policy was mainly aimed at tackling issues such as:

(i) Determining whether Malaysia should have a centralised or decentralised system in information reporting;

(ii) Identifying key people for implementing planned activities and developing modalities for information acquisition;

(iii) Helping to establish nation-wide hardware and software acquisition standards in order to minimize the incompatibility among micro computers and mainframes.

Apart from this, as a catalyst to encourage the growth of the micro electronic industry in the country, the Malaysian Institute of Microelectronic Systems (MIMOS) was established in January 1985. This institute was established because it was felt that the micro electronics industry is increasingly being threatened by other developing countries which can provide lower labour costs to investing foreign electronics companies. The aim of MIMOS is to assist Malaysia to produce semi-customised chips which can be used in the local production of consumer electrical and electronic goods. The institute will also train local engineers to master the art of designing very large scale integrated (VLS) circuits.

As far as computer education is concerned, training facilities are available right from secondary school upwards. Many public and private sector institutes are providing short familiarisation courses of one to two months and accredited certificate/diploma courses of one to two years.

Standardisation, quality control, testing and calibration are performed by the Standards and Industrial Research Institute of Malaysia (SIRIM). SIRIM was established in 1975 as a

statutory body administered by the Ministry of Science, Technology and the Environment. The main activities of SIRIM involve standards development, industrial research and technology transfer. With regards to standards and testing, this institute is given the responsibility to promote, develop and promulgate standards for commerce and industry and for goods produced in or imported into Malaysia by:

(a) Conducting tests on products and encouraging the various industries to set up their own quality control capabilities.
(b) Certification of control of quality,

Basically SIRIM consist of four main divisions and three technology centres. The four divisions are:

(i) Administrative Division
(ii) Industrial Research Division
(iii) Standards Division
(iv) Industrial Consultancy Unit

The three centres are:

(i) Metal Industry Technology Transfer Centre
(ii) Metal Research and Development Centre
(iii) National Metrology Centre

Consultancy services in civil, mechanical, electrical, mining, and chemical engineering are available in Malaysia. Engineers and firms providing such services are registered with the Association of Consulting Engineers of Malaysia. Management training and consultancy is provided by state agencies such as the National Productivity Council, the Malaysian Institute of Management and private management consultancy companies.

II.5.3. PHILIPPINES

The central agency for S&T information in the Philippines is the Scientific Clearing-House and Documentation Services Division (SCDSD) of the Science Promotion Institute under NSTA. It collects, processes and disseminates S&T information from conventional local and foreign sources. It publishes abstracts, indexes and bibliographies; maintains library and reference services; and operates locally produced computer-readable databases. It has publication-exchange agreements with over 650 institutions in 60 countries. SCDSD also operates a technical-inquiry service. It also entertains telephone and walk-in inquiries.

SCDSD is the main base of the National Information System for Science & Technology (NISST), a network of 50 academic and research institutions designed to facilitate exchange of S&T information. It maintains linkages with the Technology Resource Centre (TRC) of the Ministry of Human Settlements which monitors and stores information on technological advances from local and international sources. Through the TRC, the SCDSD also has access to over 200 foreign databases. Other international databases which can be accessed by SCDSD are the UNIDO world industry database, MEDLARS (WHO) and AGRIS (FAO).

The Philippines is also participating in multi-country networks such as the Regional Network for the Exchange of Information and Experiences in S&T in Asia and the Pacific (ASTINFO), Technology Information Pilot System (TIPS) and Global Network.

Extensive computing services are available in the Philippines. However, wide application is evident in the business sector more than in pure S&T fields. Besides several private companies, the National Computer Centre and the University of Philippines-IBM-Meralco Foundation play key roles in upgrading skills in computer usage.

The governmental body that implements, promotes and coordinates standardization activities in the Philippines is the Products Standard Agency (PSA). It was established in July 1981 as a bureau under the Ministry of Trade and Industry (MTI). Its activities are focused on four major functions, viz: standards development, product inspection, testing and certification, technical assistance, and promotion of standards and the metric systems. In 1984, the PSA stepped up standards implementation through product standards certification, quality assurance consultancy services for industries and exporters, intensive information dissemination regarding the services it offers and the fundamentals and significance of metrication and standardization. All these were undertaken to attain the Agency's twin objectives of upgrading the quality, safety, and competitiveness of Philippine products and of protecting the consumers from unsafe and substandard goods. The Philippine Standards Association comprising of professionals involved in standardization work, and the Quality Control Engineers Association of the Philippines also advise PSA in setting up standards.

In addition to the PSA, the National Standards and Testing Laboratory (NSTL) of the National Institute of Science and Technology conducts tests on products and materials including samples submitted by the Bureau of Customs for verification and tariff classification, and by the Commission on Audit and the Bureau of Supply Coordination for determination of conformance to specifications and national standards. The NSTL also calibrates standards of weights and measures used by the municipalities as per Presidential Decree 213 which was passed in June 1973. Another Presidential Decree (PD 1865) provides that inspection, calibration, and sealing of all volumetric measures used by the petroleum industries shall be done by NSTL. Another government agency involved in the quality control of consumer products from the food and the drug industries is the Food and Drug Administration (FDA).

Prior to 1972 there were very few engineering consultancy companies in the Philippines. Increased government infrastructure development projects and expanded programs of foreign lending institutions (such as the IBRD and ADB) led to a great demand for such expertise in the 1970's and 1980's. The Philippines now has adequate capabilities, especially in civil engineering fields, to carry out engineering consultancy. The growth of experience over the last two decades has enabled Filipino consultants to qualify for overseas consultancy work. However due to the inability to meet local consultancy demands, extensive overseas involvement is unlikely. Also the engineering consultancy industry continues to lose its high quality manpower to overseas projects.

Management consultancy is also a well-developed field in the Philippines. Of the numerous firms in operation, foremost is Sycip, Gorres, Velayo and Co., which maintains branches in several Asian countries. Other firms include: AG&P Management Corporation; Benguet Management Corporation, Philippine Investment-Management Consultants, Inc., U.P. Business Research Foundation, and EVSA Corporation.

II.5.4. SINGAPORE

The National University of Singapore (NUS) Library acts as the major S&T information centre in Singapore. It provides a full range of information and documentation services to meet the science and technology information needs of professionals, industrialists and researchers through its operations in acquisitions, cataloguing, loans, information retrieval and document delivery as well as documentation such as indexing. All these operations have been computerised. Although its primary responsibility is to service the needs of the University and researchers in Singapore, its services are also extended to the public and private sectors.

Services provided by the University Library include the following:

- **Online Information Search Service:** The service provides fast retrieval of information sources in all disciplines from the Library's own databases as well as over 500 databases supplied by ten vendors both local and outside Singapore.

- **Interlibrary Loan Services:** Besides the general loan service, the Library operates an inter-library loan service between NUS Library and both local and overseas institutions.

- **Document Delivery:** The service operates mainly through the Library's Reprographic Service whereby the Library obtains resources it does not hold from other institutions and supplies its resources in photocopy or microfilm format at request, within the stipulations of the Copyright Act of 1987.

The University Library is also a participant of the Singapore Integrated Library Automation Services (SILAS), a national bibliographic database system established in April 1987. Through its participation, the Library enjoys the benefits of cooperative cataloguing and the sharing of the country's library and information resources through networking.
Singapore standards are used by industry, trade and government as nationally-accepted guidelines for product quality; safety and health; use of energy and materials resources; and other matters related to national needs. The standards are voluntary documents unless government authorities use them in legislation or administrative control. The Singapore Institute of standards and Industrial Research (SISIR) coordinates the establishment of Singapore Standards under the direction and guidance of the Singapore Standards Council. The Council's 12 members, appointed by the Minister for Trade and Industry on SISIR's advice, represent a cross-section of private sector and government organisations. Each year, over 600 people who are voluntary representatives of industry, trade, government, professional and consumer organisations deliberate on Technical Committees convened by the Council to develop the Singapore standards. At the end of Fiscal Year 1987, the number of Singapore standards was 496.

The standards include specifications for a wide range of products as well as codes of practice for industrial or engineering applications. The main industry areas covered are in the electrical engineering, mechanical engineering, building and construction, chemicals, food, consumer products and packaging. SISIR also participates in standardisation activities at the international levels. It represents Singapore in the International Organisation for Standardisation (ISO). SISIR can provide local manufacturers and exporters with information and advice on overseas standards requirements. Under the SISIR Certification Mark Scheme, products which are certified to comply with the relevant Singapore Standards or other acceptable standards are authorised to bear the SISIR Certification Mark as a symbol

of their quality. At the end of Fiscal Year 1987, the Scheme covered some 956 product items.

To promote better quality control among Singapore manufacturers, SISIR also operates the Good Manufacturing Practice Scheme to asses and certify their quality assurance systems. Some 61 companies had been certified as at the end of Fiscal Year 1987. In addition, SISIR provides training and consultancy services to help companies improve quality control. In keeping with Singapore's export-oriented economy, SISIR also encourages manufacturers to meet overseas standards requirements and qualify for overseas product certification schemes. SISIR is the appointed inspection agent in Singapore for 11 overseas certification and testing authorities, and another 11 approval authorities recognise SISIR's test reports and certificates for specific products.

SISIR's Library and Information Department also provides a range of services to meet the technical information needs of professionals, industrialists and researchers in Singapore. These include:

- Patent Information Service: A comprehensive collection of US, UK, Australian and European patents on microfilms, as well as Japanese Patent Abstracts in English, is maintained. Online access to overseas computerised patent databases is also available. Services cover state-of-the-art patent searches, selective updates on new patents, and document backup services.

- Current Awareness Service: Subscribers to this service receive monthly updates, based on individual interest profiles, on articles culled from current journals, reports and periodicals covering some of the latest developments in technology.

- Online Information Retrieval Service: With computerised access to over 300 overseas databases, online searches for information on any field of study are carried out by trained officers.

- Library Service: The SISIR Library is Singapore's national centre for information on standards and related technical regulations. It also maintains a collection of specialised publications on science and technology.

Information Technology has been singled out as a new growth industry in Singapore in the 1986 Economic Committee Report. Thus many training institutes were set up to produce the necessary skilled people and the government offered fiscal and financial incentives for this purpose. The government also embarked on a massive computerisation programme of the civil service in 1982. In the future the government plans to upgrade these to include higher order systems, networks among government departments and private sector companies.

The National Computer Board's (NCB) research arm, Information Technology Institute (ITI) is currently doing R&D in software engineering, networking and communications, and knowledge engineering. The main objective of ITI is to develop innovations of potential commercial value and transfer this technology to industry. Among the software developed by ITI in collaboration with industry include the computer aided software engineering product called POSE (Picture Oriented Software Engineering) and ProFax which is a hardware card working with software on the PC to turn the PC into a facsimile machine. Some of the current research interests in Singapore include:

- Software Engineering - Development Tools, Methodology;

- Integrated Office Systems;
- Public Office Automation Network;
- Local Area Network;
- Bilingual Information Systems;
- Artificial Intelligence/Expert Systems;
- Computer Aided Design/Computer Aided Manufacturing (CAD/CAM);
- Computer-Integrated-Manufacturing (CIM)
- Microprocessor Applications;
- Videotex Systems;
- Integrated Services Digital Network; and
- Optical Fibre Network.

The major Information Technology training institutes in Singapore include the NUS's Department of Information Systems and Computer Science (DISCS), the ISS, the Japan-Singapore Institute of Software Technology (JSIST), the Centre for Computer Studies (CCS) and ICIS. The DISCS offers a three-year degree programme in Computer Science and Information Systems. Students can further choose from a variety of electives covering Artificial Intelligence, Software Engineering, Computer Graphics, Asian Language Computer, Computer Networking and Data Communications. JSIST produces software professionals for the information processing industry. Its primary goal is to educate students for careers as application programmers, systems analysts etc. The CCS also educates and trains computer professionals to meet the demand of the private and public sectors. Other major tertiary institutes which also produces manpower for the Information Technology industry include NUS, NTI, the Singapore and Ngee Ann Polytechnics.

In the field of instrumentation and testing, SISIR is Singapore's national testing authority. The main areas of specialisation are:

- electrical and electronic testing;
- mechanical and structural testing;
- materials testing and analysis;
- chemical analysis; and
- food and microbiological analysis.

Among the major test and analysis facilities available in SISIR are:

- a range of sophisticated equipment for materials evaluation and failure analysis in the Materials Technology Center;

- computer-aided engineering (CAE) capabilities for evaluation and improvement of product designs; and

- advanced facilities for the evaluation of electronic components, products and systems in the new Electronics Test Centre.

SISIR also maintains the national physical standards of measurement for Singapore. These standards are traceable to leading national metrology laboratories in the developed countries. Areas covered include mechanical metrology, electrical standards, and temperature standards. With the standards as reference, SISIR provides calibration and precision measurement services to industry, trade and government.

It is SISIR's policy to encourage commercial laboratories to undertake more of the routine testing and calibration, while it concentrates on more advanced testing and analysis, and

higher-level calibration work. Towards this end, it has launched the Singapore Laboratory Accreditation Scheme (SINGLAS), a national scheme to give recognition to competent laboratories through an impartial system of assessment and accreditation.

SISIR - through its R&D Incubator Centre, and the National University of Singapore - through its Engineering Faculty have been active in providing engineering consultancy services to industry. In addition a large number of local and foreign engineering and management consultancy groups operate in Singapore.

II.5.5. THAILAND

While there is no single scientific and technological information system in Thailand, there are several information systems dealing with specific sectors. The major Thai Universities, the Asian Institute of Technology, ESCAP, the Ministry of Science, Technology and Energy, the National Environment Board etc. are some of the institutions which maintain specialized S&T databases.

Computing activities are well established in Thailand ranging from assembly of computers, training and consultancy. Private sector involvement is high in these activities.

Standardization, metrology and quality control come under the purview of the Thai Industrial Standards Institute (TISI), Department of Science Services (DSS), Commodity Standards Office and the Department of Commercial Registration.

During the Fifth Plan Period (1982-1986), the Government set out its major objectives for standardization activities as follows:

(a) Build up TISI, the Commodity Standards Division of the Foreign Trade Department and the Food and Drug Administration to carry out standardization, legal and standards enforcement work;
(b) Expand the evaluation and standard testing ability of various government and private agencies;
(c) Conduct research on standardization, metrology and calibration activities with a view towards raising levels of activities in these areas to international standards.

At present in addition to the universities, the important testing and calibration agencies are the Thailand Institute of Scientific and Technological Research (TISTR) and the DSS. The Fifth Plan envisaged upgradation of capabilities and facilities at these two agencies as well.

The Sixth Plan Period has witnessed the emergence of important technology support agencies such as the National Centre for Genetic Engineering and Biotechnology (NCGEB), The National Electronics and Computer Technology Centre (NECTEC), The National Centre for Metal and Material Technology (NCMMT), The Science and Technology Development Board (STDB) and The Thailand Development Research Institue (TDRI). The roles of these institutes have already been mentioned in Part II.3.

Adequate engineering and management consultancy services are available in Thailand. The major universities are also involved in providing such services. The involvement of many foreign consultancy group in Thailand is hampered by the fact that English is not the working language in Thailand. Nevertheless there are many large consultancy groups operating in Thailand whose key staff are mainly of Thai origin.

II.6. NATIONAL POLICIES INFLUENCING TECHNOLOGY IMPORTS AND INDIGENOUS TECHNOLOGY DEVELOPMENT

Technology development is influenced to a great extent by national policies that affect technology imports and indigenous technology development. Too restrictive a policy with respect to technology imports can act as a barrier to technology upgradation efforts based on latest developments. On the other hand very liberal technology import policies can dampen indigenous technology development efforts. The ideal would be something in between. The purpose of this section is to briefly present policies pertaining to technology imports and indigenous technology development in the ASEAN countries. The presentation will also review ASEAN policies with respect to foreign investment since this is one of the important vehicles of international technology transfer.

II.6.1. INDONESIA

The Indonesian government recognizes that foreign investment has a major role to play in the continuity of the country's economic development. Indonesia welcomes private foreign investment, particularly in areas where capital, advanced technology and management skills are not yet available internally. Investment projects given high priority are those which best support Indonesia's national development objectives. Certain government policies have been formulated to encourage business activities in general and capital investment in particular, especially with respect to:

- increasing of exports of certain or all products of investment projects (especially non-oil commodities) without neglecting domestic requirements;

- saving of foreign exchange by reducing imports or producing substitutes for imported goods;

- utilization of local raw materials and products, including capital goods;

- added value, i.e., promoting the processing of raw materials into half finished or finished products, stepping up assembling to manufacturing, etc.;

- augmenting economic and social effects of capital investment so that they yield more benefits;

- absorbing new technology know-how through the transfer of technological and managerial skills to Indonesians;

- development of technologically advanced products particularly capital good or industrial raw materials;

- protecting the economically-weak entrepreneurs from possible competition, from investors who receive investment facilities/incentives, by assisting them in promoting their activities;

- protecting companies against competition from foreign investors who possess greater capital and technological capabilities;

- protecting investment projects, which have passed the period in which facilities/incentives are provided, against possible competition from new projects in the same field of activity;

- development of measures for environmental conservation with regard to certain types of activities which pose environmental hazards;

- local equity participation in accordance with the priorities of the national development plans;

- the creation of an efficient business climate.

Priorities are determined on the basis of fulfillment of all or some of the above considerations and requirements. Included in the priority categories are investment projects which are expected to contribute to the implementation of development programmes. The approval of investment projects is usually based on the consideration of: type of projects, technology required, capital required, their effects on exports and government revenues.

Each year BKPM publishes an Investment Priority List or Daftar Skala Priorities (DSP), both for foreign and domestic investments. Certain conditions affecting investment, such as the location of the project, the amount of production targeted for export and requirements of participation of certain economic groups, are also set out in the DSP. The Investment Priority List is reviewed annually by BKPM in consulation with the various ministries and departments responsible for overall economic and sectoral development. Investment policy, on which the list is based, is formulated within the framework of the Five-Year Plan.

However, in order to ensure that the Priority List remains compatible with changing situations and the development on investments in various sectors, adjustments are made every six months.

All new foreign investment must constitute a joint venture with an Indonesian partner, a new additional partner, or through the capital market. Non-bank financial institutions may act as the Indonesian partner for a maximum period of five years, with a minimum shareholding of 20%. In specific cases, particularly fields of investment where the total production is exported, domestic marketing would be impossible, and where large employment opportunities are created, 100% foreign investment may be considered. The following is a brief list of selected foreign investment fields in the top-two priority categories, as of 1984.

- agricultural food crops
- plantations
- preservation of meat
- preservation and canning of fruits and vegetables
- manufacture of pulp and paper
- manufacture of basic industrial chemicals
- manufacture of fine and special chemicals
- manufacture of pharmaceutical raw materials
- basic metal, iron and steel industries
- manufacturing with copper, zinc and lead
- non-ferrous basic metal industries
- manufacture of hand tools
- shipbuilding and repair
- manufacturing of motor vehicle components

- manufacture of scientific and measuring equipment
- manufacture of other metal machinery and equipment.

Industries vital to national defence, such as those producing arms, ammunition and military equipment, are entirely closed to foreign investment. Public utilities such as telecommunication, shipping, aviation, drinking water, public railways, atomic power plants, and mass media, are closed to foreign investment unless the government retains sufficient management control.

The decision making procedure related to importation of technology in each of the sectors is basically the same because the supply of goods is arranged and controlled by the Government through a regulation called Kepres No. 29/1984 (Presidential Decree No. 29, 1984). The implementation of the Kepres No. 29 is under the jurisdiction of a team called "Tim Pengendali" (Team for Control of Supply of Goods), which is coordinated by each of the ministry concerned. The procedure for importing technology is given below:

As a general rule, domestic and foreign investment applications pass through five distinct phases:

Phase 1:

Once the application form for a domestic or foreign investment has been completed and submitted, BKPM will assess whether the investment plan specified by the applicant complies with the Government's investment policies and priorities. If these requirements are fulfilled, BKPM will issue a provisional letter of approval or Surat Persetujuan Sementara (SPS). The SPS is the Government's approval in principle for implementation of the proposed investment project.

Seven copies of the application form must be submitted to BKPM. On applications for renovation or expansion of investment projects already approved by the Government, forms to be used vary depending on the action requested.

The investor/enterprise which is going to invest in the main priority category grouping is obliged to consult with BKPM prior to submitting an application to BKPM. This consultation is intended to guide the investor/enterprise in preparing its project and assisting in the resolution of any problems that might exist.

Phase 2:

To enable the issue of a final approval for the project, the Board often requires additional information or data from the investor. The information required is specified in attachments to the SPS. The investor is allowed 12 weeks to supply the information, although the time limit can be extended by agreement of BKPM. Seven copies of the additional information are required.

Phase 3:

Within four weeks BKPM will complete its evaluation of the application and any additional material. If approved, the Chairman of BKPM will recommend to the President of Indonesia that the foreign investment project be sanctioned.

The President's approval can be expected to be issued within two weeks after BKPM's recommendation. At this point BKPM will issue a permanent letter of approval or Surat Pemberitahuan Persetujuan President (SPP). Attachments to the SPP include:

- a temporary operating permit enabling the investor to proceed with his project and produce on a trial basis. The permit expires on the estimated date of the start of commercial production when it is replaced by a permanent operating license.
- an application form for the initial licenses required by the project.

Phase 4:

Once the permanent letter of approval (SPP) is received, the investor is able to begin construction and trial production of the project. During this phase, a number of separate licenses and permits must be acquired for various activities. These include:

- regional permits;
- import and purchasing licenses;
- approved list of imports qualifying for duty concessions;
- master list of materials and supply
- recommendation for letter of credit;
- import clearance permits;
- foreign personnel permits;
- regional licenses;
- permanent operating licenses.

When the plant is built and the running of trial production are nearing completion, the investor should apply to BKPM for a permanent operating license or Izin Usaha Tetap. This specifies the field of activity in which the company is allowed to operate, together with production capacity and other operating conditions.

To issue the permanent operating license, BKPM assures itself through a physical inspection of the plant, executed by BKPMD, that the project complies with all requirements.

At the same time, investment projects that intend to export are required to obtain a limited export license or Angka Pengenal Exportir Terbatas (APET). This gives the investor an export identification number and allows the company to export goods directly rather than through an agent.

Phase 5:

This is the phase which commercial operation and production of a project begins. All companies must have a permanent operating license to begin commercial operation.

When it comes to indigenous technology development, very little information is available on special policies in this regard. However credit is available at concessionary rates to assist economically weak entrepreneurs. R&D efforts in private enterprises is mainly confined to the tackling of production and quality assurance problems. There do not appear to be any significant financial concessions for such efforts.

II.6.2. MALAYSIA

The Malaysian economy, especially the manufacturing sector, is strongly dependent on transnational corporations. Though transnational corporations play an important role in the industrialisation process of the country through provision of increased capital resources and technical and managerial expertise, these technologies and services are supplied at a high cost. These costs are either direct financial costs or indirect costs arising from restrictive conditions in the technology transfer agreements. It was observed by the Ministry of Trade and Industry that the outflow of technical and royalty fees from Malaysia between 1975 and 1978 increased by 115%.

Initially, transnational corporations came mainly from the United Kingdom investing in the mining and plantation sectors but since independence, Malaysia has been attracting a substantial amount of investment from other developed and developing countries. The largest group of foreign investors in Malaysia are the Japanese who are estimated to have invested M$1 billion by the year 1980. These investments are spread out over various types of industrial activities such as textiles, chemicals and chemical products, electronics and electrical machinery. Some of the major TNCs are Matsushita Electric Industrial Company, Toray Industries and Sumitomo from Japan, Exxon, Motorola and Goodyear from the United States, ICI, Unilever, and Dunlop from United Kingdom; and Robert Bosch, Siemens and Nordmende from Federal Republic of Germany.

Though government welcomes foreign investment, its policy is to reduce foreign equity in the corporate sector to 30% by the year 1990. To achieve this target, certain guidelines have been laid down with regard to capital ownership and equity participation. For new projects and established projects not complying with the New Economic Policy ownership targets, certain restrictions will be placed on expansion or diversification.

For those projects that are dependent on domestic market demand, the government requires a majority of Malaysian participation. If foreign participation is necessary such participation is limited to only 30% of total equity. For projects that are involved in extraction and primary processing of non-renewable resources, at least 70% Malaysian equity including 30% bumiputra equity is required.

The Investment Guarantee Agreements protects foreign investments against expropriation. Malaysia has signed such agreements with 12 countries namely U.S.A., Canada, the Netherlands, France, Switzerland, Sweden, the Federal Republic of Germany, Benelux Union, United Kingdom, Sri Lanka, Romania and Norway. Majority foreign ownership is permitted in export oriented manufacturing projects. Even 100% foreign equity may be permitted if circumstances warrant it.

To accelerate the growth of domestic industries and to create international market competitiveness of manufactured goods, export licensing and export duties on certain manufactured goods have been abolished and export allowances have been extended to more categories of locally made products. There is also selective abolition or reduction of import duties and sales taxes on essential industrial imports.

Investment tax credit has also been provided to ancilliary industries which contribute to the development of heavy industries to facilitate the take off of the heavy industrialization programme planned by the government. These industries in the private sectors involve forward and backward linkages of secondary and tertiary sectors. Increased capital

allowances have also been made available to all existing and new industries engaged in the expansion and modernization of their production processes.

All new manufacturing concerns in Malaysia that employ 25 or more full time workers and have shareholders funds of M$250,000 or more have to apply for a licence before commencement of operations under the Industrial Coordination Act of 1975. Approval must be given by the Ministry of Trade and Industry before any agreement for a joint venture involving foreign partners can be signed.

The Technology Transfer Unit (TTU) of the Ministry of Trade and Industry has been set up to ensure that transfer of technology takes place through such joint venture agreements in a way that Malaysians are benefitted. This unit screens all types of agreements that Malaysian companies sign with foreign owners of technology. This procedure is designed to ensure that Malaysian entrepreneurs or licencees are not placed in a weak bargaining position or taken advantage of and made to pay excessive fees for acquiring knowhow. This unit also ensures that conditions in the agreement will not be prejudicial to the security and other interests of the nation. Agreements screened include licencing agreements, patent and trademarks agreements, sales commission agreements and turn key projects agreements.

TTU has drawn up a check list of items to assist Malaysian entrepreneurs in negotiating technology licence agreements and to highlight provisions usually incorporated in such agreements.

The general guidelines for screening agreements are:

(i) Where the Malaysian firm is seeking technologies, the TTU first advises the potential licensee to determine whether the specific technology has already been commercially proven and is not yet obsolete.

(ii) The licensee is also advised to evaluate available technologies vis-à-vis the cost of obtaining them, the principal inputs required, estimated manufacturing costs, profitability of utilising them etc., and to initially assess the licensor's expertise and capability to provide the technical assistance required and the licensor's previous licensing experience.

The TTU requires detailed specifications, in each case, of the technological content and main features of technology or the manufacturing process acquired, anticipated production levels and product specifications. All matters relating to technical assistance, and technical services that will be rendered by the technology supplier and specific manner in which they are provided must be amply specified. General Ministry guidelines also require that the technology imported must incorporate the "latest developments known to the technology supplier" and if improvements, innovations or breakthroughs in technology are affected during the period of the agreement, the guidelines require the agreement specifies that the technology buyer be amply informed and be given full access to such improvements, etc.

Payment for technology can be made either as a fixed lump sum fee, a continuing royalty or a combination of both for a specified time period. Lump sum payments are allowed only in those cases where the technical knowhow can be fully transferred and absorbed in a comparatively short time. The level of royalty payment is usually connected to the level of technology and the main elements involved in the transfer. A rate of between 1% and 5% of net sale is allowed but the usual rate is around 2% of net sales. Technology suppliers are not allowed to itemize services under separate agreements and to charge separate fees

for them. Capitalisation of knowhow fees and royalties over and above foreign sponsored participation is also not allowed. For heavy machinery, construction machinery, motor vehicle assembly and related industries involving assembly operations, the royalty calculation is done on a "local value added" basis.

Another general guideline with regard to technology import is that the licensor must make provision for adequate training of the licensee's personnel in both the supplier's facilities and in-plant training in the local firm's plant. The agreement should define the number of personnel to be trained, the areas of training and duration of training together with arrangements and facilities. Patents involving process knowhow must also be explicitly defined in agreements and the local firm be granted user rights over such patents. Provision must be made for continued use of patents even after expiry of the agreement.

There are also guidelines for guarantee of variables such as production capacity, product quality etc. A withholding tax of 10% of all payments made to foreign suppliers of technology has to be borne by the supplier of technology. The condition that local firms be free to sell manufactured products via a licenced technology in Malaysia and other countries is also enforced by the Government.

In the mid 1980's Malaysia's total R&D investment was roughly estimated to be about 0.5% of GNP. Research activities in universities and industrial sector are concentrated mostly in research involving agricultural products. The Standards and Industrial Research Institute of Malaysia (SIRIM) does some industrial research, concentrating mainly on the utilisation of natural resources and agro waste treatment to produce energy, fabrication and design of simple machines, with the major amount of its annual budget being spent on providing industrial testing and standardisation services.

The major portion of the nation's expenditure on R&D is financed by the government through annual budgetary allocations to research institutions. Institutes like Rubber Research Institute Malaysia and the Palm Oil Research Institute Malaysia are financed by a cess collected on the basis of the amount of the commodity produced.

Since the late 1970's more attention has been given to R&D on downline agricultural products and generally to the manufacturing sector. In the early 1980's due to recession and fluctuating low commodity prices, the Malaysian government decided to emphasize on the development of high technology, capital intensive industries with the government providing both initiatives and initial inputs for large capital intensive projects such as the Heavy Industry Corporation of Malaysia (HICOM). This move was to provide a catalyst for stimulating heavy industries and encouraging the inflow of high technology. The targeted industries were pulp and paper, cement, sponge iron and a Malaysian built car. Planning was also started to develop a Malaysian micro-electronics industry.

The present Prime Minister of Malaysia on numerous occasions has indicated the importance of developing a Malaysian Research and Development base as a prerequisite to successful assimilation of technology from the industrialised countries. He has suggested that it would be useful to make it mandatory for joint venture agreements in specific industries to include R&D clauses, citing the experience in other countries in which technology transfer in industrial fields such as ship building, electronics and chemicals were accomplished through mandatory clauses in joint venture agreements. The Prime Minister has also recommended that the government work closer with the private sector in an effort to develop R&D activities in areas where there is extensive commercial potential for Malaysia.

Other policy guidelines on R&D include:

(i) Research in Malaysia must be applied research and must be relevant to social, cultural and economic needs as described in the New Economic Policy.

(ii) Research should focus in applied fields, in which Malaysia already has capabilities, such as product development in agriculture.

Before 1983, a tax deduction of 133,33 % of approved research and development expenditure was granted to firms under Section 34A of the Income Tax Act. Under Section 34A research activities which qualify for such deduction are defined as any systematic study undertaken in the field of natural or applied science for enlarging knowledge leading to and facilitating an extension of technical efficiency of the business or improving material devices, products processes and improving the welfare of workers. However this does not include:

(a) Quality control of products, or testing of materials, devices and products.
(b) Research in social sciences or amenities.
(c) Routine data collection or surveys.
(d) Management studies.
(e) Market research or sales promotion.

Research can be carried out by the tax paying industrialist or contracted to be done by any association, university, college or research institution on his or her behalf. Apart from this, buildings for research and development are also eligible for Malaysian Industrial Building allowance of 10% and annual allowance of 20%.

The Malaysian Patent System was based on the Reregistration of Patents already granted by the United Kingdom. Protection of industrial property rights was only afforded to those who had already obtained a patent in the United Kingdom and reregistered it in Malaysia. As a measure to encourage inflow of foreign technologies and in order to grant protection and provide an incentive for the promotion of local innovation and invention, the Ministry of Trade and Industry in conjunction with the Ministry of Science, Technology and the Environment has formulated a new Patents Act 1983 which has now become law.

II.6.3. PHILIPPINES

As a rule in the Philippines foreigners may invest in most business activities to the extent of 30% of the capital stock of an enterprise without seeking the approval of the Board of Investment (BOI). The foreign investor need only report his proposed activities to the BOI for record purposes. However, should a foreigner desire to invest in more than 30% of the capital stock of a company, or to establish a wholly owned foreign company, he must do so through registration with either the BOI or the Export Processing Zone Authority (EPZA).

If a foreign investor wishes to contribute more than 30% of the capital of an enterprise without seeking incentives, he may do so provided the investment is approved by the BOI and the following conditions are met:

(i) the area of activity is not fully exploited by Filipinos;

(ii) the activity will contribute to the development of the economy on a self-sustaining basis;

(iii) the activity is not in conflict with existing laws;

(iv) the operation is not inconsistent with the Investment Priorities Plan (IPP);

(v) the activity will not promote monopolies or combinations in restraint of trade.

Should the investor desire to enjoy incentives, the investment must be made in a preferred area listed in the IPP. Full foreign ownership is allowed in areas considered pioneer. However, divestment is required within 30-40 years. Firms exporting 100% of their production may have up to 100% ownership.

Should a foreign enterprise wish to invest in an activity not listed in the IPP, it may do so via a request for the inclusion of the proposed activity in the IPP or provided it makes a commitment to export at least 50% of its production. Either approach requires BOI approval. Another alternative for a foreign investor wishing to invest in an unlisted activity is to apply for registration with the EPZA and locate its facility in one of the country's export processing zones. The EPZA normally allows enterprises to conduct any type of export manufacturing activity within the zones. EPZA enterprises are not required to divest any part of their holdings to Filipinos, that is, they can remain 100% foreign-owned.

Non-Philippine nationals who enter pioneer areas or high-priority areas are granted the following incentives:

(i) exemption from all taxes under the National Internal Revenue Code, except income tax, from the date the new area of investment is included in the subsequent IPP;

(ii) post-operative tariff protection up to 50% of the dutiable value of import items similar to those being manufactured by it;

(iii) duties and taxes on importations of machinery and equipment limited to 5% customs duty and 5% internal revenue tax.

After a period of three years, a non-Philippine national enterprise may enter a preferred non-pioneer area, which is a preferred area where there are other enterprises manufacturing the same products, if the measured capacity of the area selected has not yet been filled and the non-Philippine national is otherwise qualified for registration in that area. The non-Philippine-national enterprise must obligate itself to attain the status of a Philippine national within 30 years. Upon its registration in a preferred non-pioneer area, the non-Philippine-national will be entitled to all the incentive benefits granted to a preferred non-pioneer enterprise and non-Philippine nationals who invest therein will receive the following incentive benefits:

(i) deduction from taxable income of organizational and pre-operating expenses attributable to the establishment of a registered enterprise;

(ii) accelerated depreciation of fixed assets at a rate not more than twice the normal rate;

(iii) carryover into the next six years of net operating losses incurred in any of the first ten years of operation;

(iv) partial exemption from tariff duties and compensating tax on importations of necessary machinery, equipment, and spare parts within seven years from the date of registration;

(v) tax credit equal to 100% of the value of the compensating tax and customs duties that would have been paid on machinery, equipment, and spare parts purchased from a domestic manufacturer, had these items been imported. Another tax credit equal to 50% of such compensating tax and customs duties is given to the domestic manufacturer;

(vi) credit for taxes withheld on interest payments on foreign loans under certain conditions;

(vii) the right to employ foreign nationals in supervisory, technical, or advisory positions up to five years from the date of registration;

(viii) deduction from taxable income of certain amounts to be determined by the BOI of undistributed profits reinvested by a registered enterprise in its capital stock for procurement or expansion of machinery and equipment used in its business, upon prior approval by the BOI;

(ix) antidumping protection with respect to importations of goods and commodities that unfairly or unnecessarily compete with those produced by the registered enterprise;

(x) protection from government competition;

(xi) deduction from taxable income of 50% of labour training expenses up to 10% of the direct labour wage;

(xii) protection from infringement of patents, trademarks, copyrights, trade names, and other proprietary rights.

The importation of technology per se is regulated by the Technology Transfer Board (TTB). All technology-transfer arrangements are subject to a set of policy guidelines imposed by the Board. These include:

(i) appropriateness of and need for the technology/industrial property rights;

(ii) reasonableness of the technology payment in relation to the value of the technology to the technology recipient and the national economy as well. For this purpose, the rate of payments for contracts involving manufacturing or processing technology shall not go beyond the rate that will be established by the Board for the specific technology or industrial right to be transferred;

(iii) Restrictive business clauses are not allowed in any agreement; specifically, the following clauses are prohibited:

- those which restrict the use of technology supplied after the expiry of the agreement;

- those which require payments for patents and other industrial property rights after their expiration, termination or invalidation;

- those which restrict the technology recipient from acess to continued improvements in techniques and processes related to the technology involved during the period of the agreement even if the technology recipient is willing to make additional payments thereon;

- those which provide that patentable improvements made by the technology recipient shall be patented in the name of the technology supplier to be exclusively assigned to the technology supplier; or required to be communicated to the technology supplier for its use, free of charge;

- those which require the technology recipient not to contest the validity of any of the patents of the technology supplier;

- those which restrict a non-exclusive technology recipient from obtaining patented or unpatented technology from other technology suppliers with regard to the sale or manufacture of competing products;

- those which require the technology recipient to purchase its raw materials, components and equipment from the technology supplier or person designated by him (except where it could be proved that the selling price is based on international market prices and is the same price that the supplier charges third parties and that there are no cheaper sources of supply);

- those which restrict directly or indirectly the export of the products manufactured by the technology recipient under the agreement;

- those which limit the scope, volume of production, or sale/resale prices of the products manufactured by the technology recipient;

- those which limit the research activities of the technology recipient to improve the technology;

(iv) The agreement shall provide that the law of the Philippines shall govern the interpretation of the contract;

(v) The agreement shall provide for a fixed term not exceeding five years and shall not contain an automatic renewal clause in order to ensure adequate adaptation and absorption of technology.

In cases where substantial benefits will accrue to the economy, exemption from any of the above requirements may be allowed if feasible under such guidelines as will be determined by the Board.

With respect to indigenous development of technology, the Philippines Government has declared that maximum support will be given to the development of domestic technology to achieve self-reliance in key areas. Some proposed measures include the following:

(i) The national research system will be strengthened to effectively produce technological innovations in national priority areas. The S&T council system will be oriented to ensure the timely availability of technologies;

(ii) Technology development will proceed principally from a demand-pull approach, i.e., based on potential-user needs;

(iii) Appropriate mechanisms (public and private) will be set up to hasten the commercialization and utilization of technologies developed in various research laboratories;

(iv) The immediate promulgation and implementation of laws and other legal measures providing fiscal incentives for domestic technology development and application will be worked out;

(v) Greater assistance to local inventors will be provided to raise the level and quality of inventive activity;

(vi) The development of technological capacities will be encouraged. Immediate attention will be given to strengthening design-engineering capabilities;

(vii) Linkages and interaction among design-engineering organizations, academic and research institutions, and industry will be promoted. Likewise, the further development of local engineering consultancy will be stimulated;

(viii) The selective recovery and upgrading of traditional technologies, especially in agriculture and natural resources utilization, will be given attention;

(ix) Legal measures relating to intellectual property rights and patents (with guarantees of appropriate reward for successful researchers, inventors, and innovators) will be updated and further strengthened.

To implement these measures some of the proposed incentives are as follows;

- exemption from taxes and duties on imported capital equipment and supplies;
- tax credit on domestic equipment and supplies;
- net operating loss carryover;
- tax credit for withholding tax on interest;
- employment of foreign nationals wherever necessary;
- protection of patent and other proprietary rights;
- deduction of research and development expenses, science and technology training cost and consultancy fees in computation of taxes;
- special loans for priority S&T activities and outright grants;
- assistance by government S&T agencies;
- anti-dumping protection.

II.6.4. SINGAPORE

There are no specific schemes for technology import in Singapore. However, to ensure that Singapore's local industries are competitive, the EDB encourages and facilitates the import of technology from overseas by providing various financial and tax, as well as training and business development schemes. These include the following:

(a) Multinational Corporation - Local Industry Upgrading Programme

This programme was initiated in 1986 and is aimed at promoting technology transfer between participating multinational corporations and local industries. Under the

programme, a group of small and medium enterprises are selected for focused assistance under a project manager.

(b) Joint Venture Matching Service (JVMS)

This programme is aimed at providing a channel for small and medium enterprises to upgrade, diversify and expand their operations through strategic links with foreign organisations. Local firms will have access to new technology and international linkages.

(c) Business Development Scheme (BDS)

This scheme allows local enterprises to develop business opportunities through organised overseas missions. Local enterprises will be able to study new developments in technology and management.

(d) Small Industry Technical Assistance Scheme (SITAS)

This scheme is designed to help small and medium enterprises to modernise, upgrade and improve their management and business operations through foreign expertise and training. It provides grants to cover part of the approved costs of engaging external experts and of training managerial and technical staff.

(e) Venture Capital Scheme (VCS)

In addition, the EDB has set up a venture capital fund to:

- invest directly in venture capital funds and projects; and
- co-invest in venture capital funds or projects with local companies.

Venture capital finances small and medium-sized rapidly growing private companies and can be used as a tool for promoting the transfer of technology and investments from overseas.

A number of cash-rich local companies in traditional mature businesses have already ventured into new technology investments in the United States with the intention of transferring some of the projects back to Singapore. The companies which have ventured into this area include Wearne Brother's Wearne's Technology, Natural Iron's Singawn and Singapore Technology Corporation.

With respect to indigenous technology development, Singapore provides several incentives to institutions which undertake such activities. These incentives can be divided into two categories namely R&D Grants and Tax Incentives for R&D. These are described briefly below.

1. Research and Development Grants

i) Research & Development Assistance Scheme (RDAS)

This Scheme, administered by the Science Council of Singapore, is a grant scheme to encourage medium to long term mission-oriented research projects for the

advancement of specific objectives. The scheme funds projects arising from industry, or those involving joint collaboration between industry and the public sector.

The objectives of the scheme are to:

- Help to provide training for local personnel in R&D methodologies;
- Develop the establishment of company-based R&D activities;
- Encourage cooperative R&D efforts between the public sector and industry; and
- Enhance industrial competitiveness of Singapore-made products and services.

ii) Product Development Assistance Scheme (PDAS)

This scheme, which is administered by the Economic Development Board is aimed at encouraging both large and small local companies in building up product/process design and development capability. Under this scheme, a grant up to 50 per cent of the direct costs may be given to a local company engaged in the development of new or substantially improved products or processes.

iii) Software Development Assistance Scheme (SDAS)

This scheme, which is administered by the National Computer Board is designed to encourage local companies in the business of information technology to initiate and develop innovative and high quality software products. The scheme funds the development cost in software product design, development and enhancement. It provides grants equal to 50 per cent of the approved direct development costs incurred.

2. Tax Incentives for Research and Development

The main schemes administered by the Economic Development Board are the following:

i) Pioneer Status Scheme

Longer periods of pioneer status may be considered for desirable manufacturing projects which include research and development as part of their operations.

ii) Investment Allowance Scheme (IAS)

Under this scheme, a company which incurs capital expenditure in research and development may be given an investment allowance of up to 50 per cent (in addition to the normal capital allowance) for new fixed investments by firms which undertake manufacturing, R&D and services related activities for a period upto three years. Capital investment refers to equipment and plant but excludes buildings.

The qualifying activities under this scheme are:

- Approved manufacturing and servicing activities;
- Approved specialised engineering & technical services;
- Approved research and development activities;
- Approved construction operations;
- Approved projects for reducing consumption of potable water; and
- Computer-related projects.

iii) Double Tax Deduction for R&D

This incentive may be considered for companies whose R&D activities are clearly defined (e.g. machine-oriented projects or those contracted out of local institutions like SISIR or the Applied Research Corporation [ARC]) and are incremental to that already being performed in the company.

The recurrent R&D expenditure may be deducted twice from taxable income for a period of up to five years. Under the current corporate tax rate of 40 per cent, a company spending S$1 on R&D will benefit 80 cents in taxes. Qualifying R&D expenditure includes manpower, materials and utilities.

In addition to the above special tax incentives, companies undertaking R&D projects can also avail themselves of the following incentives which are extensions of provisions under existing tax legislation:

- Accelerated depreciation over three years for all plant and machinery for Research and Development;

- Extension to R&D buildings, initial capital allowance (tax depreciation) of 25 per cent and annual allowance of three per cent on cost of building; and

- Complete exemption or reduction to 20 per cent (from 40 per cent) of withholding taxes payable in respect of payments made to non-residents for royalties, technical assistance fees or contributions in R&D.

II.6.5. THAILAND

The Board of Investment has granted various incentives to promoted investors. Important incentives other than tax and duty privileges are entry permits for skilled workers and experts to work in the promoted projects and permits for remittance of foreign exchange.

Tax and duty privileges that the Board of Investment is empowered to give a promoted project are:

- exemption from corporate income tax.
- exemption from or reduction of taxes and duties on machinery.
- reduction of taxes and duties on raw materials.
- reduction of taxes and duties for projects located in an Investment Promotion Zone.
- exemption from and reduction of taxes and duties for export production.

In considering approval of foreign investment in a wholly foreign owned project or for foreign equity participation in a joint venture to obtain promotional privilege, the Board of Investment utilizes the following criteria.

- For a project manufacturing mainly for the domestic market, foreign equity shall not exceed 49% of the registered capital.

- For a project in agriculture, animal husbandry, fishery, mineral exploration and mining, foreign equity participation shall not exceed 40% of the registered capital.

- For a project exporting at least 50% of the output, the foreign investor may hold shares comprising more than 50% of the registered capital, and comprising all registered capital if the production is totally for export.

The Board of Investment may consider waiving the above criteria when there are justifiable reasons such as a very large investment, a high level of technology, a large number of employees, a regional location, or significant social and economic benefits from the project.

Bringing in foreign technologies can be done without any constraints imposed by the government but in order to request that foreign exchange remittances for technology fees be allowed, remitting companies are required to submit, along with the request, the contracts or parts of the contracts relating to payment terms and conditions. The main purpose of this requirement is to regulate foreign exchange remittances and not to control technology transfer.

The government deems it essential for imported technologies to be adapted, to suit the local production system. Government agencies concerned with technology import, such as the Technology Transfer Center, consider adaptation of foreign technologies as one of their major policies. But for the private sector, such opportunities are limited due to commercial interests and levels of capability in technology. For the public sector, the adaptation of imported technologies is seen mostly in the agricultural sector and in small-scale industries in rural areas such as cottage industries.

Thailand has had no explicit policies or incentives for the promotion of demands for the development of indigenous technology. As it is, demands for indigenous and imported technology development have been treated equally. However, there are some implicit policies and incentives such as industry promotion policy and government agencies' bidding for commodities. Policies for promoting industrial investment give top priority to industries using local raw materials. Demand for raw materials essential for such industries has thus increased. This, in turn has brought about linkages with other sectors of the economic system and has to a certain extent benefitted indigenous technology development. In the case of Government's procurement - the bidding for commodities by government agencies and public enterprises it is stipulated that prices of goods purchased from local producers can be 15% higher than imported goods of the same type. This practice has substantially benefited local producers in their attempt to compete with producers in the world market and has had an indirect effect on the promotion of their technology.

With respect to financial incentives the Government, in 1984, approved a fund of about 15 million Baht which the private sector could borrow at concessional rates for the development of indigenous technology for commercial purposes. This fund has now been increased to 70 million baht. It was envisaged that this fund could be enhanced in future based on the demand for it. Also the Government has been considering proposals to grant tax concessions to encourage R&D efforts by firms. Both these schemes come under the purview of the Ministry of Science, Technology and Energy (MOSTE).

At present, no privileges are granted to industries using indigenous technology over those using imported technology. Export production activities enjoy the same privilege, such as exemption of import tariff on machinery, raw materials, etc. Actually, in the past, BOI-promoted projects using locally produced machinery were at a disadvantage over those using imported machinery. This was because the import of machinery was granted an exemption of import tariff. But indigenous technology users received no such privileges. Changes were made subsequently so that those using locally-produced machinery also

received the same privileges on machinery through and exemption of business tax on locally-produced machinery.

During the Sixth Plan Period (1987-1991) the Government has decided to emphasize three main areas of technology namely biotechnology, materials technology and electronics. Through the establishment of specialized centres such as the NCGEB, NECTEC and NCMMT (see section 3) the Government hopes to upgrade Thailand's technological capabilities in biotechnology-based industries, electronics and information technology-based industries and materials technology-based industries. Suitable policies and incentives are currently under consideration to facilitate this upgradation.

II.7. INTERNATIONAL COOPERATION PROGRAMS IN THE ASEAN WITH EMPHASIS ON S&T

During the last two decades there have been several developments in the ASEAN which have a distinct bearing on S&T development and its utilization for economic growth. Several cooperation programs - both international and intra-ASEAN - have been developed. These include the following:

- Asean Industrial Joint Ventures (AIJV)
- Asean Committee on Science & Technology (ASEAN-COST)
- EC-Asean S&T Cooperation
- US-Asean S&T Cooperation
- Japan-Asean S&T Cooperation

An attempt will be made in this section to briefly outline these programs.

II.7.1. ASEAN INDUSTRIAL JOINT VENTURES (AIJV)

On November 7, 1983 the Basic Agreement on ASEAN Industrial Joint Ventures (BAAIJV) was signed by the ASEAN Foreign Ministers. The BAAIJV provides a framework for industrial cooperation within the ASEAN private sector. A revised Basic Agreement was signed by the Heads of ASEAN Governments at the Summit of Manila (14-15 December 1987).

An ASEAN Industrial Joint Venture (AIJV) is an entity which:

- produces an AIJV product in any of the participating countries,

- has equity participation from nationals of at least two participating countries.

The main purpose of the AIJV system is:

- in general, to consolidate the markets of the ASEAN countries and to support joint ventures, thus contributing to strengthening the industrial base of the region. This in turn is seen as promoting greater linkages for other industries and expanding intra-ASEAN trade.

- in particular, to create an ASEAN free-trade area based on selected industrial (AIJV) products.

The list of AIJV consists solely of processed or manufactured products (excluding products from the primary or the tertiary sector). A local content of 35% is necessary (42% for Indonesia).

The AIJV products list can become an important instrument for promoting selective industrial cooperation and development within the Asean region. Products of AIJV's are to get a 90% margin of preference (MOP) instead of 75%. The ASEAN Committee on Industry, Minerals and Energy (COIME) invites tentative nominations for AIJV from the

ASEAN Chamber of Commerce and Industry (ACCI) and ASEAN member countries through their respective Boards of Investment. The list of AIJV products is finally approved by the Asean Economic Ministers, and thereafter by the ACCI, the national Boards of Investment and various national Chambers of Commerce and Industry.

A minimum 5% equity contribution from nationals of each participating country in an AIJV is required. The ceiling on non-ASEAN equity in AIJV's can be raised to 60% from the present 49% for applications submitted before 31 December 1990.

A survey initiated by the Commission of the European Communities and prepared by a German consultant (EC-ASEAN Industrial Cooperation, European Community, Brussels, September 1988) confirmed the interests of ASEAN ministers in EC-Asean industrial cooperation through the AIJV scheme. The survey also has identified 25 highly promising product groups with potentials for industrial cooperation or that may be promoted on an AIJV basis. Among these, the following technology-intensive products can be mentioned: hard rubber technical products, electric tools up to 2 Kw, office machines, electric equipment, machining and precision tools, automatic data processing equipment, and others.

In 1986 at the 28th Council Meeting of the ASEAN Chambers of Commerce and Industry a proposal was made to study and recommend measures for the advancement of ASEAN economic cooperation and integration. A group of 14 was established for this purpose. The recommendations of this group included the following two major initiatives which can have a major impact on AIJV.

- the launching of an ASEAN Market Liberalisation Initiative

- forging a new era of ASEAN industrialization by improving, among others, the AIJV industrial cooperation schemes, and by accrediting more existing industrial projects with ASEAN status if they comply with BAAIJV.

II.7.2. ASEAN - COMMITTEE ON SCIENCE AND TECHNOLOGY (ASEAN-COST)

ASEAN regional S&T cooperation started in 1970. A Permanent Committee on Science and Technology was established in 1971, becoming the present Committee on Science and Technology (COST) in 1977. COST aims at promoting regional S&T cooperation. COST has set up a number of Sub-Committees and Working Groups, in order to administer the various technical projects. COST developed in 1980, an ASEAN Plan of Action on S&T, to provide the basis for continuing support for ASEAN S&T programmes. In that Plan, the major programme areas identified to strengthen S&T capabilities of ASEAN at both national and regional level were:

- food and agricultural development,
- energy and natural resources development,
- manufacturing industries, transportation and communications development,
- health and social development,
- S&T infrastructural development,
- environment.

As some of the ASEAN Economic Committees have interest in programmes touching upon S&T, ASEAN decided that as a general guideline COST would deal with R&D activities, while the other ASEAN Economic Committees like the Committee on Industry, Minerals and Energy (COIME) would focus their attention on projects at the production and commercial stage.

Among the on-going COST projects special mention can be made of :

- the project on management and utilisation of food waste materials, initiated in 1980, with the help of Australia,

- the project on food technology R&D, starting in 1982, funded by the ASEAN-Australian Economic Cooperation Programme,

- the projects on non-conventional energy, under collaborative programmes with Australia, Canada, the EC and the USA,

- the project on the management of S&T launched in 1985.

COST has been responsible for the organisation of the ASEAN Science and Technology Week, during which key people and top professionals from ASEAN and the industrial dialogue partners (Australia, Canada, EC,US) meet, and conferences, exhibitions and fairs are held, etc. These ASEAN S&T Weeks are organised triennially on a rotational basis among ASEAN countries (the first in Kuala Lumpur in 1986, the second in Manila in 1989).

COST has also developed collaborative programmes in the field of materials processing, metal corrosion, biotechnology and microprocessor applications.

At the 4th Meeting of the ASEAN Ministers for Science and Technology (Manila, January 1989), the ASEAN Plan of Action on Science and Technology was finally adopted. The following policy guidelines were agreed to implement the Plan:

- ASEAN S&T cooperation shall emphasise food, biotechnology, microelectronics and computers, materials science and technology, non-conventional energy, marine sciences, meteorology and geophysics, remote sensing, and the development of S&T infrastructure and resources,

- the encouragement of technology transfer and the commercialisation of research results with a view to promoting investments in ASEAN,

- emphasis on human resources development,

- the intensification of the dissemination of scientific and technical information,

- cooperation in the development of software and hardware components of information technology.

These guidelines have served as a basis for ASEAN formulating S&T cooperation programs with EC, USA, Japan and other leading countries.

II.7.3. EC-ASEAN S&T COOPERATION

Since the inception of the ASEAN-EC cooperation agreement in 1980, ASEAN-EC relations appear to have become very important especially in the fields of trade, economic cooperation schemes such as European investment in ASEAN, training, science and technology, and industrial cooperation. The EC has been important for ASEAN also as a major source of development assistance to the region.

II.7.3.1. Trade Relations

The export-import relations between EC and ASEAN have shown a steady increase. Total trade, EEC exports to ASEAN and EEC imports from ASEAN have increased during the period 1980 to 1987 by 55%, 65.8% and 46.2% respectively.

The more important features in the trade relations between the two are as follows:

- The EC was the third biggest export market for ASEAN in 1986
- The EC was the third largest supplier to ASEAN in 1986
- The EC accounts for a significant share of manufactured products from ASEAN
- Textiles and clothing imports to EC from ASEAN are becoming more and more significant.

II.7.3.2. Economic cooperation

The EC-ASEAN ministerial meeting in Jakarta in 1986 marked an important landmark in the promotion of investment by EC in ASEAN countries. The introduction of "Partner Research Network" was seen as a means of encouraging joint ventures between EC and ASEAN.

The establishment of Joint Investment Committees (JIC) in 1987 and 1988 in the ASEAN countries was intended to encourage and investigate investment opportunities in the ASEAN countries.

The JIC generated projects, among others, are topped by:

- the establishment of an Investment Advisory Unit at the European Chamber of Commerce;
- market researches;
- a study of the Custom System in ASEAN countries;
- the promotion of ASEAN countries to be host countries for European investment (Mini-Ambassadors Program).

Industrial cooperation activities between EC and ASEAN are aimed at improving and encouraging business contacts. These programs mainly support investors of EC in finding business opportunities in the ASEAN region through publications such as investment guidelines. The major steps taken in this regard include human resource development activities between EC and ASEAN. These progressed rapidly after the meeting on economic

matters in Bangkok in October, 1985. The most important projects that have been initiated in this regard are:

- The establishment of a Data Bank on training opportunities in the EEC which would identify training opportunities available for ASEAN graduates and professionals.

- The Executive Exchange Program which would facilitate the exchange of executives between EC and ASEAN and lead to the familiarisation of the business environments in both regions.

- The Business Familiarization Program which would allow ASEAN executives to become acquainted with ASEAN firms and business environments through visits to EC corporations and Chambers of Commerce.

- The Business Graduate Placement Program for ASEAN business management teachers in the form of series of annual seminars organized by the European Asian Center and INSEAD

- The Management Centre which is expected to be used in promoting training in public and business management in ASEAN.

- Public Administration training for ASEAN officials by the European Institute of Public Administration (EIPA)

- Civil Aviation where the ASEAN-EC Ministerial Meeting in Bangkok identified two major areas under this namely, air traffic control and airport management

- Container Terminal Management for providing training and technical advice to ASEAN authorities

In addition to these, industrial technical training and development and project management programs are included.

II.7.3.3. Science and technology

EC-ASEAN cooperation in the field of S&T has been mainly concentrated in three major areas :

- Technical assistance for upgrading S&T capacities and development of national industrial research institutes. Under this program, since 1982, 27 scientific advisory actions, 12 seminars have been carried out. Other similar activities are in progress.

- Joint scientific research projects in the areas of environmental planning, biotechnology and health care.

- The Science and Technology for Development (STD) research program which is being carried out in phases through various research projects. During 1984-1985, 39 such projects were carried out and the period 1987-1991 is expected to see more extensive cooperation in this regard between EC-ASEAN.

The EC-ASEAN Energy Management Training and Research Center established in Jakarta serves as a research and training center for energy management for the ASEAN countries.

Another area of S&T cooperation is the Regional Development Cooperation Program which provides programs in the areas of:

- Grains post harvest technology;
- Timber technology (through the ASEAN Timber Technology Centre in Kuala Lumpur);
- Aquaculture development;
- Industrial standards and quality control;
- Marine fisheries resource assessment and training.

In general, the EC assistance for ASEAN countries for 1980-1986 in the form of financial and technical assistance has been mainly concentrated in projects on:

- Irrigation;
- Agriculture research and training;
- Fisheries;
- Industrial development.

The area of biotechnology has become an important area for cooperation especially after the ASEAN-EC Seminar on Biotechnology held in November 1983 in Singapore. In this regard, EC has expressed special interest in the area of nitrogen fixation.

Also, environmental improvement programs have been an important area between EC and ASEAN. Under this, during 1985-1986, a funding of 435,000 ECU was allocated for the project entitled "Upgrading ASEAN Capability in Air Pollution Control and Monitoring". The most important activities under this program were:

- A training course-cum-study tour in Italy by 10 scientists and technologists from ASEAN (April-June 1985);

- An ASEAN-EC workshop on Air Pollution Monitoring in June 1985 in Bangkok;

- An EC expert mission on Air Pollution Control and Monitoring in September-October 1985.

The third project item mentioned above and another proposal for a project entitled, "Urban Air Quality Monitoring through the Establishment of Networks" is being funded (about 1.2 m ECU for a period of five years) by EC starting from 1986.

II.7.3.4. EC-ASEAN Industrial cooperation

At the 7th EC/ASEAN Ministerial meeting in Dusseldorf (May, 1988), a memorandum on EC/ASEAN industrial cooperation was prepared and endorsed by the next meeting in Brussels, (30th November - 1st December 1988). EC-ASEAN industrial cooperation was initiated with a view towards enhancing investment promotion, cooperation in the public and private sectors, and developing closer contacts between EC and ASEAN economic enterprises.

The identification of selected product sectors which could benefit through the ASEAN Industrial Joint Venture Scheme (AIJV) focused on 7 main groups, namely, rubber based products, metal cutting machines and related products, chipless metal working machines, wood-working machines, rubber and plastic processing machines, food processing and packaging machines, and food, fruit, vegetable and fish processing.

II.7.4. US-ASEAN S&T cooperation

Since the beginning of US-ASEAN cooperation in 1979, active cooperation is seen in several areas, namely, agriculture, health, energy and natural resources.

The summit of the ASEAN Heads of Government held in Manila in 1987 followed an Eighth US-ASEAN Dialogue which aimed at increased emphasis on trade, investment and technology transfer activities. Human resource development was seen as a priority area to be improved to support these activities.

The three areas of emphasis of US-ASEAN development are trade, investment and the commercialization of technology.

- The ASEAN-US Initiation (AUI) is a new ASEAN-US mutual trade and investment benefit study financed jointly by both US and ASEAN. The automated tariff and trade data base which could facilitate trade activities between US and ASEAN as well as ASEAN-ASEAN is carried out with the cooperation of the United States Trade Representative (USTR).

- The activities under the area of investment have brought in a new proposal for a project named Private Investment and Trade Opportunities (PITO) which is expected to enhance private sector investment and trade. The objectives of PITO are:

  - to act a forum which would bring private and public sector investment together;
  - to promote US investment in the region;
  - to facilitate the creation of ASEAN Industrial Joint Ventures (AIJV) to overcome the problems faced by investors from US such as complex bilateral rules, inadequate information about investment opportunities, banking and equity and foreign exchange limits and lack of a true regional market.

- The technology component has a project named Technology for Growth (TFG) the main purpose of which is the commercialization of technology. The objectives of this project are:

  - to facilitate technology adaptation and transfer;
  - to improve quality control and standards and testing facilities in ASEAN;
  - to support legal adoption of imported technology.

II.7.4.1. USAID-ASEAN

With the assistance of USAID, projects have been initiated to facilitate cooperation between US and ASEAN.

One such project is intended to overcome the problems faced by AIJV's and facilitate the development of the following:

a) a policy environment conducive to domestic and foreign investment;
b) partnership between private and public sectors;
c) information on ASEAN as a market as well as a place for investment opportunities;
d) expansion of commercial activities with the US.

More specifically, the objectives of this cooperation project are:

- improvement of the environment for private investment;
- promotion of the development of a regional market;
- identification of opportunities for the private sector participation in both ASEAN and US economies;
- increase of US-ASEAN joint ventures;
- strengthening ASEAN financial markets;
- fostering private and public sector cooperation.

Along these lines, the project is intended to focus on 3 main components:

- policy analysis and support
- investment promotion
- capital markets development

II.7.4.1.1. Policy analysis and support

This program is expected to develop a regional institution into a center for ASEAN business development which can facilitate investment promotion. This centre will:

- carry out policy studies;
- provide technical assistance to ASEAN governments and private organizations; and
- conduct workshops and seminars.

Examples of topics that this centre may examine include the following:

- banking regulations;
- an ASEAN equities exchange;
- development of accounting and financial reporting procedures;
- standard licensing rules, procedures and protection for ASEAN investments;
- support needed for ASEAN to reduce investment barriers and streamlining procedures;
- support for ASEAN efforts to create a Private Sector Commodity Board or Exchange;
- examination of the issues to reactivate the special committee of ASEAN banks and monetary authorities.

II.7.4.1.2. Investment promotion

This component is expected to provide investment assistance to US firms and ASEAN firms which export commodities to US. The joint ventures coming under AIJV are also included. The areas of assistance are investment, market relationships and AIJV.

- Investment

  Activities in this area include:

  - preparation of a profile of investment opportunities in ASEAN;
  - feasibility studies through US Trade and Development Program (TDP);
  - sponsoring investment missions, workshops, business exchange etc.;
  - supporting marketing in the region and servicing investment;
  - assistance for US investors to understand ASEAN accounting practices;
  - promotion of joint ventures.

- US-ASEAN Market Relationships

  Activities in this area include identification of US firms interested in ASEAN, broker trade relationships between US and ASEAN and providing assistance for seminars on US import considerations, the General System of Preferences (GSP), and on packaging and display.

- Activities also include the promotion of AIJV by supporting the streamlining of complicated approval processes and promotion of the AIJV to include general and screened US groups.

To promote US-ASEAN investment and trade activities, the US-ASEAN Center for Technology Exchange (CTE) established in 1984 is expected to be supported by this project. The CTE has developed a network with regional businesses, US-ASEAN Business Council and the American Chamber of Commerce.

II.7.4.1.3. ASEAN Capital markets

The question of access to private equity capital is a major constraint for expansion of investment and hence the project will try to ease this situation in the ASEAN region by considering the following possibilities:

- an ASEAN growth fund
- an ASEAN reinsurance fund
- an ASEAN bankers acceptance market
- a regional equities market

The most promising one appears to be the ASEAN Growth Fund which is expected to serve not only as a source of equity funding for chosen private sector projects but also as a means of industrial diversification, technology development, adaptation, and transfer and establishing linkages among US joint ventures. The Fund could provide equity financing to a wide range of manufacturing and agro-industrial ventures.

The project's cost is shared by approximately 25% by ASEAN and 75% by USAID. The budget shows that 1.85 m, 2.55 m and 2.55 m US$ are shared by USAID for 1989, 1990 and 1991 respectively while 0.45 m, 0.65 m and 0.65 m US$ are shared by ASEAN for 1989, 1990 and 1991 respectively.

II.7.4.2. US-ASEAN (COST) - Energy development

The COST has programs in energy related activities with several countries joining it. US is a major partner with ASEAN-COST in energy programs. The US-ASEAN energy cooperation started in 1980 and has 3 distinct phases.

First Phase

This stage was allocated an amount of US$ 0.44 m and covered mainly 4 areas;

- technical assistance by sending a US expert to the Asian Institute of Technology (AIT)
- two-week seminar on planning and programing of R&D projects on Alternative Energy Development held in Bandung in 1982
- 10 fellowships granted to ASEAN students to study energy technology at AIT
- provision of support to AIT's Renewable Energy Resource and Information Center (RERIC)

Second Phase

This phase had 3 main areas and an allocation of US$1 million.

- Coal Training

  Training started in January 1983 for 8 weeks for 30 ASEAN participants at Argonne National Laboratory. Those who participated were given 2-6 months on-the-job-training.

- Energy Conservation in Buildings

  Energy control in buildings with the use of computer programs developed in US was tested in Singapore's Lawrence Berkeley Laboratory and the Singapore Public Works Department. The result of this was made known to the participants at the Regional ASEAN Conference on Energy Conservation in Buildings held in Singapore in May 1984.

- A demonstration site for water pumping technologies (photovoltaic, gasfier drives etc.) was established in Malaysia.

Third Phase

This phase has got an allocation of US$5 m and covers a five-year-period from July 1985. The two main components coming under this phase are:

- energy conservation in buildings; and
- training in coal technology and energy management.

The first component includes training on energy conservation in buildings, technologies and economics, research work on important aspects of energy use, and management of policies.

The second component includes:

- formal and on-the-job-training for 20 ASEAN engineers in the areas of coal use in electric power and industrial plants and coke production;
- provision of support to AIT in energy planning;
- training in energy management in Malaysia and specialized training in US.

II.7.4.3. US-ASEAN (COST) - Environment

The ASEAN project in toxic and hazardous chemicals and wastes is an example of US contribution to environment improvements in ASEAN. This project has mainly two components namely workshops and study tours to US. The assistance in the management of ASEAN heritage parks and reserves is an example of US cooperation with ASEAN in nature conservation.

II.7.4.4. US-ASEAN - Marine science

The project on US-ASEAN Coastal Reserves Management (1985-1988) was a major project under marine science, covering the fields of aquaculture, fisheries and forestry. The major areas of thrust of this project are:

- living resource assessment, planning and research;
- training and information dissemination.

The project was funded by US and ASEAN with US$5 m being provided by US and US$1.75 m (in kind) by ASEAN. The implementation of the project was coordinated by the International Center for Living Aquatic Resources Management (ICLARM).

Under this cooperation program each ASEAN country had proposed sub-programs as well. These were:

- research on fisheries reserve assessment and coastal reserve management (Indonesia);
- research on integrated coastal resource management (Philippines);
- effects of land reclamation on living coastal resources in Singapore (Singapore);
- development of marine finfish farming systems (Singapore); and
- research on integrated coastal reserve development and planning of the upper south coastal development (Thailand).

II.7.5. Japan-ASEAN S&T cooperation

The cooperation between ASEAN and Japan has been significant in the past. The main reasons for this, may be the rapid economic and technological development of Japan, its proximity to the ASEAN region and the fast economic growth in the ASEAN countries the leaders of which also attached great importance to regional cooperation.

A series of cooperation activities in S&T are currently being executed by Japan and ASEAN. Seminars and workshops conducted for various S&T activities appear to be quite prominent in this area. Some of the important completed and planned activities are discussed below.

II.7.5.1. Seminars and workshops

Some major activities in this area include:

- ASEAN Food Conference with the participation of Japanese experts in Thailand in October 1988;

- Participation of five Japanese experts at SASTW (Second ASEAN S&T Week) Technical Sessions which was also attended by the Japanese private sector.

- Research activities in the field of materials science and technology, in the areas of:

  - corrosion technology of structures;
  - characterization of polymeric materials;
  - technology for preparation and characterization of fine ceramics; and
  - evaluation of corrosion resistance of metallic materials.

An important landmark in ASEAN-Japan cooperation is considered to be the Seminar on Corrosion of Structures held in June 1989 in Singapore in which the importance of Japan-ASEAN cooperation in materials science and technology was emphasized. The importance of Japan's intervention and provision of advanced equipment and the need for cooperation among scientists of ASEAN and Japan were matters that were discussed at the seminar.

Future cooperation is envisaged in the areas of new advanced technologies such as microelectronics, biotechnology (research, development and application of enzyme technology) and computer technology.

Many activities have been planned for 1990 in the form of seminars and workshops. The planned seminars and workshops are in the following areas

- corrosion of structures;
- characterization of polymeric materials and fine ceramics;
- investigation methods of existing structures;
- Instrumental analysis, sample preparation technologies, monitoring and evaluation methods for fine ceramics and corrosion.

II.7.5.2. Collaborative research work planned for 1990

Collaborative ASEAN-Japan research work for 1990 includes topics on:

- polymers;
- preparation of rare earth addition glass;
- atmospheric corrosivity;
- corrosion of steel;
- tests on corrosion of materials.

After the 2nd ASEAN-Japan senior officials meeting on science and technology held in December, 1984, projects in the area of material science have received great emphasis. Japan's support in this regard mainly covers the following areas:

(a) technology assistance for corrosion resistance of metallic materials;

(b) research on corrosion of steel structures, concrete structures and building materials;

(c) research on inorganic materials;

(d) utilization of renewable biomass resources;

(e) advanced technology in glass;

(f) modification of polymeric materials.

The projects undertaken by Philippines and Thailand are (a), Brunei and Singapore (b), Malaysia (c) and Indonesia (f).

II.7.5.3. Microelectronics

Cooperation in this area has been mainly in providing training opportunities. Several fellowships have been granted during 1985-1986 for study in the fields of computers, computer management, robotics and automation. These are being coordinated by JICA (Japanese International Cooperation Agency).

II.8. SCOPE FOR COOPERATION BETWEEN EC AND ASEAN IN THE FIELD OF SCIENCE AND TECHNOLOGY

While the ideal approach to identify areas of potential cooperation would be to examine the S&T needs of each of the ASEAN countries in a comprehensive manner, this would not be possible in a literature-based study of this nature. However, one way of identifying technological needs would be to examine the current areas of S&T cooperation between ASEAN and the advanced countries. Another approach would be to identify the sectors where the ASEAN countries are currently having or increasing their revealed comparative advantage in international trade. It may also be useful to look at areas where import substitution is possible. The areas for cooperation suggested in this section are based on these consideration.

II.8.1. AREAS FOR POTENTIAL COOPERATION

Industrial Cooperation

The EC in a 1988 study entitled, "EC-ASEAN Industrial Cooperation" has identified some "promising" areas for industrial cooperation between the ASEAN countries and itself. These areas have been identified based on export performance and import patterns. Such industries if set up in the ASEAN countries can facilitate export growth while enhancing import substitution. A potential, but certainly not comprehensive, list of such areas are listed below based on the study by Cuyvers [24] and the EC report.

Indonesia

Quarrying	-	grinding wheels
Casting	-	iron,steel and malleable castings
Forging	-	drop forgings, hammer forgings
Steel Construction	-	steam boilers
Machinery	-	machine tools, mechanical testing machines, pumps and compressors, weighing machines, material handling equipment
Specialised Machinery	-	machinery for food, chemical, ceramics, glass and textile industries, hydraulics and pneumatic control,
Electrical	-	motors, generators, measuring instruments, medical equipment
Electrical (household)	-	washing machines
Precision/Optical	-	measuring devices, microscopes, lenses, navigation instruments, measuring devices, domestic water meters, medical examination instruments

Tools	-	assembly tools, carbide tipped tools
Sports goods	-	lawn sports goods, water sports goods
Jewellery	-	gold and silver jewellery, cut precious stones
Chemicals	-	synthetic fibres, dyes and pants, pharmaceuticals, protective materials for buildings.
Office Machines	-	typewriters, calculators, accounting machines, cash registers, components for such machines
Ceramics	-	insulators, technical fine ceramics
Glass	-	blank flat glass, roughed and smoothed glass
Wood	-	plywood, wicker furniture, office/school furniture, paint brushes, brooms
Plastics	-	parts for precision and optical products, machines, vehicles, and electrical goods
Rubber	-	soft rubber products for technical, medical and sanitary use, hard rubber technical products.

Malaysia

Quarrying	-	grinding wheels
Casting	-	iron, steel and malleable castings
Forging	-	screws, standard and form-turned parts
Machinery	-	machine tools, pumps and compressors, weighing machines, material handling equipment
Specialized Machinery	-	machinery for food, textiles, rubber, plastic industries, agricultural and construction equipment water craft
Automobiles	-	motor vehicle components
Electrical	-	motors, generators, transformers, capacitors, switchgear and systems, electric tools, welding equipment
Electrical (Household)	-	lighting, heating, cooling and washing machines, radios, TV
Precision/Optical	-	measuring devices, microscopes, lenses, medical examination instruments, cameras, photocopying apparatus, clocks
Tools	-	saws, saw blades

Metal Products	-	furniture, locks
Sports goods	-	lawn sports goods, water sports goods
Jewellery	-	gold and silver jewellery, cut precious stones
Chemicals	-	synthetic fibres, dyes and paints, pharmaceuticals, fertilizers, pesticides, plastics, synthetic rubber, toilet chemicals, abrasive
Office Machines	-	EDP equipment, memory units, I/O units,
Ceramics	-	sanitary ceramics
Glass	-	blank flat glass, hollow glass ware, roughed and smoothed glass.
Toys	-	general

Philippines

Quarrying	-	grinding wheels, abrasive papers
Metal	-	semifinished products of non-ferrous metals and precious metals
Forging	-	screws, standard and form-turned parts
Machinery	-	machine tools, mechanical testing machines, pumps and compressors, weighing machines, material handling equipment
Specialized Machinery	-	machinery for food, ceramics, glass, textile, plastics, rubber, paper, printing, shoe and leather industries, water craft
Electrical	-	motors, generators, measuring instruments, transformers, capacitors, switchgear and systems, welding equipment, medical equipment, signalling and safety equipment, electromagnetic equipment
Electrical (Specialized)	-	thermionic tubes, telecommunication
Precision/Optical	-	balances, measuring devices
Metal Products	-	tableware, fancy goods
Sports goods	-	lawn sports goods, water sports goods
Chemicals	-	synthetic fibres, dyes and paints, pharmaceuticals, fertilizers, pesticides

Office Machines	-	EDP equipment, memory units, I/O units,
Ceramics	-	chinaware, pottery, crockery, stoneware, sanitary ceramics, tiles, architectural ceramics, dental porcelain
Glass	-	glass blowing products
Wood	-	wicker furniture, office/school furniture,
Paper	-	pulp, reels and sheets, cardboard, office supplies
Plastics	-	parts for fabricated metal products, sacks and bags

Singapore

Casting	-	iron, steel and malleable castings
Forging	-	drop forgings, hammer forgings, sintered products
machinery	-	machine tools, mechanical testing machines, IC engines
Specialized Machinery	-	machinery for food industries
Electrical	-	motors, generators
Electrical (specialized)	-	telecommunications
Precision/Optical	-	medical instruments
Metal Products	-	metal tapes, foils, powders, cans, tubes and caps
Chemicals	-	pharmaceuticals, abrasive compounds, building protective materials, toilet chemicals
Office Machines	-	EDP equipment
Food	-	processed fruits and vegetables

Thailand

Casting	-	iron, steel and malleable castings
Forging	-	drop forgings, hammer forgings, screw, standard and form turned parts, metal springs, sintered products
Machinery	-	machine tools, pumps and compressors, weighing machines, compressed air equipment, ventilating equipment, materials handling equipment

Specialized Machinery	-	machinery for food, ceramics, glass, textiles, shoes, leather, building material and paper industries, agricultural and industrial cooling and refrigeration machinery
Automobiles	-	motor vehicle components
Electrical	-	motors, generators, switchgear and systems, electric tools, welding equipment
Electrical (Household)	-	washing machines
Electrical (Specialized)	-	medical equipment, signalling and safety equipment
Precision/Optical	-	measuring devices, microscopes, lenses, medical examination instruments, cameras, photocopying apparatus, geophysical instruments
Tools	-	tool bits, nippers, plate shears, files
Sports Goods	-	lawn sports, water sports
Jewellery	-	gold and silver jewellery, cut precious stones
Chemicals	-	dyes and paints, pharmaceutics, protective materials for buildings, plastics, synthetic rubber
Office Machines	-	EDP equipment, memory units, I/O units
Ceramics	-	chinaware, pottery, crockery, stoneware, dental porcelain, sanitary ware, insulators, technical fine ceramics, architectural ceramics
Glass	-	blank flat glass, hollow glass ware, glass blowing products
Wood	-	preserved wood, wood cases, paint brushes, brushes, brooms
Paper	-	pulp, reels and sheets, cardboard
Plastics	-	semi-products, parts for machines, vehicles and electrical products
Rubber	-	soft rubber products for technical, medical and sanitary use, hard rubber technical products
Toys	-	small musical instruments, general
Leather	-	uppers, linings, heavy leather, fancy leather goods, work shoes and boots
Textiles	-	yarns

Clothes	-	outerwear, furs, leather clothing, corset ware
Food	-	grinding and peeling products, processed fruits and vegetables, fish and fish products, tobacco products.

The above list while indicating several areas for industrial cooperation shows that most of the ASEAN countries either produce or want to produce similar goods. This could be due to their resource endowments being similar. This was quoted by many Thai officials as one reason why AIJV are facing difficulties - the countries are really competing with one another in the international markets.

Standardization and Quality Assurance

This is an area where considerable potential exists especially in the light of Europe 1992. Many of the ASEAN countries are uncertain of their future markets in Europe and are keen to ensure that non-corformity to standards does not become a reason for shutting out ASEAN exports.

Human Resources Development

This is again another area where considerable cooperation has taken place in the past as outlined in Part II.7. These can be continued and strengthened further with a view towards alleviating the skill shortages in the ASEAN region. The establishment of EC sponsored training institutes for technicians and skilled workers may help EC-ASEAN joint ventures to overcome problems of skill shortages.

Support for R&D Activities

Currently the EC is supporting R&D activities in the ASEAN region in selected areas. Since all the ASEAN countries appear to have identified biotechnology-based industries, materials technology-based industries and electronics and information technology-based industries as their leader sectors, commercially oriented R&D projects in these area would have a beneficial impact on ASEAN industry. Joint R&D ventures in these areas are attractive propositions. However, inadequate intellectual property protection in the ASEAN countries, with the exception of one or two countries, appears to be a barrier in formulating such programs.

Environment

The ASEAN countries, as experience has shown, are gravely concerned about the environment. The intensity of environmental protection and conservation activities differ from one country to another. However, this is a promising area for cooperation between ASEAN and the EC not only in terms of providing training and consultancy but also in designing and implementing schemes for conserving and protecting the environment.

The above mentioned proposals are intended to highlight the broad areas within which specific programs can be formulated. However, as past experience has indicated it may be easier to formulate bilateral agreements between the EC and the ASEAN countries. EC-ASEAN multilateral programs could be time consuming in their formulation and implementation.

ANNEXES

ANNEX 1 - STATISTICAL TABLES

ANNEX 2 - LIST OF KEY PERSONS PARTICIPATING AT THE EC SPONSORED WORKSHOP "S&T DEVELOPMENT IN ASEAN COUNTRIES : PROBLEMS, PROSPECTS, SCOPE FOR COOPERATION WITH THE EC", BANGKOK, 7-8 JUNE 1990

TABLE 1 : Socioeconomic statistics of five Asean countries

Items	Indonesia	Malaysia	Philippines	Singapore	Thailand
General					
Land Area (sq.km)	1,919,443	329,293	299,998	636	514
Population (1988) millions	175.90	17.00	58.70	2.64	54.6
Population growth rate per annum (% 1988)	2.00	2.50	2.35	1.00	1.7
Economic					
GDP (US$ bn, 1988)	73	34	39	24	55
Rate of real GDP growth (% 1988)	6.0	8.7	4.6	6.0	11.0
Real per capita GDP (US$ 1988)	416	2,010	662	9,040	1,000
Labour force (1988) millions	70.6	6.6	23.5	29.7	1.28
Growth rate per annum (% 1988)	3.2	2.7	2.5	2.0	1.5
Inflation rate (% 1987)	<10	4	7.5	1	2.5
Currency	Rupiah	M$	Peso	S$	Baht
Exchange rate estimated to 1 US$ Average (mid-1988)	1,788	2.68	20.8	2	25

Source : Technology Climate Assesment, APCTT, Bangalore, 1989
Asian Business (Sep.1989)
Asian Business (Jan.1990)
Asian Business (Mar.1990)
EC-Asean Industrial Cooperation Survey Initiated by The Commission of the European Communities, Brussels, 1988.

TABLE 2 : Exports & imports 1984-1988 (in US$ millions)

Country Export/import	1984	1985	1986	1987	1988
Indonesia					
- Exports	21,902	18,590	14,824	17,135	19,465
- Imports	13,882	10,259	10,718	12,512	13,492
Malaysia					
- Exports	16,590	15,442	13,753	17,939	21,110
- Imports	14,069	12,301	10,823	12,701	16,551
Philippines					
- Exports	5,274	4,607	4,770	5,649	7,032
- Imports	6,432	5,459	5,394	7,144	8,721
Singapore					
- Exports	24,070	22,812	22,495	28,687	39,307
- Imports	28,667	26,285	25,511	32,559	43,870
Thailand					
- Exports	7,413	7,120	8,868	11,665	15,716
- Imports	10,398	9,242	9,178	13,006	19,539

Source : International Financial Statistics Year Book, 1989,
International Monetary Fund, Washington D.C., 1989

TABLE 3 : Major exports and imports of five Asean countries

Indonesia	
Major exports	Major imports
Oil and gas	Machinery and transport equipment
Coffee	Chemicals
Spices	Manufactured goods
Shrimps	Minerals, fuels and lubricants
Plywood	Crude materials
Sawn wood	Food and live animals
Garments	Beverages, tobacco
Rubber	Vehicles
Palm oil	Animal oil
Aluminium	
Nickel materials	
Electric appliances	
Processed goods	
Fertilizers	
Paper/paper goods	
Rattan	
Copper	
Tin	
Gold	

Malaysia	
Major exports	Major imports
Electric machinery and appliances	Intermediate goods
Electric components	Consumption goods
Crude petroleum	Investment goods
Sawlogs and sawn timber	Imports for re-export
Natural rubber	
Palm oil, crude & refined	
Textiles, clothing and foot wear	
Chemical and petroleum	

Philippines	
Major exports	Major imports
Dessicated coconut	Raw materials
Sugar	Fuels, lubricants
Electronic micro-circuits	Electrical machinery, apparatus and appliances
Garments	
Wood manufactures	Chemical elements and components
Coconut oil	Transport equipment
Shrimps and prawns	Electronic parts
Bananas	Plastic material
Copper concentrates	Cereals and cereal products
Canned pineapple	Manufacturing of metals
Lumber	

Singapore	
Major exports	Major imports
Electronic components	Electrical machinery
Computers	Fuel
Automated office machines	Industrial machinery
Refined oil	Textile manufacturers
Industrial inputs	Transport equipment
Crude rubber	Plastic material
Clothing	Photographic apparatus
Textile manufactures	Road vehicles
Plastic materials	Iron and steel
Organic chemicals	
Transport equipment	
Thailand	
Major exports	Major imports
Textiles	Non-electrical industrial machinery and components
Rice	Diesel oil
Tapioca products	Chemicals
Integrated circuits	Fuel & lubricants
Precious stones	Iron and steel
Jewelry	Vehicles and parts
Canned fish	Food and beverages
Footwear	Electrical appliances
Maize	Fibers for weaving

Sources : Asian Business (Sep.1989)
Asian Business (Jan.1990)
Asian Business (Mar.1990)
EC-Asean Industrial Cooperation Survey Initiated by the Commission of the European Communities, Brussels, 1988

TABLE 4 : Import-export ratios of five Asean countries

Description	Import-export ratios				
	1982	1983	1984	1985	1986
Food items (SITC 0,1,4)					
- Indonesia	1.05	0.91	0.84		
- Malaysia	0.73	0.46	0.48	0.52	0.57
- Philippines	0.52	0.46	0.34	0.47	0.44
- Singapore	1.36	1.59	1.30	1.46	1.34
- Thailand	0.10	0.13	0.14	0.15	0.16
- Asean	0.60	0.58	0.51		
Raw Materials (SITC 2,3)					
- Indonesia	0.21	0.27	0.21		
- Malaysia	0.24	0.31	0.23	0.25	0.21
- Philippines	2.73	2.81	2.87	3.26	2.03
- Singapore	1.50	1.30	1.18	1.17	1.04
- Thailand	4.44	4.17	3.60	3.20	2.11
- Asean	0.56	0.60	0.52		
Processed materials (SITC 5,6)					
- Indonesia	4.42	2.90	1.92		
- Malaysia	2.49	2.21	2.60	2.03	2.17
- Philippines	4.33	4.00	2.70	1.90	2.16
- Singapore	1.44	1.95	1.81	1.56	1.63
- Thailand	1.98	2.65	2.37	2.08	1.92
- Asean	2.31	2.47	2.13		
Machinery & equipment (SITC 7)					
- Indonesia	34.90	43.29	22.75		
- Malaysia	2.66	2.33	2.07	1.88	1.40
- Philippines	10.67	6.61	2.64	2.44	1.96
- Singapore	1.49	1.22	1.15	1.11	1.09
- Thailand	4.80	8.25	5.71	4.06	2.92
- Asean	2.91	2.46	2.06		
Other manufactured goods (SITC 8)					
- Indonesia	2.71	1.67	1.03		
- Malaysia	1.84	1.56	1.41	1.20	0.93
- Philippines	0.30	0.29	0.19	0.19	0.20
- Singapore	1.40	1.33	1.23	1.22	1.23
- Thailand	0.43	0.52	0.48	0.34	0.24
- Asean	1.11	1.04	0.95		

Source : Calculated from ESCAP (1988), Asia Pacific Trade Statistics

TABLE 5 : Major trading partners of Asean Countries (1988)

Country	Major Export Destinations			Major Sources of Imports		
Indonesia	Japan (44.8)	U.S.A. (19.6)	Singapore (8.4)	Japan (29.2)	U.S.A. (13.8)	Singapore (9.0)
Malaysia	Japan (22.5)	Singapore (17.1)	U.S.A. (6.6)	Japan (20.5)	U.S.A. (18.8)	Singapore (15.1)
Philippines	U.S.A. (35.7)	Japan (17.8)	F.R.G. (5.0)	U.S.A. (20.6)	Japan (17.0)	Hong Kong (5.0)
Singapore	U.S.A. (24.3)	Malaysia (14.3)	Japan (8.9)	Japan (20.6)	U.S.A. (14.8)	Malaysia (13.8)
Thailand	U.S.A. (17.9)	Japan (14.1)	Singapore (8.9)	Japan (26.3)	U.S.A. (13.7)	Singapore (15.1)

Source: Outline of Asian-Pacific Region, MITI, Japan, 1989.

The United States and Japan are, respectively, the main destination for exports orginiating in the ASEAN region, Japan is the number one exporter to the ASEAN region, followed by the United States.

TABLE 8 : Investment in Asean ($ million, %)

	1984	Share	1985	Share	1986	Share	1987	Share	1988 Jan-Jun	Share
Indonesia										
from: World	1107	100.0	852	100.0	826	100.0	1457	100.0	2032	100.0
Japan	112	10.1	120	14.1	329	39.8	532	36.5	169	8.3
U.S.	94	8.5	143	16.8	154	18.6	72	4.9	14	0.7
NIEs	722*	65.2	112	13.1	123	14.9	164	11.3	490**	24.1
Malaysia										
from: World	118	100.0	131	100.0	203	100.0	298	100.0	293	100.0
Japan	27	22.9	33	25.2	23	11.3	92	30.9	90	30.7
U.S.	9	7.6	37	28.2	7	3.4	24	8.1	37	12.6
NIEs	24	20.3	31	23.7	47	23.2	68	22.8	62	21.2
Philippines										
from: World	234	100.0	132	100.0	78	100.0	167	100.0	245	100.0
Japan	34	14.5	26	19.7	22	28.2	29	17.4	32	13.1
U.S.	102	43.6	58	43.9	22	28.2	36	21.6	80	32.7
NIEs	14	6.0	6	4.5	8	10.3	38	22.8	113	46.1
Singapore										
from: World	626	100.0	404	100.0	546	100.0	670	100.0	408	100.0
Japan	78	12.5	111	27.5	226	41.4	278	41.5	187	45.8
U.S.	102	60.4	194	48.1	204	37.3	252	37.6	123	30.1
Thailand										
from: World	104	100.0	69	100.0	119	100.0	323	100.0	569	100.0
Japan	38	36.5	6	8.7	64	53.8	140	43.3	255	44.8
U.S.	12	11.5	27	39.1	5	4.2	22	6.8	47	8.3
NIEs	21	20.2	12	17.4	14	11.8	80	24.8	86	13.1
ASEAN Total										
from: World	2189	100.0	1588	100.0	1772	100.0	2915	100.0	3547	100.0
Japan	289	13.2	296	18.6	664	37.5	1071	37.5	733	20.7
U.S.	595	27.2	459	28.9	396	22.3	406	22.3	301	8.5
NIEs	781	35.7	161	10.1	192	10.8	350	10.8	751	21.2

Source : Outline of Asian-Pacific Region, MITI, Japan, 1989.

Special Factor : * Hong Kong ---> Indonesia ; Sealess Pipe Factory (Long-Scale Joint Venture) $594 Million

** Taiwan ---> Indonesia ; Large Scale Expansion of Paper Pulp Factory $235 Million.

TABLE 9 : Investment commitments 1986 - Indonesia (Value in US$ million)

Country	Jan 1967-Dec 1987	Jan -Apr 1988	Jan 1967-Apr 1988
Japan	5,650.7	61.1	5,711.8
Hong Kong	1,875.9	131.8	2,007.7
FR Germany	867.2	949.6	1,816.8
United States	1,243.6	1.8	1,245.4
Netherlands	880.6	257.3	1,137.9
United Kingdom	560.0	57.1	617.1
Taiwan	143.7	259.2	402.9
Singapore	298.5	4.5	303.0
South Korea	221.9	31.2	253.1
Australia	216.9	-	216.9
Switzerland	173.2	-	173.2
France	154.7	2.3	157.2
Others	4,719.7	-	-
Total	17,006.6	1,759.9	14,042.8

Realized commitments amounted to 65% of the commitments.
Investment (1-12) comprise 72% of total commitments.
Source : EC-ASEAN Industrial Cooperation, Survey Initiated by the Commision of the European Communities, Brussels, 1988.

TABLE 10 : Investment commitments 1986 - Malaysia (value in US$ million)

Country	Paid-Up	Fixed Assets
U.S.A.	293	704
Japan	921	1,759
Europe (Total)	1,284	2,005
EC	1,136	1,714
- France	13	29
- Fr Germany	125	160
- Italy	4	5
- Netherlands	121	467
- U.K.	713	893
Other EC	160	160
Foreign	2,092	2,377
Total	4,590	6,845

Source : EC-ASEAN Industrial Cooperation, Survey Initiated by the Commision of the European Communities, Brussels, 1988.

TABLE 11 : Investment commitments - Philippines 1984-1987 (value in US$ million)

Country	1984	Fixed Assets
U.S.A.	1,306	1,620
Japan	331	377
EC	296	341
- Netherlands	109	130
- U.K.	83	102
- France	42	42
- Fr Germany	27	29
- Denmark	14	15
- Luxembourg	13	14
- Spain	4	4
- Ireland	2	2
- Belgium	1	2
- Italy	1	1
Others	421	492
Total	2,354	2,830

Source : EC-ASEAN Industrial Cooperation, Survey Initiated by the Commision of the European Communities, Brussels, 1988.

TABLE 12 : Investment commitments - Singapore 1984-1987 (value in US$ million) (Manufacturing excluding petrochemicals)

Country	Paid-Up	Fixed Assets
U.S.A.	402.95	271.75
Japan	83.30	300.55
Europe (Total)	162.55	142.90
EC	159.45	120.50
- France	-	7.60
- Fr Germany	7.15	45.15
- Italy	22.40	11.00
- Netherlands	35.15	35.45
- U.K.	93.30	21.20
Other EC	1.45	0.10
Foreign	2,092	2,377
Total	2,740.80	3,092.20

Source : EC-ASEAN Industrial Cooperation, Survey Initiated by the Commision of the European Communities, Brussels, 1988.

TABLE 13 : Investment commitments - Thailand (value in US$ million)

Country	1985	1987
Japan	6.76	144.20
Taiwan	4.44	61.70
U.S.A.	29.58	22.96
Hong Kong	6.52	14.04
Australia	0.52	1.52
Singapore	1.48	2.16
Malaysia	3.88	0.64
India	0.48	2.08
Republic of Korea	0.48	4.28
United Kingdom	1.80	4.48
Nethermands	0.84	2.16
FR Germany	0.44	1.16
Others	18.24	71.40
Total	75.46	332.78

Source : EC-Asean Industrial Cooperation, Survey Initiated by the Commission of the European Communities, Brussels, 1988

ANNEX 2 : LIST OF KEY-PERSONS PARTICIPATING AT THE EC SPONSORED WORKSHOP "S&T DEVELOPMENT IN ASEAN COUNTRIES : PROBLEMS, PROSPECTS, SCOPE FOR COOPERATION WITH THE EC", BANGKOK, 7-8 JUNE 1990.

Thailand

Dr. Charoen Vashrangsi, Secretary-General, National Research Council of Thailand, Ministry of Science, Technology and Energy.

Prof.Dr. Sakarindr Bhumiratana, Deputy-Director, National Center for Genetic Engineering and Biotechnology, Ministry of Science, Technology and Energy.

Dr. Chatri Sripaipan, Director, S&T Development Program, Thailand Development Research Institute.

Dr. Wirojana Tantraporn, Deputy-Director, Science and Technology Development Board.

Indonesia

Mr. Djoko Pitono, Head of the Centre for Analysis of S&T Development, Indonesian Institute of Sciences (PAPIPTEK-LIPI).

Ms. Astrid Susanto, Assistant to the State Minister for the National Development Planning Agency (BAPPENAS).

Malaysia

Mr. Mohd. Noordin Hassan, Secretary-General, Ministry of Science, Technology and the Environment ; Chairman of the ASEAN Committee on Science and Technology (COST).

Dr. Hamzah Kassim, Head of the Consultancy and Technology Transfer Division, Standards and Industrial Research Institute of Malaysia (SIRIM).

Philippines

Dr. Emanuel V. Soriano, President, Center for Policy and Development Concerns (CPDC).

United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)

Mr. Shahid R. Din, Economic Affairs Officer, Technology Section, Division of Industry, Human Settlements and Environment, ESCAP, Bangkok, Thailand.

Dr. Nilyardi Kahar, Adviser on Technology Management, Asian and and Pacific Centre for Transfer of Technology of the UN/ESCAP, Bangalore, India.

Commission of the European Communities

Mr. Ronald Gallimore, Counsellor, Delegation of the Commission of the European Communities, Bangkok, Thailand.

Mr. Bruno Schmitz, Head of SAST Unit, Directorate-General for Science, Research and Development (DG XII), Brussels, Belgium.

SAST research team

Prof.Dr. Ludo Cuyvers, Faculty of Applied Economics, University of Antwerp (RUCA), Belgium.

Dr. Kurt Hoffman, Director, Sussex Research Associates Ltd., England.

Dr. K. Ramanathan, School of Management, Asian Institute of Technology, Bangkok, Thailand.

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