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INDUSTRIAL DEVELOPMENT IN THAILAND IN THE 1990s

Prospects, Constraints and Priority Areas for Technical Assistance

V.90-89827

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ABBREVIATIONS

BMR	Bangkok Metropolitan Region
BOI	Board of Investment
CMEA	Council for Mutual Economic Assistance
DIP	Department of Industrial Promotion
DIW	Department of Industrial Works
ESCAP	Economic and Social Council for Asia and the Pacific
FDI	Foreign direct investment
FTI	Federation of Thai Industries
GDP	Gross Domestic Product
IEAT	Industrial Estate Authority of Thailand
IEPD	Industrial Economics and Planning Division
ISIC	International Standard Industrial Classification
LIBOR	London Interbank Offered Rate
MBA	Master of Business Administration
MIDI	Metalworking and Machinery Industries Development Institute
MOI	Ministry of Industry
MOSTE	Ministry of Science, Technology and Energy
MVA	Manufacturing value added
NEB	National Environment Board
NESDB	National Economic and Social Development Board
NICs	Newly Industrializing Countries
NIEs	Newly Industrializing Economies
OECD	Organization for Economic Co-operation and Development
ONEB	Office of National Environment Board
R & D	Research and Development
TDRI	Thailand Development Research Institute
TISTR	Thailand Institute for Scientific and Technological Research
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization

I. INTRODUCTION

In the context of preparatory work for the Fifth Country Programme, UNDP has requested UNIDO to prepare an industrial sector report providing (a) an overall review of Thailand's state of industrial development and major prospects and constraints in a medium-term perspective, as well as, (b) recommendations for development objectives to be supported in the next Country Programme and suggestions for areas of concentration within the field of industry.

The present report reflects both work undertaken at UNIDO headquarters based on available data and studies as well as the findings of a mission which visited Bangkok from 8-14 July 1990 and consulted a number of official and private sector institutions involved in industrial development (see Annex II for the list of persons met). The mission team consisted of Wilfried Lütkenhorst, Industrial Development Officer, Regional and Country Studies Branch, whose work was actively supported by Nils Ramm-Ericson, UNIDO Country Director, and Roeland Kortas, Junior Professional Officer.

From the outset it was clear that the team's report, for various reasons, would need to be limited in scope. Firstly, the very nature of the task was not to present a comprehensive study on Thailand's industry but only to highlight salient features of current trends and the priorities and issues emerging for the 1990s as a basis for identifying target areas for possible external assistance. Second, the draft Seventh National Development Plan was not yet available at the time of the mission. Only the broad outlines of government policy and some information on its key orientation and targets could be ascertained. Finally, it must be stressed that the identification of longer-term international co-operation prospects is necessarily an iterative process through which initially conceived broad areas of possible co-operation are narrowed down, subsequently elaborated and possibly reformulated. The present report intends to provide a first basis for this process by suggesting main programme areas for future co-operation efforts. Detailed projects may be formulated in a next stage.

The report is structured along the following lines. In Chapter II, selected global and regional (Asian) trends of recent industrial development are briefly outlined with a view to derive a notion of the key challenges emerging for the Thai economy. Chapter III reviews the main features of industrial development in Thailand in the 1990s and identifies the most important constraints and bottlenecks for the future. Chapter IV, after a brief look on the industrial strategy and policy setting of the Seventh Plan, discusses some crucial programme areas which could serve as focal points for future external assistance activities.

As indicated above, no attempt is made to formulate a detailed UNDP/UNIDO country programme. Indeed, this report deliberately excludes 'project identification' from its objectives. The elaboration of precise projects and activities responding to the suggested programme areas will have to follow in the next stage. Moreover, this report - in response to a specific request by UNDP - is highly selective in its coverage of issues. It concentrates on a small number of perceived priority programmes for future technical assistance. As these priority programmes are of a broad nature cutting across

different industrial activities - such as regional dispersal, strengthening of supporting industries or human resource development - they can be seen as guiding principles for the identification of specific projects.

The members of the UNIDO mission team wish to express their thanks to UNDP Bangkok and the Government of Thailand for organizing and co-ordinating the mission's work programme. Without their co-operation and support the tasks foreseen could not have been accomplished in such short time, considering the complexity of the exercise.

II. INDUSTRIAL DEVELOPMENT IN THE 1990s: SELECTED GLOBAL AND REGIONAL TRENDS AND CHALLENGES

Change has always been an inherent feature of a global environment in which all countries are seeking to chart the course of their future development. In recent years, however, change has become more rapid and more fundamental than in previous decades. Contributing factors are the emergence of scientific and technological breakthroughs in various fields with pervasive effects on all aspects of industrial development; fundamental shifts in the nature of demand and in the shape and size of the main markets; and transformations in industry structure - at the firm level and in inter-firm relationships.

While having to respond to such pervasive changes can be a daunting prospect, the reality is that this phase of change is not only creating challenges but also many opportunities for developing countries to gain benefits in the short and long-term - the availability of new equipment, new products and new services allows effective users to become more productive and more competitive; new markets have opened up for new products and services; new opportunities for learning have arisen; and in a general sense, massive R&D efforts worldwide are enlarging the pool of knowledge which developing countries can, in principle, draw on to solve their problems.

Change produces potential problems as well but the negative impacts can be greatly alleviated if countries are able to respond to the challenges in an appropriate and timely fashion. There are many examples of developing countries' enterprises that have responded to the opportunities and challenges posed - starting from whatever problems they have; they have marshalled their resources, exploited their strengths and moved forward. This positive attitude and approach points the way ahead.

The critical issue confronting developing countries then, in this era of change, is how to respond to the opportunities and challenges they face. In the following sections, selected areas of recent international economic trends are briefly reviewed. The focus is on those aspects which are of specific relevance to Thailand as a developing country at a fairly advanced level of industrial development and at a high level of integration into the world economy.

1. Changing notion of industrial competitiveness

In recent economic research undertaken and policy advice given by UNIDO the following observations were made with regard to the changing international division of labour and international, regional and national industrial restructuring processes:

- increasing uncertainty in terms of changing prices of final products and production inputs; new production processes; trade policies of major economic powers; the development of financial markets; and many other factors;

- increasing competition due to the emergence of new competitors; shorter product cycles; and the continuous development of new products;

- rapid technological advances, including the emergence of new technologies (such as microelectronics, biotechnology, new materials) with great inter-country differences in the pace of diffusion and application thus leading to increasing technological gaps between developed and developing countries;

- associated organizational changes within companies (new approaches to production organization and management), between companies (new types of long-term contractual relationships) and in the economy as a whole;

- a resulting socio-political pressure in all countries to maintain or re-establish a hign level of employment amidst drastic structural changes and to secure sustained economic growth in the future through active policy measures.

Given these trends, it has proven to be increasingly difficult to make detailed long-term growth projections and to prepare comprehensive development plans. Visions of a country's future development, say up to the year 2000, and of priority areas and sectors to be promoted, thus increasingly substitute for detailed planning exercises. It is against this overall background that the changing modalities and notion of "international competitiveness" need to be considered.

Competitiveness has traditionally been defined as a company-level or even plant-level phenomenon. Attention has been directed at minimizing unit costs of production through low wages, low capital costs, efficient sourcing of inputs and management skills in general. In other words: labour productivity has been and continues to be seen as the core variable of competitiveness.

However, recent trends show that the volume and structure of international trade in manufactures are less and less an expression of the production costs of companies. This is due to many factors, inter alia, the increasing role of non-price competition (product quality, product variety, pre-sales and after sales services) and the growth in tariff and particularly non-tariff protection measures. Furthermore, within overall production costs, labour costs are rapidly losing in significance because of far-reaching automation advances.

As governments have felt, however, to be more and more responsible for establishing a conducive business climate - in terms of the industrial and institutional infrastructure, human resources development and the provision of special incentives - it can be argued that international competitiveness these days is as much determined at the national level as it is at the company level. A whole national economy can be regarded as a unit in competition with other economies in the international market for investment locations. Therefore, national competitiveness needs also to be seen in a longer-term perspective, as the competition of entire economic and social systems. In the long run, the development strength of an economy would depend upon the ability of its productive sectors to dynamically develop and secure future competitiveness and thus future increases in real wages and living standards of the population.

In this context, the creation of an efficient industrial system[1/] plays a crucial role. Key elements of such a system would be

- a sufficient number of large corporations which can realize economies of scope in research & development, marketing and sourcing networks and financial capabilities, follow new technological trends and market opportunities and have a pull effect on associated companies;

- a dynamic small- and medium-scale industry sector which can be innovative in terms of identifying product and market niches - as well as improving process technologies and which can offer itself as a nucleus for future growth industries;

- an effective linkage and interplay between the various types of companies such as through sub-contracting of products; sub-deliveries of parts, components and services; and joint small-scale firm co-operation.

In efforts to establish efficient industrial systems, two elements have recently been particularly emphasized: Firstly, the significant role of a broad range of so-called supporting industries which not only provide parts and components (thus reducing import dependency) but also contribute to innovation through close buyer-supplier relationships. Second, the importance of inducing clusters of inter-related industries in close proximity to each other to take advantage of co-operation potentials. Related attempts to pool resources, capabilities and efforts in an integrated manner have brought the regional development dimension into focus in many countries, developed and developing alike. Both elements assume critical importance also in the case of Thailand and will be dealt with in more details in chapter IV of this report.

2. Impact of new technologies[2/]

Global industry is in the process of radical technological innovations which may be referred to as a new industrial revolution. Major 'new technologies' include advances in the transfer of information

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1/ The national system aspect of competitiveness is much emphasized in recent research: "In a world of increasingly global competition, nations have become more, not less, important. As the basis of competition has shifted more and more to the creation and assimilation of knowledge, the role of the nation has grown." (Porter, M.E., The Competitive Advantage of Nations, in: Harvard Business Review, March-April 1990), p. 73.

2/ For a comprehensive study of industrial strategy implications of new technological developments cf. UNIDO, New Technologies and Global Industrialization. Prospects for Developing Countries, PPD.141, 13 November 1989.

(telecommunications and microelectronics) and advances in the transformation of matter (biotechnology and new materials). These new technologies exhibit certain characteristics with regard to the nature, scope and direction of their impact on industrial development: they are transformational (i.e. redefine the conditions under which industrial goods are produced), pervasive (i.e. their application cuts across most sub-sectors of industry) and work in favour of increased homogeneity of industrial production processes.

The introduction of new technologies is bringing about a sea-change in global industrial relations and the pattern of current and future competitiveness. The implications of this change for developing countries have been and will continue to be profound. In many branches of industry comparative advantages based on the intensive use of low cost labour are being eroded or lost due to progressive automation in industrialized countries. A further implication is the tendency of the raw materials intensity of industrial production to decline thus jeopardising the long-term development prospects of raw materials producers and exporters.

Furthermore, cost determinants of competitiveness are increasingly complemented - and sometimes indeed superseded - by other considerations. The two most significant ones have been product quality and flexibility of production. Product quality is the overriding concern e.g. in the manufacturing of precision tools and professional instruments. In these areas the use of CNC-machinery has effectively become an industrial standard. The use of conventional machinery would inevitably lead to exacting requirements and close tolerances not being met, rejection rates being comparatively high and eventually competitiveness being lost. Flexibility has become a must in many industrial branches such as metalworking and engineering products (where approx. 80% is small batch production) and particularly in garments manufacturing where more frequent fashion changes demand flexible adjustment and quick response.

Indeed, this emphasis on flexibility, quality and a built-in capacity to quickly adjust to changing customer needs can be said to constitute the central characteristic of the new technologies. This explains why organizational innovations have to go along with the introduction of new hardware. The much heralded Japanese success has at least as much been caused by new management styles as by new machinery: quality circles, group technology, just-in-time inventory planning and multi-skilled production workers are some of the basic determinants.

Developing countries differ widely in their capability to effectively utilize new technologies which in most cases will initially have to be imported. The experience of many countries has clearly demonstrated that the efficient assimilation, adaptation and diffusion of imported technology can yield substantial long-term benefits. Furthermore, it does not preclude the later domestic development of the same or even more advanced technologies. Accordingly, the sequential aspect in absorbing technology needs to be stressed. The external sourcing of advanced technology may be considered a logical first step. As these technologies are increasingly diffused and utilized in a country's industrial sector, they create both learning effects and a broader market which also domestic producers will subsequently seek to tap.

The effects on human resource requirements of increasing technological sophistication in industrial production are far-reaching. Skill intensities are rapidly increasing in industry and related supporting services. Therefore, new educational and vocational training approaches need to be developed to meet future needs in a cost-efficient and flexible manner. The absence of adequately trained human resources - a key issue of concern at present in Thailand - is in many cases a major bottleneck for advancements in high and new technology areas. Furthermore, it must be stressed that technology advances are spurred by close interaction between the research, finance, policy, administration and production centres in an economy. Developing countries are generally lagging behind in such networking. An important issue is therefore the restructuring of their institutional machinery.

3. Internationalization of industrial production[1/]

The increasing internationalization of industrial production - largely driven by foreign direct investment (FDI) flows - is by no means a new development. Recently, however, it has been generalized to most countries on the global scene. Today, virtually all developing countries as well as the CMEA countries are attaching a new importance to FDI thereby creating for the first time an almost universally shared belief in the positive and valuable contribution FDI can bring to economic development. A number of political and economic reasons account for this growing convergence of opinion towards FDI but surely chief among these is the desire both of developing countries at large and of CMEA countries to integrate themselves into an increasingly globalized economy. Among the many implications of these developments is the intensified competition between various groups of countries to attract these flows and thereby to either enter into, or consolidate their position within an increasingly integrated world production, trading, and investment system.

At the same time, a clear tendency can be observed for FDI flows to concentrate more on OECD countries with the share of developing countries declining over time: the latter absorbed about 40 per cent of global FDI inflows in the 1960s, approximately one third in the 1970s and only less than 15 per cent in the second half of the 1980s. Moreover, the trend of FDI to flows to focus on only few developing countries with relatively high *per capita* income has become even more accentuated in recent years. In regional terms, it is clearly the Asian developing countries which have successfully managed to attract the lion's share of FDI flows to developing countries.

In the context of efforts pursued by most developing countries, including Thailand, to attract more FDI the changing patterns and determinants of FDI flows need to be fully understood. Above all, a general qualitative trend is emerging for FDI to become technologically more ambitious. Whereas the "first round" of North-South industrial redeployment involved primarily

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1/ For a broader treatment of this issue cf. UNIDO, *Foreign Direct Investment Flows to Developing Countries: Recent Trends, Major Determinants and Policy Implications*, PPD.167, 10 July 1990.

labour-intensive goods requiring only simple production technologies (e.g. in clothing production or simple consumer electronics), worldwide industrial restructuring is now spreading into many additional product groups in branches such as transport equipment, electrical machinery, machine tools and others. This technological upgrading of FDI to developing countries is a gradual long-term process which will affect a relatively small group of more advanced developing countries in the short run. At the same time for many others, labour-intensive, low technology industrial relocation will remain significant also in the years to come.

For an advanced developing country like Thailand this implies that in a medium-term perspective the most dynamic elements of FDI inflows will be based on higher levels of technology. Accordingly, they will essentially be determined by (i) the availability of high levels of skills relevant to specific areas of production, design or management; (ii) the availability of a variety of supporting firms providing components, services and technical backup of various kinds; and (iii) the existence of an efficient power, transport and particularly telecommunications infrastructure.

In general, FDI flows are extremely sensitive to economic conditions and economic policies in recipient countries, and the events of the 1980s have brought this sensitivity into sharp focus. The variations between developing countries in attracting FDI arise, in this context, from differences in their macroeconomic management (especially of external debt, but also of internal inflation and exchange rates); their other economic policies (price controls, taxes, attitudes to the private sector, intellectual property rights, labour laws and conditions, stability of incentives and so on); their political stability; and their anticipated economic and export performance. The diminishing flow of FDI has been directed increasingly at countries that had a stable, transparent and predictable environment with good prospects for overseas investors to earn and repatriate healthy returns and to integrate the new locations into their global strategy as determined by technological and market factors.

The recent trend towards more liberal policies therefore constitutes an initial necessary condition for the encouragement of FDI flows to developing countries, yet it is by no means sufficient. No amount of policy reform directed at foreign investors (better investment codes, faster procedures, liberal treatment, tax holidays) or at macroeconomic variables (inflation, wages, exchange rates) is likely to offset structural economic weaknesses. It is the overall industrial capabilities at the country level more than anything else which decisively determine FDI inflows. The industrial capabilities most relevant to the attraction of FDI are those that directly determine the skills available to prospective investors, as well as those affecting the efficiency of local suppliers, consultants, service firms and the physical and technological infrastructure. In a general sense, therefore, the level and efficiency of development of the domestic industrial structure, including a thriving locally-owned sector and a network of supporting public or private institutions, indicates the availability of the capabilities that will enable foreign investors to set up competitive modern facilities.

4. Recent developments in Southeast and East Asia[1/]

While the previous sections have given a synoptic view of some key trends shaping global industrial development at present and in the future, the focus is now narrowed down to the Southeast Asian region which has become the most dynamic growth area of the world economy.

According to UNIDO forecasts (Table 1), the Southeast Asian region (meant to encompass also the East Asian NICs) will continue to outperform all other developing regions - as well as the developed countries - by a considerable margin in terms of both GDP growth and MVA growth. The Southeast Asian region is expected to achieve average annual growth rates in the 1990s of 5.5 per cent for GDP and 7.5 per cent for MVA, the latter being almost twice the forecast world average. This in turn would raise the region's share in world MVA to 6.1 per cent, ahead of Latin America and the Caribbean which has so far been the first-ranking developing region in this respect.

Table 1. UNIDO forecast of long-term growth of GDP and MVA, regional shares, and per capita GDP, 1990-2000
(Percentage)

Region or economic grouping	Average annual growth rate 1990-2000		Share of world				Per capita GDP (1980 dollars)	
			MVA		GDP			
	GDP	MVA	1990	2000	1990	2000	1990	2000
World	3.5	4.0	100.0	100.0	100.0	100.0	2,917	3,406
Developing market economies	4.5	6.0	14.2	17.0	17.2	19.0	946	1,161
Regions								
North Africa	4.6	6.1	0.5	0.6	1.1	1.3	1,238	1,521
Tropical Africa	3.5	4.8	0.5	0.5	1.3	1.3	439	459
Latin America and the Caribbean	4.0	4.2	5.7	5.8	5.7	5.9	1,958	2,301
Western Asia	4.5	7.3	1.4	2.0	2.9	3.2	2,462	2,888
Indian Subcontinent	4.4	6.1	1.6	2.0	2.5	2.8	330	407
South-East Asia	5.5	7.5	4.5	6.1	3.7	4.5	1,433	2,036
China	5.0	..	..	..	4.7	5.5	591	805

Source: UNIDO data base.

1/ This section draws on UNIDO, Industry and Development Global Report 1989/90; UNIDO, Foreign Direct Investment Flows, op. cit.; and Asian Development Bank, Asian Development Outlook 1990, Manila 1990.

It is noteworthy that in 1989 the ASEAN countries have significantly surpassed the East Asian NICs with regard to their growth performance. In the latter group the rate of GDP expansion slowed down considerably to 6.4 per cent while in the former it remained at a high level of 7.8 per cent.[1/] Despite a slower growth of world trade globally, growth in the ASEAN countries continued to be largely export-driven, with Thailand and Malaysia recording an expansion of manufactured exports of more than 30 per cent. At the same time, there are signs that the domestic market in these countries, by virtue of its rapidly increasing purchasing power, will become more important as a source of growth in the future.

The exceptional growth achievements of the Southeast and East Asian region in general and, more recently, the ASEAN countries in particular are due to a wide range of factors which cannot be discussed here in any detail. They comprise both external factors, such as currency realignments, strong export demand and massive inflows of foreign capital as well as internal factors, such as policy reforms (specifically trade liberalization measures) leading to increased economic efficiency and high rates of domestic resource mobilization allowing the introduction of new production technologies and a rapid structural transformation of the industrial sector.

In recent years, industrial restructuring in Southeast and East Asia has worked in favour of increased levels of intra-regional trade and investment flows and more specifically - despite the continued central position of Japan - has induced stronger interlinkages between the developing countries in this region. In 1988, the ASEAN countries[2/] sourced almost 60 per cent of their total imports from other Asian countries - with the East Asian NICs (27 per cent) ahead of Japan (23 per cent) as most important supplier. Exports to Thailand of the Republic of Korea, Taiwan Province and Singapore rose by 97 per cent, 78 per cent and 76 per cent, respectively, in 1988.

While this tendency towards increased intra-regional trade is significant, it is somewhat pushed into the background by recent trends in intra-regional FDI flows: "Rapid growth in intra-Asian trade during the last few years has been accompanied by a phenomenal increase in intra-Asian direct foreign investment. The strong investment flows from Japan and the Asian NIEs to Southeast Asia are likely to reshape the regional structure of production over the next decade and sustain developing Asia's economic growth in the 1990s... and make the region a more cohesive entity in the world economy."[3/] This upsurge in intra-regional FDI partly reflects a gradual transfer of relatively labour-intensive industries from both Japan and the NICs to Southeast Asia caused by appreciating currencies, rising land and

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1/ These figures are based on ADB sources and include Singapore among the East Asian NICs. Inclusion of Singapore among ASEAN would further accentuate the difference in group growth rates.

2/ Except Singapore which is included among the East Asian NICs.

3/ ADB, op.cit., p. 39.

labour costs, the availability of unutilized export quotas in some host countries, and shortages of semi-skilled labour in some home countries. In addition, foreign investors are increasingly seeking to tap the growth potential of domestic markets in areas such as transport equipment and industrial machinery which tend to enjoy a high protection level in most Southeast Asian countries. Table 2 shows that in 1988 almost two thirds (64 per cent) of all FDI approvals in the ASEAN countries (except Singapore and Brunei) originated from other Asian countries; in the case of Thailand the corresponding figure was even as high as 81 per cent. It is further to be noted that for all four ASEAN countries taken together FDI inflows from the East Asian NICs exceeded those from Japan in 1988.

Within these intra-regional foreign investment flows, an increasing role of small- and medium-sized firms is clearly noticeable. This applies in particular to FDI from Japan - with smaller supplier companies often following large transnational corporations who invest abroad - and to FDI from the Republic of Korea. FDI by small and medium companies accounted for only 2 per cent of total Korean FDI in 1986, yet for as much as 15 per cent in 1988 and 23 per cent in the first half of 1989, most of it directed at manufacturing industries in Southeast Asian countries.

As a result of the dramatic increases in FDI flows in recent years, the capacity of many Southeast Asian countries to absorb further investment has become limited. Serious strains have emerged on most infrastructural facilities in view of the normally high geographical concentration of FDI. Thailand is certainly a case in point in this respect.

In the past, economic trends in Southeast and East Asia have predominantly been determined by developments in the NICs and the ASEAN countries. The countries of Indochina, some of which are resource-rich and hold great economic promise, have not been integrated into the regional division of labour and, in view of their distinct inward orientation and relative seclusion, could be neglected as important economic actors. With the onset of a gradual opening up and economic liberalization of Viet Nam (1987) and Myanmar (1989), however, this situation is bound to change. Both countries are rich in agricultural and mineral resources for industrial processing, possess vast pools of easily trainable cheap labour and may therefore soon become attractive targets for foreign investors from both within and outside the region. While more precise predictions would be difficult to undertake at this stage, it appears that, assuming a continued economic reform process the emergence of economic competitors from Indochina will substantially change the medium-term parameters in the region - posing both new threats and opportunities for the region's 'established' economic actors.

Table 2. Approved foreign direct investment in selected Southeast Asian countries, by country of origin, 1988

From \ To	Thailand[a] $ mn	Thailand[a] share in total	Philippines[b] $ mn	Philippines[b] share in total	Malaysia[c] $ mn	Malaysia[c] share in total	Indonesia[d] $ mn	Indonesia[d] share in total	Total of 4 countries $ mn	Total of 4 countries share in total
Japan	3,063	49.2	95	21.0	214	27.8	225	5.0	3,597	30.3
Hong Kong	446	7.2	27	6.0	50	6.5	232	5.2	775	6.5
Korea, Rep. of	106	1.7	2	0.4	9	1.2	209	4.7	326	2.7
Singapore	275	4.4	2	0.4	66	8.5	255	5.7	598	5.0
Taiwan Province	850	13.6	109	24.1	147	19.1	923	20.8	2,029	17.1
Asia Total[e]	5,019	80.6	253	56.0	508	66.1	1,844	42.0	7,624	64.2
World Total	6,225	100	452	100	768	100	4,426	100	11,871	100

Source: Asian Development Bank, Asian Development Outlook 1990, Manila 1990.

a/ Total foreign investment in projects receiving Board of Investment privileges.

b/ Equity investments approved by the Board of Investments.

c/ Foreign equity in manufacturing projects approved by the Malaysian Industrial Development Authority.

d/ Total foreign capital in projects approved by BKPM; excludes investment in oil, financial sectors.

e/ Includes also other Asian countries.

III. ECONOMIC DEVELOPMENT OF THAILAND IN THE 1980s: RAPID GROWTH AND STRUCTURAL CHANGE[1/]

1. General lines of development

During the 1980s the Thai economy experienced a phase of rapid growth, significant structural change and strong diversification. While this statement does apply to the entire decade - real GDP growth averaged 6.9 per cent in 1980-89 - it is more appropriate to look at the first and the second half of the 1980s separately.

The years 1980-85 were a period of strong external pressure on the Thai economy which, due to its extremely high dependence on oil imports, was seriously affected by the second major oil price increase in 1979 and by the following rise in international interest rates. Real GDP growth was low - with manufacturing recording below average growth rates and even a decline by -0.6 per cent in 1985 - inflation rates were high (20 per cent in 1980) and heavy foreign borrowing at high interest rates led to an increasing debt service ratio which jumped from 14.8 per cent in 1980 to 21.9 per cent in 1985. The Government, facing the need to cope with growing fiscal and external imbalances, took a number of fiscal, monetary and trade policy measures aimed at adjusting the economy to the new external parameters. These included two Baht devaluations against the US dollar (1981 and 1984), curtailments in public expenditure programmes, stronger revenue collection efforts and a tight ceiling on the public sector's external borrowing. While the industrial sector appears to have suffered most in this adjustment period, the government's sound macro-economic management brought the economy back on a high-growth track in the second half of the 1980s.

The remarkable economic performance since 1986 must certainly be ascribed to a wide range of factors, including domestic and external determinants alike. It was as much caused by policy-induced adjustment efforts as it was by a booming export demand, declining interest rates (LIBOR declined from 13.7 in 1982 to 9.1 per cent in 1985) and decreasing oil prices. As a combined result of these developments, the economy took off in 1986 and achieved two-digit overall GDP growth rates in 1988 and 1989, forecast to remain at a high 9.2 per cent in 1990 (Table 3). Manufacturing production has gained an extraordinary momentum and, together with construction activities, has now become the main driving force of the economy's growth. MVA increased by 12-14 per cent annually in the last three consecutive years and is expected to continue this trend also in 1990. However, a significant downward adjustment of growth expectations will be required as a consequence of the mid-1990 oil price increase.

1/ This chapter gives a brief summary account of the Thai economy's recent development. It cannot claim to provide a comprehensive analysis and assessment. Numerous in-depth studies of the subject have recently been undertaken. The present chapter draws particularly on UNIDO, Industrial Development Review Series: Thailand, IS.548, 7 August 1985. World Bank, Thailand: Country Economic Memorandum. Building on the Recent Success - A Policy Framework, Report No. 7445-TH, 21 February 1989; Narongchai Akrasanee, Thailand in the International Community, Report presented at the 1989 TDRI Year - End Conference, December 16-17, 1989 (mimeo).

Table 3. Thailand: Key economic indicators, 1987-1990

	1987		1988		1989[a/]		1990[b/]	
	bn Baht	increase or (share) in percent	bn Baht	increase or (share) in percent	bn Baht	increase or (share) in percent	bn Baht	increase or (share) in percent
GDP		8.4		11.0		10.4		9.2
- Agriculture		-2.0		8.6		4.1		1.4
- Manufacturing		13.6		12.4		12.5		12.0
- Construction		8.1		13.7		19.8		11.3
- Services		10.4		9.5		9.5		8.9
Consumer Price Index		2.5		3.8		5.4		6.5
Export	298.1	28.8	399.2	33.9	509.7	28.5	616.0	20.1
-share of GDP		(24.2)		(27.2)		(31.5)		(34.9)
Import	341.9	39.1	501.4	46.6	646.1	29.2	774.0	19.5
-share of GDP		(27.7)		(34.2)		(39.9)		(43.8)
Current account balance	-9.3		-41.8		-59.1		-75.0	
-share of GDP		(-0.8)		(-2.9)		(-3.7)		(-4.2)
Debt service ratio		(17.2)		(12.9)		(11.0)		(10.1)
FDI inflows	4.7	-31.5	27.4	480.6	39.9	46.0	47.1	18.0

Sources: NESDB; Bank of Thailand.

a/ Estimate/provisional.

b/ Forecast.

Table 3 which is self-explanatory, further shows the tremendous growth in exports which has lifted the share of exports in GDP above 30 per cent; a rapid decline in the debt-service ratio, down to around 10 per cent at the end of the decade; and massive increases in foreign investment inflows. While the current account deficit is growing both in absolute terms and as a share of CDP, this is not seen as posing a serious problem in view of the very high capital inflows and the high positive overall balance of payments record (see Annex-Table A-1). The only disquieting macro-economic indicator at present is the rising inflation rate - which can be taken as sign of an overheating economy.

As regards the sectoral composition of GDP (at 1972 prices) it emerges from Table 4 that, following a fairly stable pattern in the first half of the 1980s, the share of manufacturing rose continuously since 1985 to reach 23.0 per cent in 1988.[1/] On the basis of the growth rates given in Table 3 it should further increase to 24.1 per cent in 1990.

As mentioned above, the external sector (specifically the growing exports and foreign investment inflows) has made a significant contribution to the economy's dynamism in recent years. In particular, export diversification has increased remarkably since 1985 from an already relatively high level. This applies both to product diversification and market diversification.

Thai exports cover a wide range of agricultural and manufactured exports with no single product group accounting for more than 15 per cent of total export value. During the 1980s, above all in the decade's second half, agricultural exports have declined in relative importance from 48 to 29 per cent of total export value whereas the share of manufactured exports surged from 45 to 69 per cent; it would even be higher if all processed food product were included in this category (Table 5).

At the same time, the combined export value share of the 10 principal export items, with textile products now topping the list, went down from 58 per cent in 1985 to 48 per cent in 1989 leaving more than 50 per cent for a variety of other products (see Annex Table A-3).

Also the geographical diversification of Thailand's main export markets is relatively high, with Japan, however, accounting for a dominant share of 39 per cent (see Annex Table A-4). Thai exports have recently made inroads also into European markets and, increasingly, regional markets in Southeast Asia and in the Arab countries. The latter applies in particular to textiles exports, the fastest growing segment in overall export performance. Saudi Arabia and the United Arab Emirates in 1989 ranked third and fourth (after the USA and Japan) as buyers of Thai textile goods - which implies a welcome shift from quota to non-quota markets.

1/ According to Annex Table A-2, manufacturing in 1988 accounted for 24.8 per cent of GDP in current prices indicating above-average price increases for manufactured products.

Table 4. Gross domestic product by industrial origin (at 1972 prices), 1980 and 1984-88

million Baht (percentage shares)

Industrial origin	1980	1984	1985	1986	1987	1988[a]
Agriculture	61,770 (20.6)	73,977 (19.4)	78,539 (19.9)	78,725 (19.1)	77,163 (17.2)	83,772 (16.9)
Mining & quarrying	7,917 (2.6)	9,535 (2.5)	9,901 (2.5)	9,705 (2.3)	10,410 (2.3)	11,818 (2.3)
Manufacturing	64,984 (21.6)	81,962 (21.5)	81,463 (20.6)	89,305 (21.6)	101,414 (22.7)	114,038 (23.0)
Construction	13,478 (4.5)	17,547 (4.6)	16,635 (4.2)	16,157 (3.9)	17,470 (3.9)	19,866 (4.0)
Electricity & water supply	5,908 (1.9)	9,023 (2.3)	9,934 (2.5)	11,162 (2.7)	12,161 (2.7)	13,787 (2.7)
Transport and communication	20,045 (6.6)	27,074 (7.1)	28,171 (7.1)	30,191 (7.3)	32,701 (7.3)	36,240 (7.3)
Wholesale & retail trade	50,667 (16.9)	62,074 (16.3)	64,162 (16.2)	67,050 (16.2)	74,730 (16.7)	84,613 (17.0)
Banking, insurance & real estate	8,286 (2.7)	11,534 (3.0)	11,772 (2.9)	12,006 (2.9)	15,252 (3.4)	18,060 (3.6)
Ownership of dwellings	14,289 (4.7)	16,649 (4.3)	17,357 (4.4)	18,027 (4.3)	18,971 (4.2)	20,215 (4.0)
Public administration & defence	15,437 (5.1)	19,958 (5.2)	21,358 (5.4)	22,030 (5.3)	22,683 (5.0)	23,550 (4.7)
Services	36,681 (12.2)	51,405 (13.5)	54,821 (13.9)	57,456 (13.9)	63,406 (14.2)	69,415 (14.0)
Total GDP	299,472 (100)	380,738 (100)	394,113 (100)	411,814 (100)	446,361 (100)	495,374 (100)
Growth Rate of GDP		6.2[b]	3.5	4.5	8.4	11.0

Source: NESDB.
a/ Estimate.
b/ Annual average 1980-1984.

Table 5. Sectoral composition of merchandise exports, 1980 and 1985-89
(percentage shares)

	1980	1985	1986	1987	1988	1989[a/]
Agricultural exports[b/]	48.1	44.0	41.0	34.3	32.1	29.0
Manufactured exports	44.8	49.9	55.8	63.1	66.1	69.4
Other exports	7.1	6.1	3.2	2.6	1.8	1.6
TOTAL	100	100	100	100	100	100

Source: Bank of Thailand

a/ Provisional

b/ Includes food-processing industry, fishing and forestry.

2. The manufacturing sector

Thailand's manufacturing sector underwent a process of continuous restructuring both in the 1960s when the government pursued an import-substitution policy and in the 1970s which saw a domestic market saturation for many import-substituting products and a shift towards an export promotion strategy. As a result, between 1960-80 the share of consumer goods in total MVA declined from approximately 80 per cent to approximately 65 per cent, largely caused by the decreasing importance of food processing, beverages and tobacco industries.

Export-oriented industries experienced high growth in the 1970s, in particular those processing natural resources and those based on cheap labour advantages such as in textiles, garments, rubber and simple electronic goods. The highest increases in export-output-ratios were recorded by leather goods (23 per cent in 1980), rubber products (80 per cent in 1980), non-ferrous metals (83 per cent in 1980) and electrical machinery products (32 per cent in 1980) (Annex Table A-5).

It is particularly noteworthy that the tremendous growth in Thai manufactured exports during the 1980s was to a large extent based on genuine increases in competitiveness. A constant market share analysis carried out by TDRI for the 1982-87 export performance reveals that the competitive effect explains 38 per cent of increases in total exports during this period. However, in the case of machinery and transport equipment (SITC 7) and miscellaneous manufactured articles (SITC 8), it was the main factor behind

export success accounting for 71 per cent and 65 per cent of additional exports.[1/]

Table 6 presents data on the branch composition of MVA. It confirms the observation made already above that the second half of the 1980s was marked by rapid structural change. Between 1985-88 the share of food, beverages and tobacco further decreased from 31.8 to 27.3 per cent of total MVA while in the same period that of engineering industries (ISIC 38) went up from 12.6 to 13.8 per cent. Furthermore, it emerges from Table 6 that the Thai manufacturing sector is characterized by a highly diversified structure which - while dominated by food products, textiles and garments - covers a broad spectrum of consumer, intermediate and capital goods.

Indeed, the degree of industrial diversification achieved in Thailand stands out also in a regional perspective (Table 7). The cumulative MVA share of the three most important branches stands at 40.9 per cent (only in the Republic of Korea the corresponding share is lower), that of the ten most important branches at 78.1 per cent which is the lowest share of all countries included in the table. Needless to say, that these indicators of industrial diversification do not reveal to what degree a country's industrial structure corresponds to comparative advantages and whether it is internationally competitive or not. In the case of Singapore, the comparatively high degree of industrial concentration is obviously a consequence of the complete lack of an agricultural base and, accordingly, the need to focus on non-food industries. With this reservation in mind, it can be assumed, however, that a broadly diversified industrial sector does by and large possess a greater resiliance and flexibility in adjusting to changing competitive conditions and to external shocks in general.

With regard to future growth prospects of Thai industry, TDRI has undertaken projections up to the year 2000 which lead to the following conclusions.[2/] Future growth of Thai industry is expected to stem largely from export-oriented industries on the one hand (with increasing levels of technological sophistication) and from industries substituting imported intermediate and capital goods on the other hand. Bright prospects are seen to develop for chemical industries and engineering industries in particular.

1/ The constant market share analysis disaggregates the determinants of export performance into a world growth effect, a commodity composition effect, a market effect and a competitive effect.

2/ Cf. Paitoon Wiboonchutikula et al., Trade in Manufactured Goods and Mineral Products, Background Paper No. 4, Presented at the TDRI 1989 Year-End Conference, December 16-17, 1989 (mimeo).

Table 6. Composition of MVA by branches of manufacturing (at 1972 prices), 1980 and 1984-88

million Baht
(percentage shares)

	1980	1984	1985	1986	1987	1988[a/]
Food	9,176	12,954	13,380	14,598	15,092	16,529
	(14.1)	(15.8)	(16.4)	(16.3)	(14.8)	(14.4)
Beverages	6,347	9,146	8,621	8,606	9,199	10,152
	(9.7)	(11.1)	(10.5)	(9.6)	(9.0)	(8.9)
Tobacco	4,263	4,021	4,022	4,086	4,327	4,567
	(6.5)	(4.9)	(4.9)	(4.5)	(4.2)	(4.0)
Textiles	9,408	11,133	11,473	13,126	15,302	16,923
	(14.4)	(13.5)	(14.0)	(14.6)	(15.0)	(14.8)
Wearing apparel except footwear	5,895	7,773	8,260	9,310	11,214	12,338
	(9.0)	(9.4)	(10.1)	(10.4)	(11.0)	(10.8)
Leather, leather products & footwear	1,167	1,861	1,904	2,265	3,072	3,611
	(1.7)	(2.2)	(2.3)	(2.5)	(3.0)	(3.1)
Wood & wood products	1,382	1,294	1,218	1,320	1,439	1,609
	(2.1)	(1.5)	(1.4)	(1.4)	(1.4)	(1.4)
Furniture & fixtures	825	975	991	1,053	1,199	1,344
	(1.2)	(1.1)	(1.2)	(1.1)	(1.1)	(1.1)
Paper & paper products	1,181	1,325	1,367	1,473	1,748	1,947
	(1.8)	(1.6)	(1.6)	(1.6)	(1.7)	(1.7)
Printing, publishing & allied products	1,042	1,460	1,480	1,508	1,490	1,494
	(1.6)	(1.7)	(1.8)	(1.6)	(1.4)	(1.3)
Chemicals and chemical products	2,717	3,606	3,808	4,161	4,589	5,148
	(4.1)	(4.3)	(4.6)	(4.6)	(4.5)	(4.5)
Petroleum refineries & petroleum products	3,366	3,736	3,908	4,325	4,526	4,813
	(5.1)	(4.5)	(4.7)	(4.8)	(4.4)	(4.2)
Rubber & plastic products	1,816	1,918	2,021	2,232	2,638	3,191
	(2.7)	(2.3)	(2.4)	(2.4)	(2.6)	(2.7)
Non-metallic mineral products	2,357	3,354	3,315	3,288	3,894	4,436
	(3.6)	(4.0)	(4.0)	(3.6)	(3.8)	(3.8)
Basic metal industries	1,180	972	1,427	1,457	1,465	1,541
	(1.8)	(1.1)	(1.7)	(1.6)	(1.4)	(1.3)
Fabricated metal products	1,201	1,471	1,488	1,611	1,839	2,088
	(1.8)	(1.7)	(1.8)	(1.8)	(1.8)	(1.8)
Non-electrical machinery	2,174	3,551	2,994	3,215	3,624	4,126
	(3.3)	(4.3)	(3.6)	(3.6)	(3.5)	(3.6)
Electrical machinery	1,901	2,709	2,415	2,720	3,247	3,776
	(2.9)	(3.3)	(2.9)	(3.0)	(3.2)	(3.3)
Transport equipment	5,054	4,755	3,175	3,780	4,677	5,929
	(7.7)	(5.8)	(3.8)	(4.2)	(4.6)	(5.1)
Other manufacturing industries	2,530	3,948	4,196	5,171	6,833	8,476
	(3.8)	(4.8)	(5.1)	(5.7)	(6.7)	(7.4)
Total MVA	64,984	81,962	81,463	89,305	101,414	114,038
	(100)	(100)	(100)	(100)	(100)	(100)
Growth rate of MVA		6.0[b/]	-0.6	9.6	13.6	12.4

Source: NESDB.

a/ Estimate.

b/ Annual average 1980-84.

Table 7. Indicators of branch diversification of manufacturing (selected countries, 1985)

	Percentage share of top 3 branches in total MVA[a/]	Percentage share of top 10 branches in total MVA[a/]
Indonesia	53.3	84.4
Korea, Republic of	35.8	80.8
Malaysia	43.5	83.2
Philippines	56.4	85.6
Singapore	54.1	89.5
Thailand	40.9	78.1

Source: UNIDO Database.

a/ Based on a total of twenty manufacturing branches as given in Table 6.

The chemical industry is a major import-substituting industry whose main products in the 1980s were inorganic chemicals, pharmaceutical products for the domestic market and plastic products mainly for export markets. The discovery of natural gas in the Gulf of Thailand has laid the basis for developing a petrochemical industry, first in terms of intermediate products for downstream industrial polymer production and, in the next stage, in terms of aromatics serving as inputs for the detergent, soap and textiles industry. "Thus, as long as downstream-industry exports continue to face bright prospects, and once petrochemical industry investment projects are in full operation in the 1990s, the growth of the chemical and chemical-product industries is likely to be high."[1/]

A second major industry group seen to have above-average growth potentials in the 1990s are engineering industries. While electronic products, particularly consumer electronics are expected to increase their export competitiveness, the transport equipment industry will be geared predominantly to the rapidly expanding domestic market. The motor vehicle industry is projected to show a 12 per cent MVA growth during 1992-96 (ranking third after chemical products and textile products) and a 14 per cent growth, ahead of all other industrial branches, during 1997-2000.

1/ Cf. Paitoon Wiboonchutikula et al., op. cit, p. 8.

IV. PRIORITY AREAS FOR INDUSTRIAL DEVELOPMENT IN THE 1990s

1. Strategy and policy framework

Development plans in Thailand have in the past been of an indicative nature outlining major public investment programmes and giving broad orientations for preferred areas of private sector activities, i.e. the government has tended to act more as a 'promoter' than as a 'regulator' of economic development. This general approach will continue to be applied in the forthcoming Seventh National Development Plan (1992-96) which is at present being drafted - with an even heavier reliance than before on the developmental role of the private sector.[1/]

The overall industry-related objectives of the Seventh Plan, as emerging from discussions and limited preliminary information provided to the UNIDO mission, can be broadly stated as follows:

- to sustain the present high rates of industrial growth and manufactured exports;
- to reverse the recent trend towards growing income disparities between different population groups and in different regions of the country;
- to improve the efficiency of the industrial production and marketing system with a view to strengthen industrial competitiveness; and
- to put increasing emphasis on qualitative aspects of industrial development, in particular environmental issues.

Three main strategic approaches have been suggested by NESDB to achieve the above objectives. Firstly, the present industrial structure is to be deepened by developing basic industries as well as supporting industries in order to strengthen inter-industry linkages and reduce the high degree of import dependence of industrial production. In this context, it is envisaged to promote specific target industries and product groups which meet the strategic objectives of technology and skill upgrading and strong utilization of indigenous resources. Second, regional industrial development is to be accorded top priority so as to halt the growing concentration of industries in Bangkok Metropolitan Area and promote a more decentralized pattern of industrial development. In this context, the Southern Seaboard Development Programme, aimed at turning Thailand into a center of international trade in the West Pacific region, will assume special importance. Also for other provincial areas, guidelines are to be developed for the promotion of new industries based on the regions' geographical environment and their natural and human resources as well as for the suitable location and delineation of industrial zones. Third, industrial development under the Seventh Plan will be subject to stricter regulations and controls in terms of employing enviromentally sound technologies and preventing environmental pollution.

1/ This section is partly based on Chakramon Phasukavanich, The Role of the Industrial Policy in Thailand, Paper presented at the Senior Policy Seminar on Managing Industrial Adjustment and Restructuring, New Delhi, India, March 19-22, 1990 (mimeo).

In accordance with the role definition of a 'facilitator' and 'promoter' of development, the Government, rather than providing targeted support to specific industries, considers its main functions to lie in

- the provision and management of an efficient physical and technological infrastructure for industrial development;

- the removal of manpower shortages in the short run and the building up of a sufficient pool of adequately trained human resources in the long run;

- the broadening of the industry-related technological and scientific basis through increasing public and private R&D expenditures; and

- the promotion of private industries through a streamlining of rules and regulations as well as encouraging the private sector to actively co-operate with the Government in improving the country's infrastructure.

The brief review of Thai industrial development in the 1980s given in chapter III and the above outline of priority objectives and themes of the Seventh Plan set the scene for the subsequent discussion of focal programme elements for future technical assistance efforts. To sum up: Thailand has recently achieved exceptionally high industrial growth which was accompanied by a gradual restructuring of the industrial sector away from agro-based and light industrial branches towards intermediate and engineering industries. Growth has been largely export-driven and both exposure to highly competitive export markets and massive inflows of foreign direct investment have lifted the technological sophistication and competence of Thai industry to a fairly advanced level. Whether the country will join the ranks of the Asian NICs by the end of this decade is a moot point. It is, however, certainly at the threshold of becoming a key economic power in the region. The challenge ahead for Thai industry, unlike in most other developing countries, therefore is not to achieve a high growth path but to translate an industrial boom into self-sustained - and sustainable - long-term industrial development. For this to become reality two formidable tasks need to be solved. Firstly, Thai industry must move out of cheap labour-based industries in which comparative advantages are rapidly shifting to regional competitors such as Indonesia, China and, in some industries, Bangladesh and Sri Lanka. Second, a number of critical constraints and bottlenecks such as an overstrained infrastructure, shortages of skilled labour and a comparatively weak technological-scientific basis need to be overcome in the near future. These issues will be discussed in the following sections.

2. Regional dispersal of industries

Industrial development in Thailand has been characterized by an exceptionally high concentration on Bangkok itself and the Bangkok Metropolitan Region (BMR). This is by no means a recent development. In 1970, 51 per cent of total MVA was generated in Bangkok alone and as much as 85 per cent of MVA originated from companies in the Central Region. At the end of the 1970s, these shares had further increased to 54 and 89 per cent, respectively. Unlike in most other countries, secondary cities have remained

insignificant in terms of their share in overall economic activity and population - the population ratio between Bangkok and the second largest city, Chiang Mai, stands approximately 30:1.

This lop-sided concentration of economic activities on Bangkok has been due to advantages of agglomeration, such as the availability of infrastructure (transport, energy etc.); the provision of essential services (finance, insurance, technological expertise etc.); the availability of both unskilled and skilled labour, the size of the near-by domestic market as well as easy access to export markets; and easy communication with government offices and with the outside world. All these factors have tended to keep production and transaction costs for companies relatively low.

The perceived economic advantages of agglomeration described above have, however, largely turned into disadvantages. Bangkok and BMR have become seriously overcrowded and the resulting strains on infrastructure have risen to almost intolerable levels. While this applies to a lot of different aspects, the shortage and rising prices of land, water supply problems (most factories actually use ground water) and the traffic congestion are among the most serious ones. Overall, the operational costs and inconvenience of locating industrial production in Bangkok have risen drastically. There is no doubt that the dwindling attraction of Bangkok as industrial site is already starting to negatively affect Thailand's image among foreign investors as an excellent investment location. The building-up of other attractive regional investment locations would appear, therefore, to be of utmost importance for the country's sustainable future industrial development. In this context, it is important to reconize that a more decentralized regional development pattern will not only contribute to equity objectives. Rather, it has become a requirement to maintain and improve economic efficiency.

Successive governments in Thailand have pursued explicit regional policies aimed at decentralizing industries away from Bangkok. These policies encompassed improvements in the provision of infrastructure, incentives policies and, to some extent, the building up of industrial estates. Some of these approaches will be briefly reviewed below. It appears, though, that the chances of launching a more successful decentralization programme are particularly promising at present. In general, spatial redistribution policies tend to be the more successful the more they are consistent with market forces. In this sense, the present environment is indeed very favourable. There is a noticeable trend now for many industries to search for locational options outside BMR. If the government were to take a lead role by e.g. building up an industrial infrastructure in selected regional growth poles, it would clearly work in line with market mechanisms, not against them.

Recent initiatives taken by the government in this respect include the Board of Investment (BOI) policy changes introduced in 1987 and 1989 providing special incentives for regional investors. The new BOI promotion approach divides the country's 73 provinces into three different investment promotion zones:

- The first zone includes Bangkok and its six neighbouring provinces.

- The second zone includes 10 provinces in the Central Region and Eastern Seaboard Region.

- The third zone includes the remaining 57 provinces including those in the North, Northeast and South.

Promotional privileges, such as tax exemptions and tax reductions, are now restricted to investment projects in the second and third zone (the latter receiving the highest amount of incentives). There are exceptions, however, for large-scale export-oriented investments which continue to receive BOI incentives also in the first zone. Furthermore, the BOI plans to resume the granting of promotional privileges for about 50 categories of industries if they locate outside the first zone. The industries - including cement industries, textiles industries, rubber industries, tanning, aluminium products and others - had previously been excluded from BOI promotional status as they were considered to be sufficiently competitive. Moreover, the BOI is planning to expand its investment promotion service in provincial areas in order to facilitate the implementation of investment projects.

The last point leads over to a crucial aspect. While the strengthened regional dimension in the incentives policy is a welcome development, its potential impact must not be overemphasized. Promotional privileges may be an additional, yet only marginal determinant of investment decisions. Much more important will be the existing infrastructure and the possibility for companies to avail themselves of key support services. The establishment of industrial estates can be a useful measure in this respect. So far, however, the existing industrial estates in Thailand are heavily concentrated in the close vicinity of Bangkok (see Table 8) with the Northern Industrial Estate Lamphung (close to Chiang Mai) being the major exception. Likewise, the industrial estates currently under construction are all located near Bangkok or in the Eastern Seaboard area. However, a large number of industrial estates projects in provincial areas (outside the Bangkok area and its vicinity) are presently at various stages of planning.[1/] While this report cannot provide an overall assessment of the Thai industrial estates programme, it would appear that up until now it has not been an effective instrument of regional industrial dispersal and decentralization. A concept that may warrant increased attention in the future is the setting up of Small-Scale Industries Estates in which essential common services could be provided jointly by the government and private industry associations.

Regional development programmes are not an easy task, however. They critically require an integrated approach combining the development of industrial sites (either within or outside industrial estates) with the development of transport, power, water and communications facilities. Furthermore, and this point has not received sufficient attention in the past, regionally decentralized industrial development must be accompanied or, indeed, preceded by a decentralization of the government machinery and the whole process of economic decision-making. This involves a number of different aspects, such as in particular:

1/ It should be noted that in recent years private investors have become heavily involved in developing industrial estates. All estates listed in Table 8 under items 8-14 have been privately developed in accordance with procedures established by the Industrial Estate Authority of Thailand (IEAT).

Table 8. Industrial Estates in Thailand

Industrial estate	Site (from Bangkok)	Year of completion
1. Bang Chan	30 km east	1972
2. Lat Krabang I/II	35 km east	1983
Lat Krabang III	35 km east	1989
3. Bangpoo	34 km east	1977
4. Bang Phli I	40 km east	1984
Bang Phli II	40 km east	1988
5. Northern Industrial Estates Lamphun	600 km north	1988
6. Laem Chabang	125 km east	1990
7. Mab Ta Put	180 km east	1989
8. Navanakorn III	46 km north	1987
9. Bangkadi Industrial Park	40 km north	1988
10. Mahboonkrong	40 km north	1988
11. Lat Krabang Industrial Zone	40 km east	1988
12. Sriracha Industrial Park	110 km east	1988
13. Suranaree Industrial Zone	259 km northeast	1987
14. M. Thai Industrial State	40 km east	1988

Source: Industrial Estate Authority of Thailand.

- a stronger representation in regions and even at provincial level of key industry-related institutions and agencies. The Ministry of Industry (MOI) is presently planning a strengthening of their Provincial Industrial Offices under a "Mini-MOI" concept. At present there are, furthermore, 5 regional offices of the Department of Industrial Promotion (DIP). The BOI has 3 regional offices. Crucial support institutions such as those involved in testing, quality control and standardization (e.g. the Thailand Industrial Standards Institute) are not represented at all outside Bangkok (except indirectly by the Provincial Industrial Offices) making the implementation of industrial standards different in the regions;

- the provision of more financial and administrative autonomy to municipal governments to enable them - together with other key actors such as banks, industrial associations and universities - to design and launch regional development efforts "from below". This would specifically involve increased provincial autonomy in granting production licenses;[1/]

1/ The government is currently planning to include more industries than hitherto under provincial approval authority.

- an enhanced capability of the regions and provinces to generate their own financial resources. A possible institutional mechanism could be the establishment of regional development funds to be administered entirely at the regional level.

In view of the paramount importance of achieving a more decentralized industrial development pattern this issue should be considered as one of the focal points for future technical assistance activities. It was pointed out to the UNIDO mission in many meetings that expert advice would be required on the most suitable approach for a restructuring and decentralization of key government institutions. This would also involve specialized training to facilitate a suitable staffing of provincial and regional offices.

Regional planning capabilities in general would need to be strengthened. So far, the locational pattern of industrial development in the country is more the result of uninhibited market forces than of any rationally designed advance zoning. This will increasingly be required, however, in the future. Optimal locations will need to be identified for different types of industrial production, be it to realize economies of scale and economies of scope in the field of high-tech industries[1/] or to facilitate the monitoring and control of heavily polluting industries. In this context, there will be a great need for technical and planning advice for the Southern Seaboard Development Programme which has just been launched. It foresees the construction of a transshipment route across Southern Thailand (a pipeline, road and rail link between the Andaman Sea and the Gulf of Thailand), the establishment of a major petrochemical complex processing natural gas and petroleum and the setting up of numerous industrial estates, mainly of an export-oriented nature, in near-by provinces.

Another promising approach could be the gradual development of the North Eastern region around Khon Kaen and Korat into an additional center for engineering industries. This would build upon the region's main assets as it has a long tradition in metalworking skills, partly derived from repair and maintenance activities for transport equipment. In Khon Kaen one of MOI's five Regional Industrial Promotion Centers is located. The Khon Kaen Centre receives assistance from the Canadian International Development Agency, particularly concerning loans for small and medium enterprises. Furthermore, a new highway is planned to link this region with the Eastern Seaboard. Khon Kaen is also one of five cities covered by the World Bank's Secondary Cities Project which, apart from infrastructure investment programmes, focusses on financial planning, investment planning and the strengthening of management capacities.

Thus, the populous North Eastern region, especially the area around Khon Kaen, appears to be one suitable target area for regional industrial development efforts which could build upon available resources and engineering skills, the

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1/ At present, a high-tech industrial estate is being established close to Bangkok as a Thai-Singapore joint venture involving private Thai investors and the Jurong Town Corporation from Singapore. Another high-tech industrial estate is planned to be completed by 1992 in the Northern region.

existence of a rudimentary institutional framework and ongoing complementary activities of bilateral and multilateral donor agencies. However, also growth poles in the Northern Region (the Chiang Mai/Lampang and Phitsanulok areas, for instance) and the South would call for similar attention.

3. "Structural deepening" and the role of supporting industries

As pointed out above, Thailand has reached a fairly advanced level of industrial development compared to most other developing countries. At this level, both international trends, challenges and opportunities and the growth dynamics of the domestic market will need to be increasingly accounted for. At the same time, it must not be overlooked that the Thai manufacturing sector is still highly dualistic and lacks a better structural integration. Efficient export industries co-exist along with protected inefficient domestic market-oriented industries and a limited number of modern large-scale companies contrast sharply with the vast majority of small traditional companies. The links between these different segments of industry have remained very weak for a variety of reasons, not the least of which are found in existing policy biases working in favour of large producers of end products.

There can be no doubt that in the 1990s international economic driving forces will have a growing significance for Thailand's industrial transformation in terms of fierce price and quality competition in various product markets (both domestic and foreign); technological innovation pressures and concomitant needs for company-level and sector-level reorganization; growing influence of large foreign companies pursuing global and regional strategies; the changing international trade environment; and many others. In addition, domestic pressures are rising towards a socio-economic development pattern which takes due recognition of the need to stem the growing disparities in regional development and income distribution.

The emerging international and national pressures necessitate the continued restructuring of the country's industrial sector towards a more dynamic and competitive yet at the same time more balanced pattern. As outlined in chapter II of this report, it is increasingly national industrial systems which compete with each other. This aspect is becoming more important along with increasing levels of industrial competence. The years are drawing to a close during which Thai industry could derive a strong position from one single factor, i.e. cheap labour. In the future, competitive advantages will be rooted in high quality production and the establishment of efficient interlinked industrial networks.

This emerging change has a variety of aspects some of which, such as a strong scientific-technological basis and efforts at human resource development, will be discussed in subsequent sections of this report. This section focusses on what is often referred to as "structural deepening". The term itself is not well-defined and it is suggested here to divide it into two different aspects.

- The first dimension refers to a horizontal industrial restructuring between different branches of manufacturing. As pointed out earlier, Thai industry is gradually turning away from its former concentration on labour-intensive production of simple consumer goods towards intermediate and capital goods employing higher levels of technology. Accordingly, chemical industries and in particular engineering industries will gain in relative importance. Bright prospects are seen e.g. in the production of general purpose machine tools (largely for the domestic market) and in electrical appliances and electronic products which have recently emerged as the most dynamic export performer.

- The second dimension refers to structural deepening in a narrow sense, i.e. the establishment of stronger backward linkages of prime manufacturers with domestic supplying firms, the so-called supporting industries.

This section will focus on the second aspect relating to the promotion of supporting industries because (i) this issue is receiving strong attention at present in Thailand and, indeed, most Southeast Asian countries; (ii) the building up of strong supporting industries can have a critical impact on a number of industrial development objectives and; (iii) external assistance is required in many different forms and can be a catalyst with high spread effects.

As the term 'supporting industries' is not yet well established and hence subject to differing interpretations, a brief conceptual outline of the term's use in this report may thus be warranted (bearing in mind, however, that a watertight definition is not intended nor does it appear to be feasible at all). In principle, each industry providing inputs to other producers can be considered as a supporting industry. In this sense, the production of textiles 'supports' clothing manufacturers, a steel factory 'supports' the fabrication of metal products, plywood manufacturing 'supports' furniture-makers etc. At the same time, being a supporting industry is not an intrinsic property of any industrial branch or factory but essentially depends upon the length and nature of the production chain and the corresponding position of a specific industry therein. Typical categories of supporting industries would cover:[1/]

- At the core of the support industry concept have traditionally been those industries producing parts and components. They tend to belong to the private sector and have been the domaine of small- to medium-sized enterprises. Often they are linked to prime manufacturers by subcontracting arrangements as is predominantly the case in the automotive sector.

1/ A similar approach is taken by the Board of Investment defining supporting industries as "all industries which sustain the activities of major manufacturing companies by providing essential materials, components and services. This includes any company supporting the production process of other industries, from the provision of basic machinery and parts, to providing processed raw materials, components parts, or testing services." (Office of the Board of Investment, Support Industry in Thailand, October 1989).

- A less obvious albeit essential segment of supporting industries are the producers of machinery and equipment, be it moulds and dies for plastic or rubber processing industries; woodworking machinery; industrial pumps etc. By definition they are part of the engineering sector although they serve, of course, other industrial branches as well.

- Finally, industrial services can be included as a third support category. Such services can either be provided by other enterprises (e.g. packaging or design) or by specialized institutions (e.g. training or quality control) which can be operated by private associations or public sector entities. Further, engineering services would be included among industrial support services.

The role of supporting industries has in recent years come to the forefront as many developing countries, including Thailand, have tended to overemphasize the promotion of assembly operations while at the same time neglecting capability generation in medium-sized firms supplying the required production inputs. A biased processing pattern in favour of final (assembled) products is the consequence. In this context, a brief comparative look at the experience of two Asian NICs, the Republic of Korea and Taiwan Province, is instructive. While the former long neglected the development of an efficient local supply base of parts/components, and consequently continues to suffer from high import dependency, in the latter industrial priorities were different from the start with stress having been placed on establishing a powerful domestic parts/components industry first. It was only out of parts manufacturing that the assembly sector subsequently grew.

This is not to say that a policy of maximizing local content would be called for. Quite obviously, in a competitive world economic environment based on comparative advantages and specialization there should be reasonable limits to a strategy of import substitution and the raising of domestic content. After all, 'support' should not be regarded as a physical concept. Whether a supplying industry effectively 'supports' or rather 'weakens' a user industry, is a question of the former's production costs and product quality as compared to a potential sourcing from the world market.

With this caveat in mind, the strategic role of strong supporting industries can hardly be overemphasized. They contribute to reducing the import dependency of industrial production (which, given Thailand's rising current account deficit would be very welcome), create additional employment, link large and medium-sized companies through sub-contracting arrangements, broaden the basis of domestic entrepreneurship and often lead to a higher utilization of domestically available natural resources.

One of the challenges facing Thai industry in the 1990s is to move away from the heavy realiance on assembly subcontracting into supplying more finished products for the world market -- either to original equipment manufacturers or, eventually, under Thai brand names. The success of such a strategy depends crucially on an efficient network of low-cost component sourcing. This is because in general the products involved in this strategy (e.g TVs, PCs or VCRs) are more component-intensive than e.g. simple

semiconductor devices or integrated circuits and require high quality, reliable and readily available supplies of inputs.[1/]

At present the level of supporting industry development in Thailand is relatively low. This is partly due to existing policy biases working against smaller companies. Foremost among these are the 'cascading effects' of the present business tax which is, however, soon to be substituted by a new value added tax system. This measure can be expected to have a significant positive impact on the economic attractiveness of subcontracting arrangements. Furthermore, small companies tend to have limited access to existing duty drawback and exemption schemes for exporters as well as to credit from the formal financial sector. They also find it hard to take advantage of BOI privileges which are often tied to minimum size criteria. Finally, the present structure of effective protection is generally granting higher protection levels to consumer goods than to capital goods thus providing a disincentive for domestic engineering industries.

For these and other reasons supporting medium-scale industries have not developed to a level at which they would be able to make a major contribution to industrial development. It is significant that as much as 96 per cent of all basic metal and engineering industries are cottage and small-scale industries with medium-scale and large-scale industries accounting for only 3 per cent and 1 per cent, respectively.

The present report cannot provide a detailed review of various types of supporting industries and their performance in Thailand.[2/] In general, supporting industries suffer, inter alia, from the following shortcomings:

- lack of basic knowledge of engineering techniques;
- outdated production technology and, as a consequence, lack of capabilities to produce goods of high and/or even quality;
- limited knowledge in selecting and using appropriate materials and equipment;
- shortage of skilled labour;
- inadequate design and innovation skills to develop new products or adapt foreign desgined products to the requirements of the domestic market.

1/ Cf. Ernst, D./O'Connor, D., Technology and Global Competition. The Challenge for Newly Industrializing Economies, OECD, Paris 1989, p. 88.

2/ For more specific information cf. UNIDO, Promotion of Supporting Industries in Thailand, PPD/R.31, 13 November 1989 (which contains a number of specific project proposals) and Damri Sukhotanang, Supporting Industries in Thailand, December 1988 (mimeo).

The key area lacking sufficient capabilities is in metal parts production, including high-quality foundry and casting services. This applies specifically to the manufacture of metal moulds and dies whereas plastic mould-making has recently made advances. The weakness of Thai supporting industries often compels foreign investors to either source from abroad (sophisticated moulds e.g. are a significant import item) or to encourage their traditional suppliers to move to Thailand as happened for instance in the case of Mitsubishi car manufacturing.

With a view to strengthening Thai engineering industries in general and supporting industries in particular, the Government in 1986 - with assistance provided from JICA - established the Metalworking and Machinery Industries Development Institute (MIDI) within the Department of Industrial Promotion (DIP) of the Ministry of Industry. MIDI's main tasks are to develop and raise the level of technology and efficiency of the small and medium-scale machinery and metal working industries as well as to develop personnel, towards building up a pool of skilled labour ready to meet the needs of foreign investors. MIDI's immediate aim is to raise the technological level of the following metal working processes: casting, welding and sheet metal working, machining, heat treatment, automation, electroplating and presswork. The Institute's aim is also to develop industrial and metalworking products in the following areas: agricultural machinery, moulds and dies, gears, pumps and valves, tools, machinery, automotive and industrial machinery parts.

To meet these objectives, MIDI is:

- providing technical training to small and medium-sized machinery and metalworking factories in Bangkok and the provinces to increase the efficiency of production;

- sending technical experts to provide firm-level advice on quality control and production planning control;

- providing testing and examination of various metal products, testing of metallurgical properties, analysis and examination of metal structures and non-destructive testing;

- conducting economic and technical research to determine the technological level of each branch of the machinery and metalworking industries to find out the problems facing them and how assistance can be provided; and to determine the extent and method of providing such assistance and technological transfers;

- carrying out research and experiments and constructing prototype machinery as a service to factories; identifying and assisting firms which would be willing to manufacture such machinery for the local market thereby reducing the dependency on imports;

- providing information and news of developments in metalworking technology and regarding engineering designs, production control, quality control, production planning, etc.

- serving as a co-ordination centre for other agencies concerned with industrial machinery and metalworking in such areas as industrial development planning, manpower development, market research and development; integrated manufacturing and technological development.

MIDI is equipped with various high precision and special processing equipment, material testing and inspection equipment and precision measuring instruments which the small- and medium industries would not be able to install easily at their own plants.

Future external assistance aimed at strengthening supporting industries in the field of metalworking could make use of MIDI as an efficient channel and counterpart for targeted activities. In this context, moulds and dies manufacturing should be made an area of special attention. Metal moulds and dies are essential to downstream industries producing a wide range of plastic, metal, rubber and glass products. The moulds and dies industry, therefore, is a key supporting industry on which many domestic industrial costumers, presently sourcing from abroad, could rely. Moreover, with the expected progress of the country's engineering and chemical industries, demand can be assumed to grow significantly in the future. It is noteworthy in this context that MIDI has recently been instrumental in organizing the Thai Tool and Die Industry Forum which at present has approximately 180 members from the private sector.

Further priority areas for external assistance include the manufacture of jigs and fixtures used in machining; tool grinding technologies; advice on simple forms of automation; training in computer-aided drafting and design; and training in machine tool design, specifically for machine tools used in food-processing industries.

In view of the diverse and highly specialized assistance requirements of supporting industries in various product areas, it may be a suitable approach to launch an 'umbrella project' for technical co-operation. Under such a project, assistance on product design, manufacturing and marketing could be provided to individual companies as required. The branch-specific Industry Clubs of the Federation of Thai Industries could act as immediate counterpart responsible for screening and processing of individual requests for assistance.

4. Scientific-technological base for industrial development and related human resource requirements

The recent economic boom in Thailand and the concomitant structural changes in the industrial sector have brought into sharp focus the weakness of the country's scientific and technological base.[1/] Policy makers,

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1/ A number of very recent studies on this subject are available the results of which are reflected in this section. Cf. in particular TDRI, Enhancing Thai Private Sector Capacity for Research, Development and Engineering, March 1990; TDRI, The Development of Thailand's Technological Capability in Industry, Volume 6: Overview and Recommendations, March 1989; World Bank, Industry Development Division, Technology Strategy and Policy for International Competitiveness: A Case Study of Thailand, 22 February 1990; Charuay Boonyubol et a., Impact Study on the Activities of the United Nations System in Science and Technology in Thailand, August 1988; TDRI, S&T Manpower Situation: An Update, June 1989 (revised November 1989).

industrialists and researchers alike are now seriously concerned that this constraint may jeopardise the country's move into more sophisticated areas of industrial production which is considered a necessity to stay competitive in the years to come. Accordingly, NESDB and other economic planning agencies have put science and technology as well as high-level human resource development at the top of their policy agenda. There is an acute awareness now that unless immediate action is taken in these fields the economic boom of the late 1980s will remain a short historical episode rather than a step towards self-sustained development in the long run.

In comparison with other Asian NICs, Thailand has long neglected the building up of scientific and technological capabilities; the main emphasis has rather been on the basic physical infrastructure for industrial development. In 1987, total R&D expenditures accounted for only 0.22 per cent of GDP. This compares to a corresponding figure of approximately 2 per cent in the Republic of Korea and, what is more significant, to approximately 0.5 per cent in Korea 15 years ago, i.e. when the country was at a comparable level of development. Even more striking is the extremely low contribution of the private sector which in 1987 carried out only about 3 per cent of total R&D, again compared to about 80 per cent at present and about 35 per cent 15 years ago in Korea. For Thailand, this implies that private industry invests only about 0.1 per cent of annual sales revenues in R&D.

The weak performance of private industry in this respect is due partly to lacking awareness of the importance of R&D (which is now, however, slowly changing), partly to the booming demand situation which has favoured an emphasis on capacity utilisation and expansion rather than on innovation, and partly to the lack of fiscal incentives. Unlike in many other countries of the region, most notably in Singapore, no tax incentives are available in Thailand to induce investment in R&D equipment. There are exceptions, however, in terms of some companies with strong R&D efforts and heavy expenditures. Siam Cement is the most prominent example. This company has established its own R&D department; it also arranges for top management experts from abroad to provide in-house training similar to MBA courses for senior and junior executives.

The overall technological capabilities of Thai industry have recently been analysed in an in-depth study undertaken by TDRI. The study focussed on crucial technology fields including biotechnology-based industries, material technology-based industries and electronics and information technology-based industries. A total of 119 firms were studied by teams of economists and engineers with regard to their acquisitive capability (utilisation of foreign technology), operative capability (good maintenance, professional management, technical competence and training), adaptive capability (minor product and process modifications) and innovative capability (own R&D activities, major product and process modifications and development of new products and processes). The results of the study point to weak overall technological capabilities of Thai industry with only very few product groups considered to be internationally fully competitive (this applies to aquaculture, machinery, engine parts and sanitary ware). Average capability levels were found to be highest in agriculture/biotechnology-based industries and lowest in the field of electronics. As to the different types of capabilities, operative capabilities tended to be highest and innovative capabilities lowest, especially those related to the need to introduce major changes.

In general, the promotion of R&D and of efficient acquisition and diffusion of new technology is an area requiring strong government involvement. On the one hand, experience shows that competitive pressure in open markets is among the most powerful mechanisms to induce changes in products and processes and respond to opportunities offered by new, more efficient technologies. On the other hand, in many developing countries only insufficient information is available on the nature and range of new technologies on offer as well as on the terms and prices of acquisition. Furthermore, the developmental role of new technologies typically implies disparities in the perceived private and social returns of their introduction. Government policy and public institutions are thus needed to complement and reinforce the market mechanism. Indeed, it is hard to overestimate the role played by an efficient institutional network in promoting the development and diffusion of technologies in developing countries.

There is a broad consensus, however, emerging from all recent studies on the subject that the institutional infrastructure for science and technology in Thailand is not fully geared to providing a major stimulus to the country's economic development. The problem does not lie in a lack of specialised institutions. A wide variety of agencies has been established to deal with questions related to science and technology for development. This includes specifically a number of institutions under the Ministry of Science and Technology (MOSTE), such as the Office of Science, Technology and Energy Policy and Planning; the Technology Transfer Centre; the Department of Science Services; the National Research Council; the Science and Technology Development Board; and specialised research institutes, such as the Thailand Institute of Scientific and Technological Research (TISTR). It further includes specialised institutes under the MOI such as MIDI and the Thailand Industrial Standards Institute.

Yet these institutions are beset with difficulties, detracting from their potential effectiveness. These include in particular:

- staffing problems in view of the rising shortage of high-level manpower and the 'brain drain' towards the private sector;

- lack of institutionalised forms of co-operation between various R&D institutions, in particular those under MOSTE and those under other line ministries, as well as partly overlapping responsibilities among different institutions;[1/]

- weakness above all in industry-related applied research and, as e.g. in the case of TISTR, on the process engineering and design side related to technological innovation;

- lack of client-oriented regular diffusion of information about research undertaken and services offered which would be easily available for private industry.

1/ Mention should be made, however, of the Science Information Access Centre recently set up within MOSTE. This Centre links up all information processing of the seven departments within the Ministry.

Remedial action on the last two issues is of immediate importance for attempts at strengthening interaction between R&D institutions and industry. Industrial companies are to be encouraged to demand research services; universities and other research institutions in turn should pursue more industry-related research. The lack of such co-operation appears to be a result partly of traditional attitudes and partly of weak communication links between the actors concerned. Transfer agencies i.e. agencies concerned with the commercialization of research results and the design of industry-relevant research programmes - could play a key role in overcoming some of these barriers. In this context, a recent initiative by Chula Unisearch of Chulalongkorn University is noteworthy. It is aimed at providing software programming services to local companies in response to specified user requirements.

More ambitious plans to foster university-research-industry linkages are being pursued at present by MOSTE along the lines of the science park concept. A project to establish science parks in each of the country's five major regions was approved by the Cabinet in July 1989. At present, a full feasibility study is carried out by Thammasat University and the Asian Institute of Technology. According to the plans, emphasis will be on research, development, design, engineering and prototyping activities related to manufacturing production.

As experience elsewhere has shown, the establishment of science parks requires a long-term commitment often bearing fruit only after an incubation period of up to 10 years. Also it needs to be emphasized that the successful operation of a science park has a number of important preconditions. In addition to the more obvious ones - availability of highly skilled personnel; an attractive site with an excellent infrastructure - this includes the existence of venture capital institutions willing to finance high risk, non-standard projects.

The number of science parks so far established in developing countries is extremely small. The most prominent example is the Hsinchu Science-Based Industrial Park in Taiwan Province of China, which testifies to the possibility of rapid progress in a realistic planning framework. Founded only in 1980, the Hsinchu Park has attracted more than 70 research-based companies (some 40 per cent locally owned), predominantly from the electronics industry. In 1987 these companies generated a total production value of approximately US$ 700 million. The main objectives in establishing the Hsinchu Park were to speed up industrial restructuring towards more knowledge-intensive production, to create proper jobs for highly skilled local workers and to promote domestic entrepreneurship.

Further related initiatives at present pursued in Thailand include the setting up of a 'Data Processing Zone' in the Eastern Seaboard Area which is to provide data processing and telecommunications services to large companies as well as, in co-operation with private industry, to offer comprehensive training in fields related to data processing. Moreover, an industrial science centre, the functions of which are yet to be defined in detail, is planned to be established also in the Eastern Seaboard Area (in Mab Ta Phud, Rayong).

The observations made in this section on the science and technology infrastructure for industrial development in Thailand have pointed to

opportunities and needs for external assistance in a number of fields including the promotion of transfer agencies between research institutions and private industry as well as the strengthening of engineering and design capabilities in industry-related research institutions. A third important area would be assistance to make the system of industrial standards and quality control more effective. Standardization results in the reduction of transaction costs, particularly for decentralized industries; it is crucial for any production of high-tech components and absolutely indispensable if these are to be exported. It has been argued in fact that in the case of Japan the early introduction of national certificates linked to industrial standards has encouraged enterprises to adopt firm-level quality control systems which in turn has rendered possible the successful expansion of the subcontracting system.

Most importantly, as was emphasized in a recent study by Chula Unisearch on the role of the UN system in the field of science and technology,[1/] technical assistance in specific areas should be preceded by policy level advisory services on the formulation of a national strategy for science and technology. Amidst the present economic boom and bright prospects for the immediate future, there is a 'window of opportunity' to assess current shortcomings and design a focussed and coherent strategy with clearer responsibilities, a more efficient division of labour, better public-private sector co-operation and effective monitoring systems.

Such an effort should be accompanied by and linked to a forward-looking assessment of the country's human resources requirements for future industrial development. As mentioned above, shortages of skilled workers and above all, engineers have already emerged and constitute a serious impediment for continued industrial growth. A crisis situation is predicted by TDRI to occur over the next 10 years unless preventive action is taken promptly. In view of the massive demand for new skills coming upon Thai industry, it is disquieting to note that only less than 20 per cent of the population get post primary school education which makes the level of secondary education the lowest in Southeast Asia. At the same time, the demand for skilled workers with at least secondary education is expected to increase from 32 to 38 per cent of the total workforce during the Seventh Plan period.

There is no doubt a great awareness now in Thailand that it is the education and skill level of the labour force which largely determine the country's competitive strength and resilience, its capacity to adjust to new sophisticated technologies and to reduce the economic and social costs of the adjustment process. This has been a clear lesson from successful countries, both developing and industrialized. It is now widely recognized that the successful industrialization of the East Asian newly industrializing countries has been largely caused by the early priority given to the development and upgrading of human resources.

Special emphasis should be put in this context on organizing an efficient country-wide vocational training system. Indeed, the quality of vocational training more than anything else is the decisive factor in coping with technical change and in applying new technologies. Even countries with a strong scientific elite will meet difficulties in <u>diffusing</u> new technologies

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1/ Cf. Charuay Boonyabol et al., <u>op. cit</u>.

unless they have given equal priority to their vocational training system. In particular, a high level of general technical training tends to increase the mobility of semi-skilled and skilled staff thus creating more opportunities for dynamizing the industrial sector as a whole. This point is especially relevant given the above-mentioned emphasis towards the creation of supporting industries and close networking of service and producing enterprises. For the most part, the smaller firms which grow up to meet the needs of more complex industrial structures are created by people who previously acquired industrial experience through working in already established larger enterprises. It might be expected that this pattern will also be observed in relation to new technologies in the coming years.

A high level of general technical training thus appears to be conducive to strengthening the position of smaller firms. The same is true for a standardized system of examinations and certificates. The more technical competence is visible from standard certificates the more will inter-firm mobility be encouraged and the less important will be internal labour markets. This would again favour smaller companies in their recruitment of skilled labour.

External assistance related to vocational and general technical training could take various forms, such as advice on designing a comprehensive vocational training system, equipment for vocational training institutions and training of teachers in such institutes in specific fields.

As a first step so as to be able to design national and supportive multilateral and bilateral programmes for industrial skill development in the coming years, it is suggested that a survey be undertaken of key human resource bottlenecks and emerging skill requirements in the context of further development and technological upgrading of the industrial sector and its institutional infrastructure. The survey would inter alia:

(i) identify priority industrial subsectors and/or across the board industrial activities for which industrial training needs are deemed most urgent;

(ii) define training and retraining needs in the identified priority subsectors, taking also into account the following functions that are directly or indirectly concerned with industry:

- research and development
- marketing, including export marketing
- industrial and industry-related services
- government policy making and planning
- engineering consultancy;

(iii) assess the existing industrial training capabilities to meet the needs identified;

(iv) assess the assistance activities in the field of industrial training provided under bilateral and multilateral co-operation agreements;

(v) recommend ways and means by which existing training programmes can be improved and expanded including new approaches, activities and programmes such as:

- upgrading the operating responsibilities of graduate professionals in industry through well-designed in-plant and on-the-job training programmes designed to meet specific identified needs and to prepare these professionals to occupy higher posts in their enterprises

- expose the professional from industry to modern industrial techniques and technologies applied in industrialized and other developing countries by sending them abroad for practical training

- the development and introduction of a computer-aided decision support and optimization system that could help the government to develop scenarios for providing and allocating human resources for selected subsectors and identify the various skills and capabilities needed in quantitative and qualitative terms. The corresponding software has been developed and UNIDO is planning to adapt, test and implement this approach in selected developing countries.

5. Environmental issues of industrial development[1/]

Along with Thailand's rapid industrial growth has come a rapid deterioration of the environment both in terms of an over-exploitation of natural resources (leading e.g. to the logging ban in 1989) and various types of pollution and waste generation in urban-industrial agglomerations, i.e. in the Bangkok Metropolitan Area and, increasingly, in the Chiang Mai region in the north of the country. For illustrative purposes, it can be mentioned that between 1972-82, the number of registered chemical plants using and disposing of toxic materials doubled from approximately 300 to 600. The level of generation of non-recyclable hazardous wastes is predicted to grow to almost 2 million tons per year in the early 1990.

The Thai society has recently developed a strong consciousness and awareness of the environmental threats it is facing and of the need to take preventive action rather than react by ex-post damage control. There is now a widespread consensus that industrial growth needs to be environmentally

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1/ This section does not go beyond stating the main issues and pointing to action to be taken. For details on the legislative and institutional framework and on technical questions of various types of environmental pollution see the following studies from which most of the information presented here is taken: Dhira Phantumvanit et al., Business and Environment in Thailand, TDRI, March 1990; Samarn Thangtontawi, Environmental Management and Transnational Corporations in Pollution-Intensive Industries in Thailand, May 1989 (mimeo); Ministry of Science, Technology and Energy, Office of the National Environment Board, National Hazardous Waste Management Plan, March 1989.

sustainable in the long run unless it is to undermine its very foundation. External assistance in various fields is actively sought and will generally meet with strong counterpart motivation and commitment.

Environmental legislation in Thailand dates back to the mid-1970s with the passing of the Enforcement and Conservation of the National Environmental Quality Act (1975), revised in 1978, and establishment of the Office of National Environment Board (ONEB), currently attached to the Ministry of Science, Technology and Energy. The National Environment Board (NEB) - although not equipped with direct enforcement power - has taken important steps such as the preparation of guidelines on Policies and Measures on National Environmental Development (approved by the Cabinet in 1981) and, above all, mandatory environmental impact assessments for major projects and activities, such as in particular large-scale industrial projects and industrial estates.

The second main institution concerned with environmental issues is the Department of Industrial Works (DIW) in the Ministry of Industry which is the traditional focus of pollution control activities. DIW has both the authority to grant licenses and to stop production and suspend or revoke factory licenses in case of environmental hazards.

The use of financial incentives to promote the adoption of environmentally sound technologies in production processes is of more recent origin. The Ministry of Finance has established an import tax reduction for a number of designated technologies with a view to stimulate energy conservation and pollution control in industrial processes. The tax reduction is set at one half of an approved item's stipulated tariff, or 10 per cent, whichever is lower. From 1983-88, the related import tax relief amounted to 75 million Baht, approximately 13 per cent of the total value of equipment submitted for deduction approval.

One of the priority areas for environmental action at present is the treatment of hazardous waste. NEB is in the process of preparing an action-oriented National Hazardous Waste Management Plan with emphasis on the construction of hazardous waste treatment facilities. As a first measure, the Bang Khuntien Industrial Hazardous Waste Treatment Center was set up by DIW in a south-western suburb of Bangkok for treating toxic electro-plating waste and waste from small textile dyeing factories. DIW has constructed the plant and has contracted a private firm to operate it for 5 years, starting from July 1988. The service area of the treatment center, in its initial stage, is planned to cover factories in Thonburi and adjacent areas. Similar facilities are to be developed in the Prakarn Samut (South of Bangkok) and Rayong (Eastern Seaboard) areas, in case this demonstration project meets expectations.[1/]

1/ Another important area is the need for waste oil recycling on which UNIDO has undertaken a techno-economic feasibility study for a waste oil refinery plant. Oils account for more than 10 per cent of total hazardous waste quantities (see Annex Table A-6).

Waste water is another priority area for attention in particular in Bangkok itself, which has no comprehensive sewerage system for its more than 5 million inhabitants. It is estimated that about two thirds of untreated waste water are derived from domestic sources with the remaining third coming from industry. Currently, the majority of the more than 23,000 registered factories in Bangkok discharge their waste water into rivers and canals without adequate treatment.

The introduction of environmentally sound technologies as well as the development and implementation of pollution control facilities offer excellent opportunities for private sector involvement.[1/] First of all, many Thai companies and foreign companies operating in the country are showing increasing awareness and commitment to environmental issues. Recent initiatives include a feasibility study by Siam Kraft Company for adopting wastewater-free paper production technology and the installation by AT & T of state-of-the-art pollution control technology for manufacturing printed circuit boards. Furthermore, private companies offering environmental expertise will find an expanding market both within the private sector and in terms of government orders as witnessed by the case of the Bang Khuntien waste treatment center. In this context, co-operation potentials between Thai private industry and external bilateral and multilateral organizations are expanding as well. A remarkable initiative has been taken e.g. by the US Agency for International Development which concluded a US $1.35 million agreement with the Federation of Thai Industries aimed at acquiring technical know-how to reduce and control industrial pollution. (For the potential and modalities of UNIDO-private sector co-operation in Thailand see the following section of this report.)

While there is a wide range of areas in which external assistance can supplement national efforts to deal with environmental issues, the following fields have been pointed out in particular to the UNIDO mission:

- There are vast training needs for staff of all agencies involved in environmental policies, planning and operations. This applies in particular to staff implementing the proposed National Hazardous Waste Management Plan who needs to gain technical expertise in a number of specialized fields.

- Expertise is needed - inter alia drawing on experience made in other advanced developing countries and in industrialized countries - on zoning approaches in regional planning, seeking to arrive at effective land use patterns by demarcating zones for residential and industrial use. Specifically, the potential design, location and operation of industrial estates concentrating on high-pollution industries should be further investigated.

- Policy advice would be required - again drawing on other countries' experience - on the optimal use of economic incentives (such as pollution fees and tax/tariff privilegies for clean technologies) as an alternative to directly regulatory measures.

1/ This point is particularly stressed by Dhira Phantumvanit et al., op. cit.

- Further areas include technological advice on available options for waste water treatment; the development of analytical tools for environmental impact assessment of industrial projects; and, in view of the country's soaring energy demand, programmes for effective energy conservation and recycling at the plant level.

Programmes in the above areas should be designed and implemented in close co-operation with concerned regional agencies located in Bangkok, such as in particular the regional headquarters of UNEP and ESCAP's Division of Industry, Human Settlements and Environment which have undertaken studies to support environmentally sound industrial development, e.g. in the context of the Eastern Seaboard Development Programme.

6. Increased private sector involvement

Private industry has been the backbone of industrial development in Thailand accounting for the lion's share of the country's manufacturing industries. State involvement in industrial production is confined to a limited number of large-scale capital-intensive projects of national significance where public-private sector joint ventures were set up. This applies e.g. to the National Fertilizer Corporation and the National Petrochemical Corporation.

Recently, private sector involvement has also expanded into unconventional areas such as the provision and management of infrastructural facilities. Examples include the developing and selling of land for industrial estates which are subsequently operated by the Industrial Estates Authority of Thailand; a government concession for private companies to construct and operate the second stage of the Bangkok expressway project; and the private management of container ports to solve the congestion problem at Klong Toey Port. These examples indicate an increasing government confidence in and reliance upon the efficiency of private enterprises in mutually beneficial forms of joint public-private sector development efforts.

Considering the growing role of the private sector and the massive demands on restructuring and reorganization of private enterprises, it appears crucial in the years to come to increasingly conceive technical and other co-operation programmes not solely directed at the various authorities and public sector institutions within the government machinery. Rather, the multilateral and bilateral agencies dealing with industry should strengthen their work directly with and for private industry in Thailand including specifically industrial associations, industrial consultancy associations, industry-related technological and other research institutes etc.

Although co-operation would still be conceived within the framework of the general Government policy and co-ordinated co-operation programme, assistance should attempt to reach the end user of its services in the manufacturing industry in direct communication. This would no doubt result in greater efficiency of deliveries of the services and enhance their operational nature. It will certainly also increase the counterpart commitment of the recipient involved. At the same time, it will require significant adjustments of procedures, and implementation practices.

There are two ongoing UNDP/UNIDO projects which have already responded to this new requirement. Both work with the Federation of Thai Industries (FTI) as counterpart agency and point the way for similar approaches to be adopted in the future. One project, through FTI, works directly for the benefit of local pharmaceutical companies seeking to introduce 'good manufacturing practices' through plant level advisory services and through the establishment of a Technical Services Center at the Chulalongkorn University. Another project is aimed at strengthening the air-conditioning industry in Thailand. Again, FTI is involved in implementation. Target beneficiaries are both Thai manufacturers of air-conditioning equipment and the Engineering Faculty of Chulalongkorn University where modern testing facilities are being established for use by private industry. Both projects are thus also contributing to promoting closer linkages between university research and private industry - a key element to be strengthened if the country is to advance to higher levels of industrial development. A similar approach is pursued by another pipeline project intended to promote the utilization of domestic mineral resources by supporting an industrial pilot programme on electronic ceramics at Chiang Mai University.

The private industry offers excellent opportunities to expand these innovate co-operation activities, as FTI and the branch-specific Industry Clubs organized under FTI are suitable counterpart organizations which are highly responsive to such projects. In addition, the Industry Fora organized under the auspices of MIDI[1/] could be utilized as appropriate channels for assistance to small and medium-scale private companies.

Increased direct co-operation with private industry will have implications for future patterns of project financing. So far, UNIDO's activities in Thailand have been predominantly financed through the UNDP country programme and associated UNDP sources. In the future, however, also other financial sources would need to be utilized for UNIDO's expanding work in the country. Special trust funds and special purpose contributions by various governments, banks and industrial companies both in Thailand and abroad should be seen as additional options. In fact, such type of projects have already started - as e.g. in the case of a study on the country's supporting industries financed from a Japanese trust fund - and should receive more attention in the future.

Indeed, Thai private industry should be able to increasingly contribute to finance technical assistance which is directly beneficial to industrial enterprises, e.g. in the framework of UNIDO's programme of self-financed trust funds. Obviously, it will take some time to fully develop such innovative forms of co-operation. They would need to be designed in such a way as to ensure the co-ordination and monitoring through relevant Government authorities and UNDP.

Such new programmes would also offer opportunities for the involvement of other bilateral and multilateral donors as witnessed by UNIDO's past co-operation, in the context of trust fund agreements, with the Danish International Development Agency, the World Bank and the International Development Association. FTI has expressed to the UNIDO mission high interest in drawing upon such schemes in the future.

1/ So far, the Thai Tool and Die Industries Forum (approx. 180 members), the Thai Electro-Plating Industries Forum (approx. 50 members) and the Thai Foundry Industries Forum (approx. 20 members) have been established.

V. FRAMEWORK FOR FUTURE TECHNICAL ASSISTANCE

The UNIDO Mission took place at an important period of Thailand's economic and industrial development. As outlined above, the country's growth performance has been exceptionally good in recent years; along with an increasing technological sophistication its industries are becoming more and more competitive; and domestic industrial development stimuli are supplemented by the capturing of new export markets. At this stage, it is important to stock-take current trends, prospects and constraints of industrial development and to outline areas requiring particular attention in the years to come. The Mission attempted to do this although it had only limited time at its disposal. It could, however, in many areas refer to analytical reports and policy-oriented work being undertaken in the country. On this basis, the present report identifies critical areas for a technical assistance programme for industry in the next country programme cycle.

Within a framework of relatively little, and mostly indirect, government intervention, industrial development in Thailand is largely driven by market forces which in turn requires a high degree of flexibility from all actors involved in this process. The Mission is of the opinion that this need for flexibility as well as the relatively advanced level of industrial development achieved in the country ought to be reflected in the nature of external assistance, both in terms of the forms of delivery and the end users:

- First, technical assistance thus needs to be formulated and delivered as a flexible response to rapidly changing trends and constraints in the key branches of industry so as to enable timely support to arising critical needs;

- second, technical assistance may have to be increasingly directed to the private sector entities such as industrial enterprises, chambers of industry and commerce and regional and sectoral industry associations as well as to the banking sector in its capacity as provider of industrial finance;

- moreover, increasing emphasis needs to be placed on the instrumental role of industrial development for the society's overall welfare. The objectives of poverty alleviation, equitable regional development and environmentally sound and sustainable development are all intimately linked to the pattern of industrial development and will require more attention in the future;

- finally, a wide range of bilateral and multilateral co-operation programmes are currently supporting the Thai industrial development process. It is obviously an essential part of the subsequent detailed programming exercise to synchronize and use the synergic effect of the entire assistance.

At this stage of the programming exercise, the Mission was asked to refrain from elaborating any specific project concepts in order to first enable UNDP and the authorities concerned to review the report in its entirety and respond to the identified proirity areas. Subsequently, UNIDO will certainly be pleased to provide its services for detailed technical project formulation work in the designated areas.

ANNEX I: Statistical Tables

Annex Table A-1. Balance of payments, 1985-1989
(million Baht)

	1985	1986	1987	1988	1989[a/]
Merchandise					
- Exports	191,703	231,481	298,099	399,230	509,669
- Imports	-253,334	-245,690	-341,376	-501,401	-646,129
Trade balance	-61,672	-14,369	-43,828	-102,171	-136,460
Net services	15,253	14,970	28,713	54,377	71,150
Unrequited transfers	4,494	5,913	5,795	5,971	6,251
Current account balance	-41,925	6,515	-9,319	-41,823	-59,059
Capital movements	51,433	11,354	21,112	72,605	150,208
- of which: FDI	4,379	6,880	4,711	27,358	42,457
Recorded balance	9,508	17,868	11,793	30,782	91,148
Net errors and omissions	2,956	15,710	6,390	9,708	20,307
Overall balance	12,464	33,578	18,183	40,490	111,455

Source: Bank of Thailand.

a/ Provisional.

Annex Table A-2. Gross domestic product by industrial origin (current prices), 1980 and 1984-88

million Baht
(percentage shares)

Industrial origin	1980	1984	1985	1986	1987	1988[a/]
Agriculture	152,854 (23.2)	175,190 (17.9)	169,895 (16.7)	180,841 (16.5)	198,284 (16.0)	247,748 (16.9)
Mining & quarrying	22,147 (3.3)	32,954 (3.3)	40,167 (3.9)	34,398 (3.1)	38,203 (3.0)	44,333 (3.0)
Manufacturing	139,936 (21.2)	218,050 (22.4)	224,456 (22.1)	255,029 (23.3)	295,512 (24.4)	357,851 (24.8)
Construction	34,764 (5.2)	56,092 (5.7)	56,824 (5.6)	56,564 (5.1)	62,995 (5.1)	74,524 (5.0)
Electricity & water supply	6,289 (0.9)	18,618 (1.9)	23,590 (2.3)	28,689 (2.6)	31,858 (2.5)	37,487 (2.5)
Transport and communication	37,863 (5.7)	69,530 (7.1)	78,076 (7.6)	85,371 (7.7)	92,947 (7.5)	106,834 (7.2)
Wholesale & retail trade	110,176 (16.7)	154,891 (15.9)	153,130 (15.0)	169,828 (15.5)	192,381 (15.5)	232,231 (15.8)
Banking, insurance & real estate	19,926 (3.0)	34,426 (3.5)	35,988 (3.5)	37,376 (3.4)	48,617 (3.9)	60,032 (4.9)
Ownership of dwellings	22,789 (3.4)	37,253 (3.8)	41,091 (4.0)	44,842 (4.0)	48,802 (3.9)	52,702 (3.5)
Public administration & defence	30,711 (4.6)	45,019 (4.6)	48,545 (4.7)	50,612 (4.6)	52,712 (4.2)	56,242 (3.8)
Services	81,047 (12.3)	131,389 (13.5)	142,637 (14.0)	151,129 (13.8)	171,665 (13.9)	195,752 (13.3)
Total GDP	658,509 (100)	973,412 (100)	1,014,399 (100)	1,094,679 (100)	1,234,030 (100)	1,465,736 (100)

Source: NESDB.

a/ Estimate.

Annex Table A-3. Value of principal exports, 1985/1989

Export item	1989[a/] million Baht	1989[a/] Share in total exports	1985 million Baht	1985 Share in total exports
Principal exports				
Textile products	74,021	14.4	23,578	12.2
Rice	45,462	8.8	22,524	11.7
Rubber	26,450	5.1	13,567	7.0
Tapioca products	24,005	4.7	14,969	7.7
Sugar	19,243	3.7	6,247	3.2
Integrated circuits	18,424	3.6	8,248	4.3
Precious stones	16,419	3.2	6,350	3.3
Prawns	16,057	3.1	3,439	1.8
Maize	4,094	0.8	7,700	4.0
Tin	2,445	0.5	5,647	2.9
Total principal exports	246,620	47.8	112,269	58.1
Other exports	269,125	52.2	81,097	41.9
TOTAL	515,745	100	193,366	100

Source: Bank of Thailand.

a/ Provisional.

Annex Table A-4. Value of exports by destination, 1989

Destination	Export value in 1989[a/]	
	million Baht	Share in total
Japan	199,135	38.6
United States	73,460	14.2
Singapore	47,130	9.1
Federal Republic of Germany	33,637	6.5
Taiwan Province	32,721	6.4
Hong Kong	19,138	3.7
Korea, Republic of	19,109	3.7
United Kingdom	16,764	3.3
Malaysia	16,660	3.2
Australia	13,039	2.5
Sub-total 10 countries	470,793	91.3
TOTAL	515,745	100

Source: Bank of Thailand.

a/ Provisional.

Annex Table A-5. Export/output ratio by industry, 1975 and 1980
(Percentages)

Industry	Export/output ratio	
	1975	1980
Food	21.8	32.0
Beverages	0.1	0.6
Tobacco	7.1	7.9
Textiles	8.1	13.7
Leather	5.8	22.6
Wood and wood products	17.1	8.8
Paper and paper products	1.3	1.7
Basic industrial chemicals	1.2	8.7
Chemical products	2.5	2.9
Refineries and petroleum products	1.5	0.2
Rubber and rubber products	58.9	80.4
Plastic products	5.6	11.5
Ceramic and earthenware	4.4	16.4
Glass and glass products	2.2	6.4
Other non-metallic products	15.4	1.1
Iron and steel	1.6	9.3
Non-ferrous metai	57.7	82.9
Fabricated metal	5.1	14.5
Machinery	1.7	5.1
Electrical industrial machinery and appliance	10.9	32.2
Transport equipment	0.2	0.3
Other manufactured products	19.0	49.1
TOTAL	13.8	20.0

Source: Thailand Input-Output Tables, 1975 and 1980.

Annex Table A-6. Projected hazardous waste quantities by waste type
(thousand tonnes/year)

Waste type	Hazardous waste quantities			
	1986	1991	1996	2001
Oils	124.19	219.47	387.89	686.36
Liquid organic residues	0.19	0.31	0.52	0.88
Organic sludges & solids	11.70	19.25	32.04	54.08
Inorganic sludges & solids	11.70	19.25	32.04	54.08
Heavy metals sludges & solids	823.87	1,447.59	2,536.03	4,418.03
Solvents	19.78	36.16	66.53	124.31
Acid wastes	81.05	125.43	196.51	311.71
Alkaline wastes	21.95	34.24	54.02	86.20
Off spec products	0.01	0.03	0.05	0.11
PCB	2.46	a/	a/	a/
Aqueous organic residues	0.12	0.24	0.50	1.04
Photo wastes	8.82	16.35	30.40	57.81
Municipal wastes	7.23	11.79	19.09	31.09
Infectious wastes	46.67	76.08	123.22	200.70
Totals	1,151.73	1,993.60	3,458.76	5,993.84

Source: Office of the National Environment Board.

a/ Total existing quantity estimated at 2,468 tonnes. It has been assumed that no new PCB containing materials were imported to Thailand after the mid-1970s.

ANNEX II: List of persons met by the UNIDO industry sector mission to Bangkok (7-14 July 1990)

Ministry of Industry

Office of the Permanent Secretary for Industry

Mr. Sivavong Changkasiri, Permanent Secretary
Ms. Orapin Weerawut, Director (Industrial Economics and Planning Division)
Mr. Charmroon Malaigrong, Director (Office of Basic Industry Development)
Mr. Songkram Thamagasorn, Director (Foreign Relations Division)

Thailand Industrial Standards Institute

Mr. Sammao Chulkarat, Secretary-General

Department of Mineral Resources

Mr. Prakong Polahan, Deputy Director-General
Mr. Nopadon Mantajit (Technical and Planing Division)

Department of Industrial Promotion

Mr. Pisal Kongsamran, Director-General
Mr. Padetpai Meekhun-iam, Director (Planning Division)
Ms. Sumalee Hongsakul, Director (Industrial Development Centre)
Mr. Thammu Vasinonta, Director (Thailand Management Development and Productivity Centre)
Ms. Prani Obhasanond, Director (Textile Industry Division)
Dr. Damri Sukhotanang, Director (Metalworking & Machinery Industries Development Institute)
Mr. Somsak Kuptakanchanakul, Director (Industrial Service Institute)
Ms. Yawanit Thongpahusatcha, Chief (Design Promotion Group, Industrial Service Institute)
Mr. Nuntapit Nakasarn, Furniture Industry Development Centre (Industrial Service Institute)
Mr. Suchart Intarachote, Textile Industry Division
Ms. Nantaya Yanumet, Textile Industry Division

Department of Industrial Works

Mr. Yingyong Srithong, Director-General
Dr. Samarn Tangtontawi, Chief (Hazardous Waste Disposal Sub-Div.)

Industrial Estate Authority of Thailand

Mr. Chavalit Chokratanachai, Director (Planning and Analysis Division, Development Department)

National Economic and Social Development Board

Government/Private Co-operation Division

Mr. Chakramon Phasukavanich, Director
Mr. Chalermsak Rabilwongse, Chief (Industrial Planning Section)

Office of the Board of Investment

Mr. Staporn Kavitanon, Deputy Secretary-General
Ms. Chaba Praritsantik, Investment Promotion Officer

Industrial Finance Corporation of Thailand

Mr. Aswin Kongsiri, President
Mr. Anothai Techamontrikul, Senior Executive Vice-President
Mr. Kavee Tovijit, Executive Vice-President
Dr. Poonsa-nga Somboonpanya, Vice-President (Research & Development Dept.)
Mr. Vorayuth Charoenloet, Second Vice-President (Business Promotion Dept.)

Federation of Thai Industries

Mr. Chaichai Boonyarat, Chairman (Food Processing Industries Club)
Mr. Wirash Krittaphol, Managing Director (The Siam Iron and Steel Co., Ltd.)
Mr. Athikom Tongnumtago, Bangkok Cable Co., Ltd.
Mr. Sopon Wichitrakorn, President (Oriental Fibre Co. Ltd.)

Department of Technical and Economic Co-operation

Mr. Prateeb Nakornchai, Chief (UN Subdivision)

Ministry of Science, Technology and Energy

Department of Science Service

Mr. Kasem Snidvongs, Director-General
Ms. Roungthong Panpaprai, Deputy Director-General
Dr. Anamai Singhabhandhu, Director (Physics and Engineering Division)
Ms. Nantana Kaewubon, Director (Biological Science Division)
Dr. Varunee Thiramongkol, Director (Research Division)
Mr. Chunchon Sermswan (Analytical Chemistry Division)
Ms. Mayuree Pongpudpunth (Division of Scientific and Technological Information)
Ms. Tasanee Vashrangsi (Chemistry Division)
Mr. Banturng Jantawat

Thailand Institute of Scientific and Technological Research

Dr. Santhad Rojanasoonthon, Acting Governor
Dr. Wiboonkiet Moleeratanond, Director (Food Industry Department)
Mr. Sunanta Ramanvongse, Director (Operation Planning Division)
Mr. Narong Yamphayak, Acting Director (Electronic Industrial Dept.)
Mr. Sachee Piyapongse, Division Director (Industrial Co-operation and Promotion Centre)
Mr. Poonsook Atthasampunna, Specialist
Mr. Chaiyuth Klinsukont, Director (Environmental & Res Mgmt Dept.)
Mr. Salaisophin Komarakul Na Nakorn, Director (Foreign Relations Division)

Thailand Development Research Institute Foundation

Dr. Narongchai Akrasanee, Executive Vice-President
Dr. Dhira Phantumvanit, Director (Natural Resources and Environment Program)
Dr. Chatri Sripaipan, Director (Science and Technology Program)

UNDP

Mr. Alan Doss, Regional Representative
Mr. Fabrizio Ossella, Deputy Regional Representative

Individual Experts

Dr. Pawadee Tonguthai, Associate Professor, Faculty of Economics, Ramkamhaeng University
Dr. Suchart Thada-Thamrongvech, Associate Professor, Faculty of Economics, Ramkamhaeng University
Mr. Pakorn Adulban, Manager, Computer Services Center, The Siam Cement Co., Ltd.
Mr. Noel Kelly, CTA, Industrial Planning Project (DP/THAI/87/007), UNIDO
Mr. Patrick Long, Regional Planner, Industrial Planning Project (DP/THAI/87/007), UNIDO

REFERENCES

- Asian Development Bank, Asian Development Outlook 1990, Manila 1990.
- Chakramon Phasukavanich, The Role of the Industrial Policy in Thailand, paper presented at the Senior Policy Seminar on Managing Industrial Adjustment and Restructuring, New Delhi, India, March 19-22, 1990 (mimeo).
- Charuay Boonyubol et al., Impact Study on the Activities of the United Nations System in Science and Technology in Thailand, August 1988.
- Damri Sukhotanang, Supporting Industries in Thailand, December 1988 (mimeo).
- Dhira Phantumvanit et al., Business and Environment in Thailand, TDRI, March 1990.
- Ernst, D./O'Connor, D., Technology and Global Competition. The Challenge for Newly Industrializing Economies, OECD, Paris 1989.
- Ministry of Science, Technology and Energy, Office of the National Environment Board, National Hazardous Waste Management Plan, March 1989.
- Narongchai Akrasanee, Thailand in the International Community, Report presented at the 1989 TDRI Year - End Conference, December 16-17, 1989 (mimeo).
- Office of the Board of Investment, Support Industry in Thailand, October 1989.
- Paitoon Wiboonchutikula et al., Trade in Manufactured Goods and Mineral Products, Background Paper No.4, presented at the TDRI 1989 Year-End Conference, December 16-17, 1989 (mimeo).
- Porter, M.E., The Competitive Advantage of Nations, in: Harvard Business Review, March-April 1990.
- Samarn Thangtontawi, Environmental Management and Transnational Corporations in Pollution-Intensive Industries in Thailand, May 1989 (mimeo).
- TDRI, Enhancing Thai Private Sector Capacity for Research, Development and Engineering, March 1990.
- TDRI, S & T Manpower Situation: An Update, June 1989 (revised November 1989).
- TDRI, The Development of Thailand's Technological Capability in Industry, Volume 6: Overview and Recommendations, March 1989.
- UNIDO, Foreign Direct Investment Flows to Developing Countries: Recent Trends, Major Determinants and Policy Implications, PPD.167, 10 July 1990.

- UNIDO, Industrial Development Review Series: Thailand, IS.548, 7 August 1985.

- UNIDO, Industry and Development Global Report 1989/90.

- UNIDO, New Technologies and Global Industrialization. Prospects for Developing Countries, PPD.141, 13 November 1989.

- UNIDO, Promotion of Supporting Industries in Thailand, PPD/R.31, 13 November 1989.

- World Bank, Industry Development Division, Technology Strategy and Policy for International Competitiveness: A Case Study of Thailand, February 22, 1990.

- World Bank, Thailand: Country Economic Memorandum. Building on the Recent Success - A Policy Framework, Report No. 7445-TH, 21 February 1989.