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THE ELECTRONICS INDUSTRY IN THE ASEAN COUNTRIES

THAILAND*

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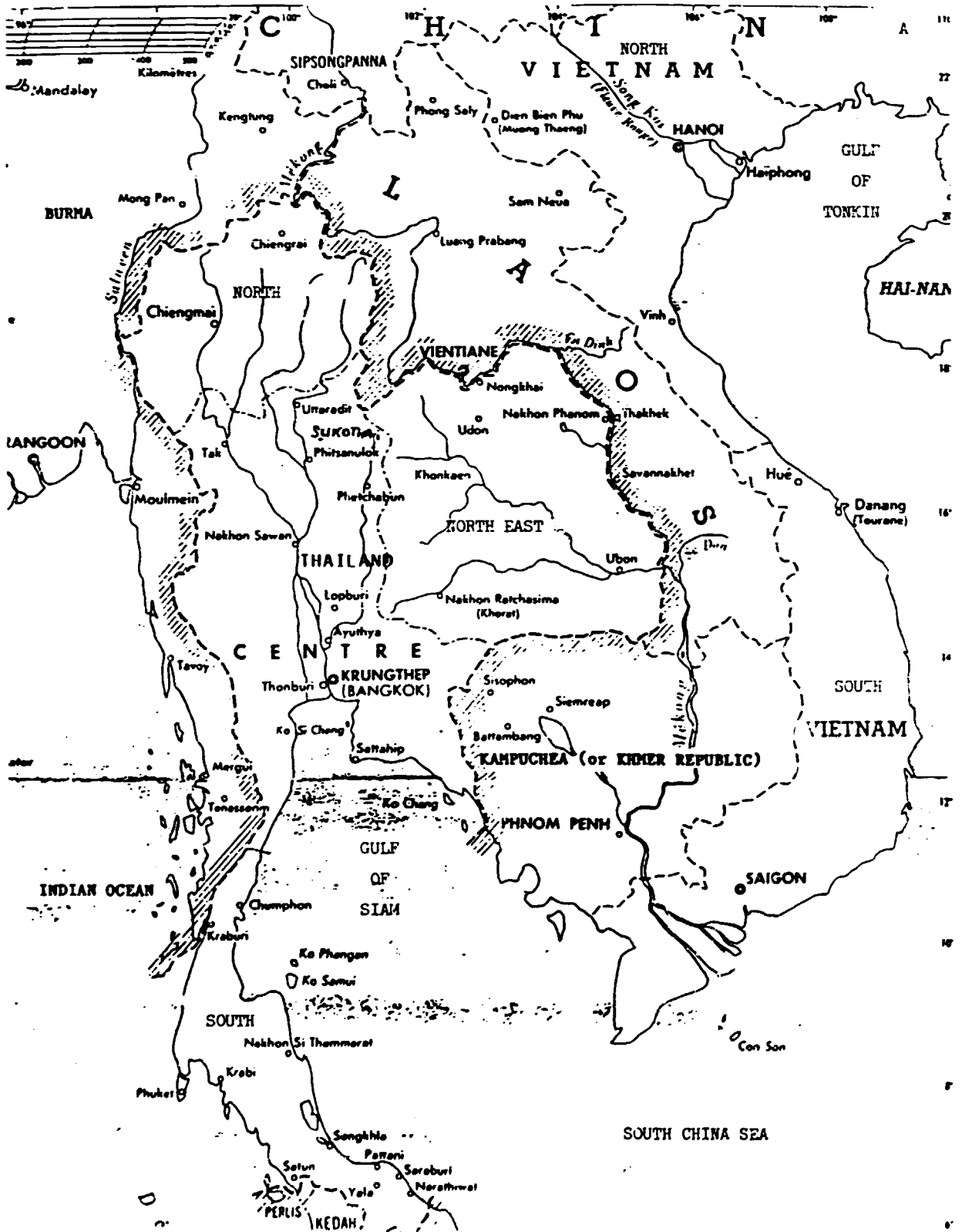
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US Dollar in Bahte :

1980 : 20.5 1981 : 21.8 1982 : 23 1983 : 23 1984 : 23.6
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1. INTRODUCTION

1.1 Economic development

Thailand, with an area equal to that of France, occupies a central position in the Gulf of Siam, and its extensive coastline opens onto the China Sea and the Indian Ocean.

Its northern part is in fact the most continental of the ASEAN countries: it includes the Central Plain which is irrigated by the Menam River and a hinterland which extends to the mountain ranges which form its frontiers with Laos and Burma, these two countries separating it from China.

To the east its frontier with Kampuchea makes it one of the front-line countries.

Its southern part forms a narrow coastal strip extending to the frontier with Malaysia.

Thailand has 53 million inhabitants, and the rate of growth of the population is falling steadily (3 per cent during the 1960s, 2.3 per cent at the present time). Bangkok, the capital of the Kingdom, has 30 times as many inhabitants as the second largest town, Chiang Mai.

The population is characterized by its high level of cohesion which is ethnic, linguistic and religious. Buddhism is the basis of the spirit of tolerance shown by the Thais. Within this region it is the country which has most effectively integrated Chinese immigration, and the only country which has never been colonized.

1950-1975: The dynamism of an agricultural economy

During the 1950s the State launched an ambitious industrial programme, creating about a hundred public enterprises in a variety of fields. This interventionist approach was not able to withstand attacks from the commercial world and the criticisms of the World Bank. As from the time of the First Development Plan (1962-1966) the State undertook not to enter into competition with the private sector.

Agriculture has been the driving force behind the economy; its contribution to the GDP has certainly become smaller, but for many years it had been responsible for most exports (95 per cent in 1970, including processed agricultural products) and it is still today the principal activity of two Thais out of three. Agriculture has experienced 20 years of rapid change, marked both by considerable increases in the quantities produced in the case of traditional crops such as rice and also by new products such as jute and cassava in the 1960s and maize, poultry raising and industrial pineapple growing in the 1970s.

Until 1975 industrial growth was ensured, without any problems, from the utilization of agricultural and mining resources to an initial phase of the replacement of imports of non-durable consumer goods and some intermediate products such as refined products and cement.

The expansion of the domestic market explains 90 per cent of the increase in industrial production between 1960 and 1975. The most dynamic branches were refining, papermaking, metal constructions, mechanical and electrical engineering

and textiles. During this period the trading balance of industry was in deficit, and it was the agricultural and mining exports which financed the imports needed by industry.

1975-1980: Deferred adjustment

The first oil crisis was a severe blow for Thailand which imports some 80 per cent of its energy requirements. The quadrupling of the price per barrel did not however constrain the country to adjust to this new factor since it coincided with the rice boom. In fact Thailand's trading reached its highest levels in 1974. It was a matter of growth within the Fourth Plan (1976-1981) and not of adjustment.

The promotion of manufacturing exports figured amongst the priorities of the Plan whilst, somewhat paradoxically, the State increased customs' tariffs, multiplied controls and licences and launched several programmes for industrial integration (including automobiles, amongst others); these reforms made the domestic market more attractive and did not encourage exporting.

Whilst the larger Thai enterprises profited from an industrial policy which had become more protectionist and developed on the home markets, the medium-sized companies became more aggressive where exports were concerned, exporting ready-to-wear clothing, cut stones and toys. Such dynamism was welcome. The boom in these exports explains a third of the increase in industrial production at the end of the decade and represented, in 1980, a third of all exports.

The discovery of gas in the Gulf of Siam encouraged a change of attitude on the part of the State; it invested in the construction of a gas pipeline which brought the gas to the coast in 1981, and studies a series of major projects located to the south-east of Bangkok (the Eastern Seaboard), projects which should by the year 2000 enlarge the industrial base of Thailand: gas separation, steam-crackers, aromatics, fertilizers, methanol, gas liquefaction, heavy iron and steel production, rock soda (ASEAN), etc. This industrial gamble is evaluated at US\$10 billion.

1980-1985: A time for consolidation

The Fifth Plan (1981-1986) envisaged both growth and adjustment, the tradition of financial prudence coming once again to the front. For the purposes of adjustment the Thai authorities operated three lines of defence:

- Irdebtedness: Thailand had more room for manoeuvre than other countries, and profited from this up to 1983: it benefited from two adjustment loans from the World Bank and remained an excellent signatory for financial contracts.
- Austerity, by applying from 1982 onwards a very strict credit policy, inspired by the IMF.
- The promotion of exports.

1.2 The global data

Between 1980 and 1987 (figure 1), the gross domestic product increased by around 5-6 per cent except during 1985 and 1986. The growth rate for 1988 should be 8 per cent, thanks to very good export performance (more than 35 per cent over the previous year). Between 1970 and 1985 (figure 2), per capita income increased by 70 per cent in real terms, or at an average annual rate of 3.5 per cent.

As regards shares by region (figure 3), one finds that Bangkok and the Central Region accounted for 44.4 per cent and 18.4 per cent of the gross domestic product respectively, indicating a very high concentration of economic activity.

With regard to shares by sector (figure 4), agriculture employs nearly 70 per cent of the economically active population and accounts for 17 per cent of the gross domestic product. Industry accounts for 10 per cent of employment and 30.9 per cent of the gross domestic product (20 per cent corresponding to manufacturing industry). Finally, services account for 52.5 per cent of the gross domestic product.

The data concerning exports and imports (table 1) show a trade deficit of 10 billion baht, or \$400 million. The share of manufactured products in exports increased by 22 points between 1980 and 1986 and they now account for 55 per cent of total exports. Imports of capital goods increased significantly over the period and account for 31.5 per cent of imports.

1.3 Manufacturing industry

1.3.1 Structure

The structure of manufacturing industry underwent profound changes between 1951 and 1980 (table 2). Industries processing agricultural products, which represented 63 per cent in 1951, now account for only 35 per cent. The share of intermediate goods has almost doubled (from 12.7 to 21.9 per cent). Already in 1980, export-oriented labour-intensive industries accounted for 11.3 per cent of the industrial sector. The production of capital goods, on the other hand, has increased only slightly.

In 1986 the structure of industry in terms of value added showed the following characteristics:

- An industry still very strongly linked with agriculture: the agro-food industries, tobacco and beverages provided one quarter of the value added;
- Textiles and clothing, the second sector in order of size, is one which has developed its exports most rapidly;
- Chemicals, refining and the converting of gas form a rapidly expanding group which has benefited from the discovery of gas in the Gulf of Siam;
- As in most of the ASEAN countries the mechanical and electrical engineering industries are still embryonic, providing only 12 per cent of the value added. The electronic engineering sector is likely to experience substantial development as an essentially export-oriented industry.

Local industry satisfies the domestic market in regard to most consumer goods; since 1980 the contribution of the latter to imports has never exceeded 9 per cent.

Industry is highly concentrated in Bangkok and the Central Region.

With a few exceptions (rice processing and pineapple canneries) industry is concentrated in Bangkok. The capital accounted for 70 per cent of manufacturing value added in 1976 and 75 per cent in 1985: if the Central Region is added this

figure becomes 79 per cent. Beyond this area it is practically an industrial desert. The Chiang Mai region, with 11 million inhabitants, accounts for only 3 per cent of production.

Geography and laissez-faire explain this state of affairs. Decentralization has been the subject of discussion and has served as the pretext for some ventures which have not produced the results expected (the Chiang Mai industrial zone, with 100 hectares occupied by five plants). But there has been little follow-up. The Eastern Seaboard is the only major programme; if this is effectively followed up this region could see its population increase by 50,000 inhabitants.

1.3.2 Trade

The evolution of exports of the principal manufactured products is given in table 3. Precious stones, jewellery, textiles, garments and, in the last few years, electronic products, particularly integrated circuits, are the main products exported.

1.3.3 The role of the State and the private national and international sectors

A discreet State

The Government has limited itself to the construction of a framework which is favourable towards business. The Thai interventionism of the 1950s is no longer the norm. Thailand is the only country in the region that has not embarked on the construction of white elephants: it is not that suggestions have been lacking (iron and steel, gas liquefaction) but they have not been followed up and so the country has avoided catastrophes.

Small- and medium-sized industries

Industry is in the hands of small- and medium-sized companies. Apart from the 30,000 rice processing units there are not less than 30,000 enterprises, 95 per cent of which have less than 50 employees: two out of three are located in the Central Region and Bangkok. Thai statistics are not very precise and there have been problems in following up the burgeoning industry.

Large Chinese groups

The expansion of small- and medium-sized companies and their dynamism must not be allowed to mask the concentration of industry in Thailand. Lacking industrial statistics this may be measured by expressing the turnover of the 10 largest local groups as a percentage of the GDP: this was 13 per cent in 1979 and 10 per cent in 1987. This is a low figure when compared with Korea (50 per cent) but it is not negligible, being twice as large as the figure for Brazil.

With the notable exception of Siam Cement the 20 leading groups have been created by the Chinese, often those born in China who, after acquiring wealth by dealing in rice or import-export businesses, entered finance and industry after the Second World War. The Sino-Thai financial bourgeoisie dominates industry; the Bangkok Bank is the largest bank in South-East Asia.

Foreign investments

Thailand is often regarded as the private preserve of Japanese firms, and this image sometimes leads to forgetting the fact that it was American firms which until recently were (and possible will always be) the principal investors in Thailand.

This is the information provided by the Bank of Thailand which measures direct flows of investment; cumulated from 1972 to 1983 they total 36 billion baht (US\$1.5 billion), a figure which is fairly modest for the region. Japan leads the United States which are followed at a considerable distance by Great Britain and then by the Netherlands and Singapore with more or less equal amounts of investments. After these come the Federal Republic of Germany, which has invested as much as Hong Kong, whilst investments from Malaysia exceed those from France.

2. THE DEVELOPMENT OF THE ELECTRONICS SECTOR

2.1 History

Although there is no sectoral policy electronics has always been seen by the Board of Investment (BOI) as one of the priority sectors.

During the 1960s the general priority was the replacement of imports, and the BOI offered privileged status to enterprises which invested in assembling. Import duties (from 60 per cent to 100 per cent) discouraged the importing of radios and television sets and favoured the assembly of sub-assemblies taxed at 30 per cent. This resulted in the appearance of companies such as SANYO, THANIN and ELCON.

Local production capacities were rapidly found to be sufficient and the assembly of consumer goods for the local market disappeared from the priority lists, with the exception of colour televisions. Only those products intended for export could claim privileged status from the BOI. This was the case with Thanin International which was created in 1974.

The privileges granted to the exporting enterprises encouraged a small number of local firms to invest in the manufacture of passive components. But the growth in electronics exports is above all due to foreign capital investments. Two American companies set up establishments in 1973 (National Semiconductors) and in 1974 (Data General), followed in 1980 by Honeywell which was subsequently bought by ATT. Other foreign companies subsequently invested, but the total amount of these investments did not reach the level of those made in Malaysia at that time.

At the end of 1984, the Ministry of Industry listed 134 enterprises in the electronics sector, with 15,000 jobs. But investment is growing very rapidly. Already in July 1988, it is estimated that there are 24,000 jobs, consisting of 18,000 in multinational enterprises, 3,000 in joint ventures and 3,000 in Thai enterprises. Twenty-five new or expansion projects started up between 1985 and 1988, representing more than 10,000 jobs.

Between 1 January 1987 and 30 June 1988, 71 projects were approved by the BOI for an investment of 5.7 billion baht in machines and 39,000 jobs.

2.2 General statistics, 1985

On the basis of homogeneous statistics provided by the company Benn Electronics, it is possible to give the most significant figures for 1985.

- Production started in 1964.
- 15,000 employees, including 8,000 producing integrated circuits.
- 134 enterprises, including the following:

Mass consumer electronics:	60
Components:	62
Semiconductors:	3
Telecommunications equipment:	9

- Production: US\$923 million
- Domestic market: US\$882 million
- Exports: US\$373 million
- Imports: US\$401 million
- Exports/Production: 60 per cent
- Imports/domestic market: 60 per cent

2.3 Macro-economic data

2.3.1 Production and value added

Data relating to the mechanical and electrical engineering, electronics and transport equipment sector as a whole (engineering industries) are set out in table 4. The sector accounted for 2.9 per cent of manufacturing production in 1960 and 15.3 per cent in 1984. There was very rapid growth in the period 1960-1970 (27.3 per cent growth per annum), corresponding to a relatively easy import-substitution phase. However, in the period 1970-1982, growth slowed down considerably - 8.2 per cent, or a rate lower than that growth rate for the manufacturing sector (9.4 per cent).

The electrical engineering sector accounts for a mere 2 per cent of manufacturing production. The growth rate since 1960 has been relatively high.

The electronics sector has undergone considerable development (table 5). Between 1970 and 1987 the average growth rate was 27.1 per cent, reflecting the extensive development of television set and integrated circuit production.

2.3.2 Employment

The Thailand Development Research Institute (TDRI) has conducted a major study ("The S and T Manpower Situation in Thailand. An Analysis of Supply and Demand Issues", April 1988). This study indicates (table 6) that nearly 2.5 million people are involved in electronics, i.e. 5 per cent of Thailand's population; about 13,000 are engineers and 48,000 technicians.

The electronics industry proper employs 21,000 people according to this survey, of whom 400 are engineers and 1,420 technicians. The manufacturing sector employs 60 per cent of the engineers and 63.4 per cent of the technicians. The government services and State enterprises constitute the second largest employer in the electronics sector.

A survey of 34 enterprises with nearly 14,000 employees (table 7) provides some interesting information. Compared with the other sectors studied, the percentage of engineers and scientists is the highest (3.2 per cent). The software and industrial equipment enterprises are the largest employers of this category of personnel. On the other hand, the consumer goods and computers sectors employ a

small proportion of engineers, no doubt because the operations involved are essentially assembly operations. With reference to technicians, the situation is more or less the same as for engineers, with a high percentage in the software and industrial equipment sectors.

2.3.3 The domestic market

The domestic market (tables 8, 9 and 10) was evaluated at US\$666 million in 1985, and 882 million in 1987. Projections envisage a market of US\$1,114 million by 1990. The level of coverage of the domestic market by imports was 60 per cent in 1985.

Equipment goods represent 60 per cent to 65 per cent of the domestic market, half of this being data processing equipment and 20 per cent being telecommunications equipment. The existing level of equipment is 10 telephones per 1,000 inhabitants (table 11) and 81 per cent of the domestic market is covered by imports.

The market for mass consumer electronic goods, which was US\$195 million in 1987, has changed little between 1985 and 1987. The projections for 1990 predict a market of US\$228 million. The level of equipment of households (table 11) is 81 television sets and 153 radios for each 1,000 inhabitants. The market is 500,000 television sets and about 1 million radios per year. It is in this sector that the replacement of imports is the highest (imports account for only 24 per cent of the domestic market). But the local content in the area of television sets is no more than 10-15 per cent at the present time.

The market for components is about US\$137 million; it increased at a rate of 10 per cent a year between 1985 and 1987. Imports cover 53 per cent of the domestic market.

2.3.4 External trade

For the whole engineering sector, including iron and steel products (tables 12 and 13), the balance of trade is very much in deficit (72 million baht in 1986 or about \$3 million). Imports of engineering products represent 41 per cent of total imports and exports of engineering products represent 12 per cent of total exports.

For the electronics sector as a whole (table 14), the balance of trade was in deficit in 1985. Imports are mainly of capital goods. According to the statistics drawn up by UNIDO in 1980 and 1984 (table 15), the principal supplier is Japan (48 per cent), followed by the United States of America (15 per cent in 1980 and 10 per cent in 1984). As regards exports, integrated circuits constitute most of these (around 80 per cent). Electronics exports, which had been almost negligible until around 1975, now account for an important share of total exports (8-10 per cent). Exports of integrated circuits amounted to a value of \$450 million in 1986. The main countries receiving these exports were the United States (41 per cent), Singapore (35 per cent) and Malaysia (15 per cent).

3. PRODUCTION AND THE ORGANIZATION OF PRODUCTION

3.1 The structure of production

The total 1987 production of the sector is evaluated at US\$923 million (table 16): it was US\$632 million in 1984, an increase of 13 per cent annually. In 1985 60 per cent of this production was exported.

The production of components accounts for the major part of the sector (60 per cent) (table 17). Between 1984 and 1987 the rate of growth of production was 15 per cent per year. The production of integrated circuits conditions the performance of the components sector to the extent that this activity represents 90 per cent of the production of components: 88 per cent of the production is exported.

Mass consumer electronics represent 20 per cent to 25 per cent of the production of the sector, exports being very low (3 per cent) in 1985. A total of 580,000 television sets are produced annually (as against only 120,000 in 1976) and 1,100,000 radios (table 17).

Electronic capital goods represent 15 per cent to 20 per cent of the production of the sector, with 46 per cent of this being exported in 1985. The rate of increase between 1984 and 1987 was more than 20 per cent. Production of data processing equipment rose from US\$15 million in 1984 to US\$90 million in 1987 (table 18).

3.2 Organization of the sector

3.2.1 Companies

Information is available through the Board of Investment (BOI), which grants privileges under the regulations in force. On 1 July 1987, the situation was as follows (table 19):

The American companies present in Thailand are the subsidiaries of multinationals producing semiconductors and, more specifically, integrated circuits. National Semiconductors started up in 1973, Data General in 1974 (later abandoning this type of production), Honeywell (subsequently bought by ATT) in 1980, Signetics in 1984. Recently AMD (Advanced Micro Devices) has invested US\$50 million in a unit which will have a production capacity of 300 million parts. These companies together exported integrated circuits to a value of US\$373 million and created some 8,000 jobs or half the employment in the sector in 1985. SEAGATE (USA), one of the world leaders (55 per cent of the market) in the production of hard disc drive, started up in 1984, after beginning operations in Singapore in 1982. This company is the first multinational in Thailand and already employs 12,000 people in 1988; the ultimate figure is expected to be 20,000 (Newsweek, 27 June 1988).

Japanese companies invested rather later in Thailand with the exception of SANYO which established a joint venture with a Thai company for the production of radios and television sets. NMB (Minebea) started up in 1982 for the production of miniature ball bearings. In 1987 this firm made a new investment (Minebea Electronics Thailand Co.) as a joint venture with Thai groups (Siam Commercial Bank, the Crown Property Bureau and the Charoen Pokphand Group) for the production of disc drives. At the same time Minebea decided to establish a Research and Development Centre. Other Japanese firms present in Thailand include Fujikura (1985, production of computer keyboards and interface assemblies) and Peimec (1986, production of miniature ball bearings).

The companies with majority Thai capital listed by the BOI produce mass consumer goods together with the less complex components. Some of them have signed joint venture agreements with Japanese companies and, latterly, with the Korean SAMSUNG company. The largest company is the THANIN group, which began to produce

television sets in 1964. This group employs 1,300 people and has a turnover of 600 million baht, 10 per cent of which is accounted for by exports. It occupies third place on the television set market behind National (Matsushita) and Philips. This group has never purchased technologies and about 15 people are engaged in development.

As at 15 July 1988, the BOI listed 25 new or expansion projects which came into production between 1984-1985 and 1988. Their principal characteristics are as follows (table 20):

- Eleven thousand jobs, including two companies with over 2,000 employees and two with between 1,000 and 2,000 employees;
- Ten companies are Japanese, five American, four Thai and two British, and there are also three joint ventures;
- Seven companies produce components (special motors, miniature ball bearings, printed circuits, integrated circuits, etc.), five produce professional equipment (telephones, computer keyboards) and three produce electronic consumer goods;
- The locally produced content is apparently 25 per cent, meaning that 75 per cent of the content is imported;
- All these projects are export-oriented (95-100 per cent).

3.2.2 Level of national integration

This is still very low. A good indication is given by the above-mentioned analysis of 25 projects (table 20): 75 per cent of raw materials, components and sub-assemblies are imported.

In the case of television sets, the local content is of the order of 15-20 per cent. However, projects for local television tube production should raise the local content to 40-45 per cent in due course. The local content of radio sets is higher - around 80 per cent.

3.2.3 Wages

There are no specific statistics for the electronics sector.

The average wage per month of private employees (table 21) was 2,123 baht in industry in 1984, i.e. about US\$85. This average wage doubled in current baht between 1977 and 1984. Since the price index rose by a factor of 1.7 over the same period, the average wage in baht, at constant prices rose by some 30 per cent in seven years.

The comparative data relate to the textiles industry in 1987. They are however significant in regard to labour costs in general and, more specifically, in the electronics industry. It can be seen that wage costs in Thailand are low, being only a third of those in Korea and a twentieth of those in France and in Japan.

Comparative wages in the textiles industry, spring 1986

Currency	France FF	Japan Yen	Korea Won	Thailand Baht
Labour costs:				
Direct wages	32.98	1 071	1 033	13.59
Other costs	7.39	432	273	1.11
Other costs	20.57	254	189	0.34
Total costs per hour	60.94	1 757	1 495	15.04
Exchange rate to US\$1	6.10	147	854	25.73
Costs in US\$	9.99	11.95	1.75	0.58
Costs in FF	60.94	72.91	10.68	3.57
Working hours:				
Hours/day	7.90	8	8	8
Hours/week	40	40	48	48
Hours/year	1 773	2 023	2 388	2 320
Normal days/year	224	253	286	290
Overtime rates (as %):				
Normal working day	25	25	50	50
Non-working day	83	25	50	100
Level of plant utilization:				
Days/year	225	251	308	350
Hours/year	5 393	5 737	7 392	8 400

Source: Werner International.

4. THE TRANSFER AND MASTERY OF TECHNOLOGIES

4.1 The acquisition of technology

The acquisition of technology in the electronics sector is effected essentially through multinational firms and joint ventures, because there is still little local research.

In most cases the units are assembly units without a very high technological content. Training of personnel takes place on the spot. Higher-level staff often receive supplementary training at the head offices of the companies. For example, SEAGATE (hard disc drive) has sent 800 employees to the United States for training, including 150 foremen and 100 engineers. The same applies to the Japanese Minebea company which has sent 100 engineers to Japan for training since 1980.

Some recent projects relate to the manufacture of products with a higher value added. Mention may be made more particularly of projects for television tubes

(Toshiba and Siam Cement CRT), which will have a total capacity for the production of about 3 million tubes. The local content of television sets will thus rise from 20 to 40 per cent.

Two studies carried out in September 1985 for the National Economic and Social Development Board ("Technology Development and Promotion for the Engineering Industries" and "Promotion of Manufactured Exports") contain interesting information on the cost of acquisition of technology.

For the economy as a whole, the total sum paid in respect of technology increased from US\$7 million in 1972 to US\$61 million in 1981 (table 22). Of these payments 40 per cent were to Japanese companies and 31 per cent to American companies (table 23).

In the electrical and electronics industries, payments doubled between 1982 and 1987 (table 24), rising from 87 million baht to 160 million baht.

At the moment there is no real registration of imported technology, merely the list kept by the Bank of Thailand for the purposes of monitoring outgoing foreign exchange. The BOI recently requested a division to look into the question of the monitoring of imported technology.

4.2 National efforts to develop technology

The State has only very recently and tentatively become involved in research. Electronics is one of the three priority areas, along with biotechnologies and materials.

The National Electronics and Computer Center (NECTEC) was set up in 1986 and has been truly operational since 1987. The budget for the fiscal year 1987/88 is US\$1 million. NECTEC has the following objectives:

- To define research policies and allocate financing;
- To accelerate the dissemination of data processing techniques;
- To develop the technological capability of the sector.

Research is conducted essentially by the University, in co-operation with industry where possible. NECTEC would like to participate in the funding of private research, as happens in Korea and Taiwan. However, this is not yet allowed by the Government, which is very anxious not to intervene in the private sector.

There are two research projects with other countries: one financed by Australia, involving the ASEAN countries and concerning the design of VLSI circuits; the other financed by Japan and dealing with translation problems.

Private research is still underdeveloped. A survey of 105 companies in the manufacturing sector showed that those companies spent 0.11 per cent of their turnover on R&D activities. The multinational enterprises carry out no research in Thailand. However, NECTEC considers that Thailand could benefit from the delocalization of design centres. In the national private sector, R&D activities are still in their infancy.

5. PROSPECTS FOR THE DEVELOPMENT OF THE SECTOR

5.1 General objectives

There is no sectoral development plan properly so called for the electronics industry, although the Sixth Economic and Social Development Plan (1987-1991) assigns priority to the construction materials, biotechnology and electronics sectors. Thailand benefited little from the wave of investment that took place in the 1970s, and the BOI was criticized for its lack of aggressiveness. Since 1985 the Thai authorities have launched several campaigns directed towards the electronics multinationals, hoping to profit from a favourable international economic situation.

The creation of jobs is the principal reason for these efforts since, under the conditions of offshore operation, the net impact on the balance of payments is small. The impact on the country's technological development is also much disputed. It would seem that the efforts made are starting to bear fruit since, from January 1987 to 30 June 1988, 70 projects were approved by the BOI (see below).

In the same way it is possible to regard as very positive the studies carried out by the National Economic and Social Development Board (NESDB) in the engineering industries sector, the recommendations of which could be applied to the electronics engineering sector.

An article entitled "Engineering Industries: an Urgent Need" which appeared recently in the Bangkok Bank Monthly Review (April 1988) is also indicative of the national preoccupation regarding this sector.

5.2 Analysis of projects approved by the BOI

The BOI approved 71 projects (table 25) between January 1987 and June 1988. This should lead to the creation of 40,000 jobs in the next three years. These recent data indicate an acceleration of foreign investment in Thailand. All the projects are export-oriented and the local content is still rather small (0.23).

The leading investors (table 26) are Japanese companies (22 projects, 68 per cent of investment and 32 per cent of jobs created, local content 0.34). They are followed by American companies (eight projects, 17 per cent of investment, 22 per cent of jobs, very low local content: 0.06). Third position is occupied by joint ventures (14 projects, including six with Japanese companies and three with Taiwan companies, 7 per cent of investment and 12 per cent of jobs). Three projects involving United Kingdom companies account for 10 per cent of jobs. The Taiwan companies are making a considerable impact: 11 projects and 5,400 jobs. Thai companies are, however, very poorly represented: only four projects with 440 jobs.

In product terms (table 27), 43 projects and 55 per cent of the jobs relate to components (hard disc drive, floppy disc drive, servo motors, printed circuits, computer components, etc.), 14 projects involve professional electronic equipment (particularly telephone equipment) and 12 projects concern consumer electronics. It is in the consumer electronics sector that the local content is greatest (61 per cent).

In terms of project size (table 28), the projects involving American and British companies are large-scale (mostly over 1,000 jobs), the Japanese and Taiwan projects are medium-scale (200-1,000 jobs) and the other projects are on a smaller scale (50-200 jobs).

5.3 Constraints

5.3.1 Manpower

One of the major constraints on the development of the sector concerns manpower. Companies which used to be accustomed to a very low turnover of senior staff and engineers are already feeling the effects of the many projects which have come into being in the last few years. This day-to-day situation encountered by companies reflects the global data provided by recent surveys.

Thus the projections by NESDB (table 29) for the period 1987-1991 indicate that demand for engineers will be greater than supply, above all if the country finds itself in the following particular situation: high growth rate in the sector (which is very likely) and relatively low growth in the numbers of trained personnel (7.5 per cent per annum). In this illustrative case, there would be a shortfall of around 700 engineers in 1991. The situation is different with regard to technicians. There are too many technicians, which is paradoxical. NESDB explains this phenomenon by the fact that the electronics industry is still an assembly industry and that it is possible to use engineers for monitoring purposes since their salaries are not much higher than those of technicians.

The study carried out by TDRI (table 30) gives the same results. Demand exceeds supply at the "post graduate" and "bachelor" levels, both in the base (moderate growth) scenario and in the high scenario. As far as "below bachelor" technicians are concerned, the number trained exceeds the demand.

5.3.2 Technology

It is very hard to evaluate this constraint since the industry is largely dependent on foreign investment. However, it can be said that a country which has achieved a certain technological level is more able, firstly, to sustain national industries and, secondly, to attract foreign companies to manufacture more complex products.

In the case of Thailand, international comparisons have been made with regard to scientific and technical manpower. Table 31 gives, for various countries, the number of scientists and engineers per 10,000 population and those involved in R&D. Thailand's position is the weakest, even though the figures are more favourable concerning personnel involved in R&D.

The same table permits a comparison of the situation in various Asian countries with regard to potential scientists and technicians per 10,000 population. Here again, Thailand is in the weakest position.

Table 1

Exports and imports by major sector

Millions of baht

EXPORT							
1. AGRICULTURE	62,506	72,998	73,150	66,484	78,292	73,398	79,397
2. FISHING	5,547	6,632	7,636	8,225	8,684	10,590	14,853
3. FORESTRY	70	143	102	109	104	365	620
4. MINING	15,420	11,814	9,824	6,806	7,588	10,126	6,283
5. MANUFACTURING	43,065	54,743	63,025	61,358	76,095	95,615	127,012
6. SAMPLE AND OTHER UNCLASSIFIED GOODS	3,798	2,632	2,122	1,340	1,312	1,518	1,772
7. RE-EXPORT	2,791	4,039	3,689	2,150	3,162	1,754	1,288
8. TOTAL EXPORT	133,197	153,001	159,728	146,472	175,237	193,366	231,255
SHARE							
1. AGRICULTURE	46.93	47.71	45.80	45.39	44.68	37.96	34.33
2. FISHING	4.16	4.33	4.78	5.62	4.96	5.48	6.42
3. FORESTRY	0.05	0.09	0.06	0.07	0.06	0.19	0.27
4. MINING	11.58	7.72	6.15	4.65	4.33	5.24	2.72
5. MANUFACTURING	32.33	35.78	39.46	41.89	43.42	49.45	54.92
6. SAMPLE AND OTHER UNCLASSIFIED GOODS	2.85	1.72	1.33	0.91	0.75	0.79	0.77
7. RE-EXPORT	2.10	2.64	2.31	1.47	1.80	0.91	0.56
8. TOTAL EXPORT	100.00	100.00	100.00	100.00	100.00	100.00	100.00
IMPORT							
1. CONSUMER GOODS	19,286	22,985	22,783	29,699	31,939	34,820	42,549
2. INTERMEDIATE PRODUCTS AND RAW MATERIALS	45,312	53,575	48,596	59,539	61,542	66,080	68,525
3. CAPITAL GOODS	46,075	56,772	47,778	69,358	72,431	74,241	76,013
4. OTHER IMPORTS	78,013	83,414	77,459	78,013	79,243	76,028	54,236
5. FUEL AND LUBRICANTS	58,733	65,100	60,765	57,065	57,353	56,718	42,350
6. TOTAL IMPORTS	188,686	216,746	196,616	236,609	245,155	251,169	241,323
SHARE							
1. CONSUMER GOODS	10.22	10.60	11.59	12.55	13.03	13.86	17.63
2. INTERMEDIATE PRODUCTS AND RAW MATERIALS	24.01	24.72	24.72	25.16	25.10	26.31	28.40
3. CAPITAL GOODS	24.42	26.19	24.30	29.31	29.54	29.56	31.50
4. OTHER IMPORTS	41.35	38.48	39.40	32.97	32.32	30.27	22.47
5. FUEL AND LUBRICANTS	31.13	30.04	30.91	24.12	23.39	22.58	13.41
6. TOTAL IMPORTS	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source : Monthly Bulletin, Bank of Thailand

Table 2
Structure of manufacturing sector, 1951-1980
Value added (as percentages)

	1951	1960	1970	1980
<u>Processing of primary products</u>	<u>63.3</u>	<u>61.9</u>	<u>45.9</u>	<u>34.3</u>
Food	23.7	34.2	22.0	13.7
Beverages	7.1	8.6	10.3	9.2
Tobacco	19.6	14.5	9.2	6.2
Wood	8.1	3.8	2.8	2.5
<u>Other consumer goods</u> (primarily for domestic market)	<u>14.0</u>	<u>18.9</u>	<u>18.1</u>	<u>19.1</u>
Furniture	1.3	1.4	1.5	1.1
Paper	-	0.3	0.7	1.4
Printing	5.8	3.9	2.5	2.5
Leather	1.6	0.5	0.6	0.4
Textiles	1.1	4.9	7.9	6.3
Garments	4.2	7.9	4.9	7.4
<u>Labour-intensive exports</u>	<u>...</u>	<u>...</u>	<u>...</u>	<u>11.3</u> a/
Textiles	...	...	...	2.9
Garments	...	...	...	3.9
Precious stones	...	...	0.7	3.0
Integrated circuits	...	...	...	1.5 a/
<u>Intermediate goods</u>	<u>12.7</u>	<u>12.4</u>	<u>21.9</u>	<u>21.9</u>
Chemicals	9.9	7.3	6.8	6.7
Petroleum refinery	-	-	7.5	6.7
Other non-metallic minerals	2.7	4.0	5.8	3.8
Basic metals	0.1	0.4	1.3	2.4
Metal products	...	0.7	2.3	2.3
<u>Capital goods</u>	<u>6.9</u>	<u>6.0</u>	<u>9.2</u>	<u>11.3</u>
Non-electrical machinery	...	0.5	2.0	1.2
Other electrical machinery	...	0.6	1.4	1.2
Transport equipment	6.9	4.9	5.8	8.9
<u>Miscellaneous</u>	<u>3.2</u>	<u>1.0</u>	<u>2.3</u>	<u>2.5</u>
<u>Total manufacturing value added</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

Source: UNIDO Data base.

a/ Estimate.

Table 3
Principal exports of manufactures, 1970-1984
(in millions of baht)

	1970	1977	1980	1982	1983	1984 ^{a/}
1. Textile	23	2,170	3,616	4,799)	...	...
2. Garments	18	1,693	4,894	8,005)	14,351	19,149
3. Precious stones	197	1,210	3,773	5,251	6,214	6,131
4. Integrated circuits		1,145	6,156	5,930	5,829	7,352
Total manufactured exports	808	21,955	43,065	63,205	61,358	76,107
Total exports	14,270	71,198	133,197	159,728	146,472	175,270
1-4 as percentage of total manufactured exports	22.0	28.3	42.8	37.9	43.0	48.0
Manufacture as percentage of total exports	5.7	30.8	32.3	39.6	41.9	43.4

Sources: World Bank, Thailand: Managing Public Resources for Structural Adjustment, August 1983; Bank of Thailand, Monthly Bulletin, January 1985.

^{a/} Provisional.

Table 4

Value of the engineering industries

Million baht

Year	G.D.P.		Value of manufactures		Value of engineering industrial products					Total for engineering industry		
	Number	Annual growth %	Value	Annual growth %	Basic metals	Metal products	Machinery	Electrical machinery	Transport machinery	Number	As % of total manufactures	As % of G.D.P.
1960	70,139		8,389		29 (0.3)	57 (0.7)	38 (0.5)	48 (0.6)	68 (4.6)	240	(2.9)	(0.34)
1965	99,544	7.3	14,249	11.2	60 (0.4)	170 (1.2)	152 (1.1)	114 (0.8)	739 (5.2)	1,235	(8.7)	(1.24)
		(aver.)		(aver.)								
1970	150,092	8.6	23,320	10.4	392 (1.7)	439 (1.9)	534 (2.3)	318 (1.4)	1,200 (5.1)	2,883	(12.4)	(1.92)
		(aver.)		(aver.)								
1975	203,514	6.3	36,787	9.5	409 (1.1)	475 (1.3)	612 (1.7)	479 (1.3)	2,419 (6.6)	4,394	(11.9)	(2.13)
		(aver.)		(aver.)								
1976	221,225	8.7	42,529	13.0	454 (1.1)	517 (1.2)	792 (1.9)	656 (1.5)	2,996 (7.0)	5,415	(12.7)	(2.45)
1977	237,173	7.2	48,071	13.0	512 (1.1)	488 (1.0)	856 (1.8)	780 (1.6)	3,768 (7.8)	6,404	(13.3)	(2.70)
1978	261,097	10.1	52,521	9.3	577 (1.1)	988 (1.9)	872 (1.7)	989 (1.9)	4,141 (7.9)	7,567	(14.5)	(2.90)
1979	276,907	6.1	57,841	10.1	667 (1.2)	618 (1.1)	997 (1.7)	1,094 (1.9)	4,382 (7.6)	7,758	(13.5)	(2.80)
1980	292,852	5.8	60,597	4.8	710 (1.2)	632 (1.0)	1,102 (1.8)	1,237 (2.0)	4,812 (7.9)	8,492	(13.9)	(2.90)
1981	311,270	6.3	64,490	6.4	593 (0.9)	612 (0.9)	1,223 (1.9)	1,322 (2.0)	5,549 (8.6)	9,299	(14.3)	(2.99)
1982	324,032	4.1	67,317	4.4	533 (0.8)	609 (0.9)	1,297 (1.9)	1,227 (1.8)	5,541 (8.2)	9,207	(13.6)	(2.84)
1983	342,946	5.8	72,252	7.3	539 (0.7)	666 (0.9)	1,425 (2.0)	1,414 (2.0)	6,861 (9.5)	10,905	(15.1)	(3.18)
1984	363,563	6.0	76,944	6.5	590 (0.8)	730 (0.9)	1,572 (2.0)	1,544 (2.0)	7,379 (9.6)	11,815	(15.3)	(3.25)
average annual growth (%)												
1960-1970		7.9		10.8	29.7	22.6	30.2	20.8	33.3		27.3	
1970-1982		6.6		9.4	2.5	3.9	7.7	13.2	13.5		8.2	

Source: NESDB

Figures in parentheses are percentage shares.

Table 5

Value added in the electronics sector
(Constant 1972 prices)
Thousands of baht

	1970	1975	1980	1985	1987	Annual average growth rate 1970-1987
Radio	12 578	26 748	46 574	38 657	30 025	5.2%
Television	7 049	69 183	180 129	376 280	434 625	27.4%
Integrated circuit	0	39 230	310 549	296 480	693 223	27% <u>1/</u>
TOTAL	19 627	135 211	537 252	711 417	1 157 872	27.1%

Source: NESDB

1/ Period 1975-1987.

Table 6

S&T manpower in electronics industry

Type of Industry	Engineers = %		Technicians = %		Other manpower		Total	%
Manufacturing of Electronics Products	402	3.1%	1,420	3.0%	19,178	0.8%	21,000	0.9%
Sales & Services of Electronics Products	1,366	10.4%	1,134	2.4%	15,000	0.6%	17,500	0.7%
Telecommun. Services	475	3.6%	2,933	6.2%	17,134	0.7%	20,542	0.8%
Government Agencies & State Enterprises	2,086	15.8%	10,843	23.0%	78,351	3.3%	91,280	3.8%
Education	860	6.5%	951	2.0%	53,200	2.2%	55,011	2.3%
Other Manufacturing	7,991	60.6%	29,878	63.4%	2,189,141	92.3%	2,227,000	91.6%
Total	13,170	100.0%	47,159	100.0%	2,372,004	100.0%	2,432,333	100.0%

Note: * - Relating to electronics industry
 - percentage distribution by type of industry
Source: NESDB (1986)

Table 7

Summary information about firms in the TDRI survey

Sector	Firms Approached		Response Rate		All Employees		Scientists & Engineers		Skilled Technicians & Technicians		R&D to Technicians Ratio	
	Firms	Unsuccessful Replied	%	Total	Per Firm	Total	Per Firm	Share %	Total	Per Firm		Share %
Biotechnology Firms	28	21	75.0%	5,295	232	113	5	2.1%	699	24	9.4%	22.6%
Agriculture	6	6	66.7%	1,446	362	15	4	1.0%	133	33	9.2%	11.3%
Agro-industry	8	7	87.5%	1,878	268	56	8	3.0%	168	24	8.9%	29.3%
Food & Beverages	8	6	75.0%	1,890	282	28	3	1.2%	150	25	8.9%	13.3%
Health Related	6	4	66.7%	281	70	22	6	7.8%	48	12	17.1%	45.8%
Electronics Firms	34	25	73.5%	13,498	540	427	17	3.2%	1,130	45	8.4%	37.8%
Software	6	5	83.3%	992	198	133	27	13.1%	186	31	18.0%	71.5%
Consumer Electronics	6	5	83.3%	3,736	747	69	14	1.9%	227	48	6.1%	30.4%
Communications Equip.	5	4	80.0%	427	107	25	6	5.9%	156	39	26.5%	16.8%
Computer Hardware	6	3	50.0%	2,609	870	23	8	0.9%	67	22	2.6%	31.3%
Other Electronics Equip.	4	4	100.0%	94	24	11	3	11.7%	34	9	36.2%	32.4%
Electronic Components	7	4	57.1%	5,648	1,410	166	62	2.9%	460	115	8.2%	36.1%
Materials Firms	26	22	84.6%	8,439	304	149	7	1.8%	519	24	6.2%	28.7%
Metals	7	5	71.4%	1,536	306	75	15	4.9%	197	39	12.9%	38.1%
Ceramics	6	5	83.3%	1,912	382	18	4	0.9%	101	20	5.3%	17.8%
Plastics	5	5	100.0%	1,348	270	18	4	1.3%	111	28	10.5%	12.8%
Rubber	5	5	100.0%	2,354	471	36	7	1.5%	80	16	3.4%	45.0%
Textile	3	2	66.7%	1,295	648	2	1	0.2%	0	0	0.0%	-
Total	88	68	77.3%	27,232	400	689	10	2.5%	2,148	32	7.9%	32.1%

Notes: r - represents the share in total employment of each sector
 st - skilled technicians includes those with and without bachelor's degrees
 0 - four firms returned questionnaires that were unusable
 Source: TDRI Survey (1987)

Table 8
Evolution of the domestic market

	1985	1986	1987	1990
Electronic capital goods	368	453	550	718
of which:				
Telecommunications	67	81	99	118
Electronic consumer goods	185	182	195	228
Electronic components	113	124	137	168
TOTAL	666	759	882	1 114

Rate of coverage of domestic market by imports:

Electronic capital equipment:	81 per cent	
Electronic consumer equipment:	24 per cent	Total: 60 per cent
Components:	53 per cent	

Source: Benn Electronics

Table 9

Domestic market: mass consumer electronics and components

Born Electronics - America, Japan & Asia-Pacific Electronics Data 1987

TRAILER : BASKETS (AC)

CONSUMER

	1985			1986			1987			1990			CAGR
	DK	SK	No. 1000	DK	SK	No. 1000	DK	SK	No. 1000	DK	SK	No. 1000	
TOTAL	8015	185		4963	182		8271	194		6166	278		4
Video Equipment													
Colour Television (Inc. Kits)	2310	82	988	2690	99	840	2800	103	840	3200	118	830	5
Monochrome Television	77	3	77	58	2	54	62	2	60	42	2	40	11-
Video Recorders	423	16	63	536	28	88	678	25	100	1000	37	150	19
Video Equipment Total	3010	111		3284	121		3532	130		4242	157		7
Audio Equipment													
Radios & Radio Combinations (Inc. Kits)	1875	40	1438	710	26	1490	740	27	1570	630	31	1750	5-
Other Audio Equipment	264	9	398	235	9	286	278	10	215	310	11	250	6
Audio Equipment Total	2139	49		945	35		1018	37		1140	42		5-
Other Consumer Equipment													
Electronic Musical Instruments	12	-		13	-		14	1		17	1		3
Electric/Electronic Watches	594	22	3000	620	23	4000	640	24	4160	680	25	4400	3
Electronic/Electronic Clocks	70	3	718	72	3	740	75	3	770	80	3	820	3
Electronic Flashlights	10	-		10	-		10	-		9	-		2-
Other Consumer Equipment Total	686	25		714	26		739	28		786	29		3

Table No. 214

COMPONENTS

	1985		1986		1987		1990		CAGR
	DK	SK	DK	SK	DK	SK	DK	SK	
TOTAL	3142	113	3388	124	3898	137	4532	168	8
Active Components									
Cathode Ray Tubes	600	22	630	23	650	24	720	26	4
Other Valves & Tubes	140	8	148	5	155	6	160	7	6
Diodes & Rectifiers	211	8	220	8	230	8	270	10	5
Transistors	270	10	280	10	300	11	340	13	5
Other Discrete Semiconductors	66	2	69	3	73	3	84	3	5
Integrated Circuits & Other Microcircuits	415	15	475	17	670	21	670	22	16
Active Components Total	1702	62	1822	66	1978	73	2464	91	8
Passive Components									
Capacitors	170	6	185	7	200	7	235	9	7
Resistors	84	3	88	3	93	3	102	4	4
Connectors	103	4	110	4	115	4	130	5	5
Small Transformers & Other Inductors	38	1	41	2	44	2	50	2	6
Relays	104	4	110	4	118	4	135	5	6
Switches	67	2	70	3	75	3	86	3	6
Printed Circuits	220	8	250	9	290	11	360	13	10
Passive Components Total	788	28	854	28	936	34	1098	41	7
Active & Passive Components Total	2490	90	2676	94	2913	107	3562	132	7
Audio Components									
Microphones	38	1	39	1	42	2	50	2	7
Loudspeakers	178	6	180	7	188	7	220	8	5
Amplifiers	93	3	98	4	103	4	120	4	5
Unrecorded Reels & P & SP for Consumer & Professional Communications Equipment	210	8	250	9	300	11	400	15	14
Audio Components Total	619	23	712	26	796	30	970	34	8

Table 10

Domestic market capital goods

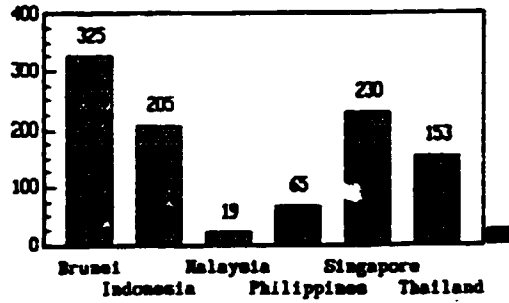
Benn Electronics - America, Japan and Asia-Pacific Electronics Data 1987
 Thailand: MARKETS (AC)
 EDP (Elec: Data Processing)

	1985		1986		1987		1990		CAAGR				
	BtM	\$M	BtM	\$M	BtM	\$M	BtM	\$M	%				
TOTAL	3827	141	5400	199	7000	257	10000	368	21				
OFFICE EQUIPMENT	1985		1986		1987		1990		CAAGR				
	BtM	\$M	No.x 1000	BtM	\$M	No.x 1000	BtM	\$M	No.x 1000	%			
TOTAL	429	17	451	17	477	16	545	20	5				
Electronic Typewriters	158	6	29	160	6	30	165	6	32	160	7	35	3
Electronic Calculators	43	2	331	46	2	350	50	2	360	57	2	430	6
Electronic Cash Registers	18	1	2	20	1	2	22	1	2	26	1	3	9
Photocopiers	210	8		225	6		240	9		260	10		6
CONTROL and INSTRUMENTATION	1985		1986		1987		1990		CAAGR				
	BtM	\$M	BtM	\$M	BtM	\$M	BtM	\$M	%				
TOTAL	1883	69	2070	76	2400	66	3000	110	10				
MEDICAL and INDUSTRIAL	1985		1986		1987		1990		CAAGR				
	BtM	\$M	BtM	\$M	BtM	\$M	BtM	\$M	%				
TOTAL	542	20	580	21	625	23	695	25	5				
X-Ray and Medical Equipment Total	436	16	460	17	500	18	550	20	5				
Industrial Equipment Total	107	4	120	4	125	5	145	5	6				
COMMUNICATIONS and MILITARY	1985		1986		1987		1990		CAAGR				
	BtM	\$M	BtM	\$M	BtM	\$M	BtM	\$M	%				
TOTAL (inc. Kits)	1460	54	1600	59	1770	65	2100	77	6				
TELECOMMUNICATIONS	1985		1986		1987		1990		CAAGR				
	BtM	\$M	BtM	\$M	BtM	\$M	BtM	\$M	%				
TOTAL	1820	67	2200	61	2700	99	3200	110	12				

Table 11

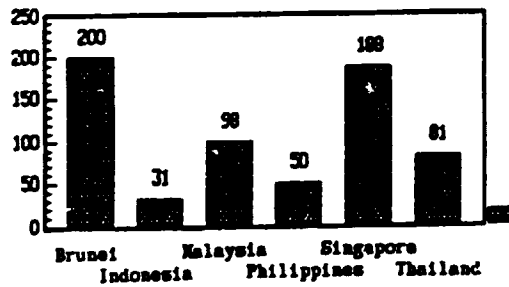
EQUIPMENT IN HOUSEHOLDS

Radios per 1000



EQUIPMENT IN HOUSEHOLDS

Television sets per 1000 persons



TELEPHONE EQUIPMENT

Subscribers per 1000 inhabitants

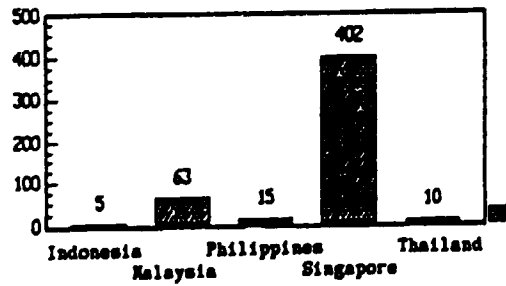


Table 12

Imports of engineering products

	Prior to 5th. Plan				5th. Plan				1987
	1979	1980	1981	1982	1983	1984	1985	1986	(Jan.-Feb.)
Basic metals (BM)	17,403.89	17,519.73	22,075.41	18,341.71	23,612.65	23,101.83	26,974.31	24,986.19	5,105.21
Iron & steel	14,745.36	14,390.58	18,764.20	15,198.74	19,712.35	19,188.37	23,295.77	21,536.45	4,462.10
Copper	984.13	983.07	879.25	870.40	1,293.15	1,315.28	1,371.45	1,288.15	259.53
Aluminium	1,674.40	2,146.08	2,331.96	2,172.57	2,607.15	2,588.28	2,307.09	2,161.59	383.58
Metal products (MP)	1,404.24	1,403.26	1,670.65	1,491.93	1,788.54	1,950.52	2,106.81	1,881.66	365.64
Tools	912.39	891.77	1,114.04	937.18	1,170.05	1,295.75	1,377.37	1,169.87	244.10
Metal products	491.85	511.49	556.61	554.75	618.49	664.77	729.44	711.79	121.54
Machinery (m)	16,761.63	18,089.20	22,672.63	19,425.56	31,153.57	33,196.10	33,392.40	31,150.58	6,073.12
Machinery	16,761.63	18,089.20	22,672.63	19,425.56	31,153.57	33,196.10	33,392.40	31,150.58	6,073.12
Electrical machinery (E)	9,376.68	13,264.86	13,710.81	13,746.77	19,695.72	21,538.70	18,690.55	28,742.94	4,789.09
Electrical machinery	9,376.68	13,264.86	13,710.81	13,746.77	19,695.72	21,538.70	18,690.55	28,742.94	4,789.09
Transport equipment (T)	11,305.65	16,119.26	19,673.00	12,490.03	16,654.56	18,108.40	16,778.59	12,672.34	2,565.66
Trains & parts	13.88	416.54	339.04	60.26	788.43	114.83	1,709.89	121.65	154.21
Motor vehicles	9,862.23	10,034.06	13,779.19	10,260.85	14,441.09	14,816.33	11,575.61	10,909.13	2,251.41
Aeroplanes	957.10	5,132.50	3,772.35	546.63	363.49	2,518.93	2,583.10	915.97	76.48
Ships	472.44	536.16	1,782.42	1,622.29	1,061.55	658.31	909.59	725.60	73.56
Total	56,252.09	66,396.31	79,802.50	65,496.00	92,905.04	97,895.65	97,942.66	99,433.71	16,898.72
Proportion to total imports (%)	38	34	36	33	30	40	39	41	-
Total of machinery and metalwork	29,471.52	35,611.72	44,016.28	33,407.51	49,596.67	53,255.02	52,277.81	45,704.58	9,004.42
Proportion to total imports (%)	20	28	20	17	21	22	21	20	-

Source: Department of Customs

Table 13

Exports of engineering products

	Prior to 5th. Plan				5th. Plan				1987 (Jan - Feb)
	1979	1980	1981	1982	1983	1984	1985	1986	
Basic metals (BM)	1,020.02	1,894.16	1,521.67	1,567.05	1,722.12	2,296.22	3,173.52	3,554.67	514.77
Iron & steel	694.11	1,449.25	1,033.90	1,070.17	1,174.41	1,815.65	2,638.85	3,027.55	430.97
Copper	68.04	95.11	108.38	74.09	71.58	79.63	52.96	67.92	15.93
Aluminium	257.87	349.80	379.39	422.79	476.13	400.96	481.71	459.20	67.87
Metal Products (MP)	177.67	309.22	293.11	295.40	265.53	264.20	252.64	423.97	61.60
Tools	129.48	250.31	200.64	184.70	174.72	159.96	142.18	182.78	16.31
Metal products	48.13	58.91	92.47	100.70	90.81	104.24	110.46	241.19	45.29
Machinery (M)	240.66	554.15	582.04	675.55	826.19	1,891.53	4,703.59	3,948.39	688.78
Machinery	240.68	554.15	582.04	675.55	826.19	1,891.53	4,703.59	3,948.39	688.78
Electrical Machinery (E)	3,427.61	6,784.20	6,850.09	7,344.02	6,946.67	9,662.67	11,758.14	17,813.07	3,040.14
Electrical Machinery	3,427.61	6,784.20	6,850.09	7,344.02	6,946.67	9,662.67	11,758.14	17,813.07	3,040.14
Transport Equipment (T)	233.33	298.91	265.15	299.20	279.60	362.88	514.29	1,021.51	87.56
Trains & parts	0.47	.02	23.74	37.05	5.90	6.50	5.55	4.83	0.00
Motor vehicles	205.35	272.01	224.50	243.01	255.77	345.65	416.90	573.37	86.75
Aeroplanes	25.34	1.00	3.55	1.31	15.17	9.44	48.39	40.92	0.61
Ships	2.17	25.88	13.36	17.83	2.76	1.29	43.45	402.39	0.20
Total	5,099.25	9,840.64	9,512.06	10,181.22	10,040.11	14,477.50	20,402.18	26,761.61	4,392.85
Proportion to total export (%)	5	7	6	6	7	8	11	12	11
Total of machinery & metalwork	751.62	1,162.28	1,140.30	1,270.15	1,371.32	2,518.30	5,470.51	5,393.70	3,878.08
Proportion to total exports	0.6	0.8	0.7	0.8	0.9	1.4	2.8	2.3	2.1

Source: Department of Customs

Trade balance of the engineering industry

	1979	1980	1981	1982	1983	1984	1985	1986	1987 (Jan - Feb)
Imports	56,252.09	66,396.31	77,802.50	85,486.00	92,905.04	97,895.65	97,942.66	99,435.71	18,898.72
Exports	5,099.25	9,840.64	9,512.06	10,181.22	10,040.11	14,477.50	20,402.18	26,761.61	4,392.85
Balance for Engineering Industry	- 51,152.84	- 56,555.67	- 68,290.44	- 75,314.78	- 82,864.93	- 83,418.15	- 68,540.48	- 72,672.10	- 14,505.87
Total Balance	- 37,982.3	- 60,421.1	- 66,025.1	- 36,887.8	- 60,136.8	- 68,917.8	- 57,803.9	- 10,132.8	-

Source: Department of Customs

Table 14

Imports and exports of electronics products
US\$ millions

	IMPORTS		EXPORTS		BALANCE	
	1984	1985	1984	1985	1984	1985
Electronic capital equipment	308	298	24	62	-284	-236
Electronic consumer equipment	52	43	4	4	-48	-39
Components	85	60	321	307	+236	+247
TOTAL	445	401	349	373	-96	-28

Source: Benn Electronics

Table 15

Origins of imported electronic products

ORIGINS OF IMPORTED ELECTRONICS PRODUCTS
 (Components, Capital goods, Mass consumer electronics)
 (SITC headings 75, 761, 762, 763, 764 and 776)

	10 ³ US\$		%	
	1980	1984	1980	1984
USA	29160	48833	15.76	9.90
Japan	88640	238147	47.90	48.27
Netherlands	3641	1098	1.97	0.22
German Fed. Rep.	10337	13765	5.59	2.79
United Kingdom	4740	3523	2.56	0.71
France	1042	400	0.56	0.08
Brunei	0	0	0	0
Indonesia	0	79	0	0.02
Malaysia	772	7639	0.42	1.55
Philippines	0	8161	0	1.65
Singapore	5146	41088	2.78	8.33
ASEAN Sub-Total	5918	56967	3.20	11.55
Hong Kong	836	12042	0.45	2.44
TOTAL	185047	493407	100.00	100.00

Source: UNIDO

Table 16

Production (US\$ million)

	1984	1985	1986	1987		
Electronic capital equipment	100	16 %	132	156	182	20 %
Electronic consumer equipment	161	25 %	146	159	171	18 %
Components	371	59 %	346	450	570	62 %
TOTAL	632	100 %	624	765	923	100 %

Source : Benn Electronics

Table 17

Production - Mass consumer electronics and components

Benn Electronics - America, Japan & Asia-Pacific Electronics Data 1987

THAILAND: PRODUCTION

CONSUMER

	1984			1985			1986			1987		
	BtK	SH	No. x 1000	BtK	SH	No. x 1000	BtK	SH	No. x 1000	BtK	SH	No. x 1000
TOTAL	3788	161		3973	146		4313	159		4662	171	
Video Equipment												
Colour Television (Inc. KIts)	2184	93	430	2419	89	480	2700	99	430	3000	110	640
Monochrome Television	88	4	92	78	3	77	70	3	68	63	2	60
TV Games	60	3		10	-		5	-		2	-	
Video Equipment Total	2332	100		2507	92		2775	102		3065	112	
Audio Equipment												
Radios + Radio Combinations (Inc. KIts)	809	34	1137	819	30	1063	860	32	1120	900	33	1170
Other Audio Equipment	105	4	30	101	4	27	108	4	28	115	4	29
Audio Equipment Total	914	38		920	34		968	36		1015	37	
Other Consumer Equipment												
Electric/Electronic Watches	813	22	1362	817	19	1384	848	20	1400	870	21	1370
Electric/Electronic Clocks	29	1	96	29	1	81	30	1	87	32	1	96
Other Consumer Equipment Total	842	23		846	20		878	21		902	22	

COMPONENTS

	1984		1985		1986		1987	
	BtK	SH	BtK	SH	BtK	SH	BtK	SH
TOTAL	8772	371	9441	346	12235	450	15521	570
Active Components								
Cathode Ray Tubes	30	1	40	1	60	2	200	7
Other Tubes & Tubes	12	1	12	-	13	-	13	-
Diodes & Rectifiers	179	8	190	7	200	7	270	8
Transistors	192	8	243	9	260	10	280	10
Other Discrete Semiconductors	63	2	62	2	70	3	80	3
Integrated Circuits & Other N. Circuits	775	279	831	307	1100	404	14000	515
Active Components Total	8211	349	8998	326	11603	426	14793	543
Passive Components								
Capacitors	91	4	77	3	88	3	93	3
Resistors	40	2	64	2	60	2	65	2
Connectors	64	3	65	2	70	3	75	3
Small Transformers + Other Inductors	8	-	10	-	11	-	12	-
Switches	18	1	15	1	16	1	17	1
Printed Circuits	195	8	275	8	360	10	300	11
Passive Components Total	416	18	448	16	607	19	842	20
Active + Passive Components Total	8627	367	9446	342	12210	445	15635	563
Audio Components								
Microphones	13	1	14	1	15	1	16	1
Unrecorded Media	60	2	61	2	64	2	60	2
AP + MP for Consumer + Professional	70	1	70	1	80	2	70	2
Communications Equipment								
Audio Components Total	143	4	145	4	159	5	146	5

Table 18

Production - Capital goods

Benn Electronics - America, Japan & Asia-Pacific Electronics Data 1987

THAILAND: Production

EDP (Elec: Data Processing)

Table No. 81

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL	388	15	1511	64	2008	74	2588	12

OFFICE EQUIPMENT

Table No. 82

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL	381	9	218	6	225	8	237	9

CONTROL + INSTRUMENTATION

Table No. 83

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL	473	20	475	14	448	17	488	18

MEDICAL + INDUSTRIAL

Table No. 84

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL	381	9	175	7	218	6	248	8
X-Ray + Medical Equipment Total	181	8	158	6	188	7	208	7
Industrial Equipment Total	88	1	25	1	30	1	48	1

COMMUNICATIONS + MILITARY

Table No. 85

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL (inc. Kits)	889	28	889	28	1048	28	1188	28

TELECOMMUNICATIONS

Table No. 86

	1984		1985		1986		1987	
	BlK	SK	BlK	SK	BlK	SK	BlK	SK
TOTAL	188	8	248	9	288	11	488	18

Table 19

Directory of BOI promoted companies (1 July 1987)

Date of creation	Company	Ownership of capital	Production
1964 1968	THANIN INDUSTRIAL ELCON RESEARCH	Thai Thai 82.5% Chinese 17.5%	Radios, televisions Radios
1970	SANYO	Thai 51.33% Japanese 48.67%	Radios, televisions Transformers
1971	ITT	USA	Telephones
1973	NATIONAL SEMICONDUCTORS	USA	Semiconductors
1974	DATA GENERAL	USA	Integrated circuits
1974	THANIN INTER. Co.	Thai	Radios, televisions
1975	THANIN ELECTRONICS	Thai	Electronics, capacitors
1975	HANA INDUSTRIES	Thai	Electrolytic capacitors
1975	SIAM CERAMICS	Thai 40% Japanese 60%	Electronic calculators
1976	THAI ELEC. INDUSTRY	Thai	Radios for export
1977	ON MERCURY ELEC.	Thai	Crystal oscillators
1980	HONEYWELL	USA (ATT)	Integrated circuits
1980	LEONHARDY Co.	Thai 40% German 60%	Electromechanical components
1981	MICROTEX	Thai	Ferrite devices
1982	NMB THAI Co. (MINEBEA)	Japanese	Miniature ball bearings
1982	NATIONAL THAI	Thai 51.3% Japanese 48.7%	Radios, televisions
1983	ORIENTAL ELECTRONICS	Thai 50% USA 30% Taiwanese 20%	Electronics products for export
1983	SEAGATE ELECTRONICS	USA	Disk drives, computer parts
1984	SIGNETICS	USA	Integrated circuits
1984	KUANG CHAROEN ELECT.	Thai	PCB's
1985	GSS ELECT. Co.	Thai, USA	PCB assembly
1985	HANA SEMICONDUCTORS	UK	Integrated circuits
1985	FUJIKURA	Japanese	Keyboards, cords, interface assemblies
1986	PELMEC THAI	Japanese	Small ball bearings for export
1986	THAI FERRITE	Thai 52% Japanese 48%	Ferrite magnets
1987	MINEBEA ELECT. THAI	Japanese, Thai	Disk drives
1987	AMD	USA	Integrated circuits

Table 20

Characteristics of 25 projects that came into production
between 1984-85 and 1988

- 25 projects
- 11,000 jobs
- Project origin: Japan: 10
 United States: 5
 Thailand: 4
- Project type Components: 7
 Consumer electronics: 3
 Professional electronic
 equipment: 5
- Local content: 25%
- Product destination: 95-100 per cent for export

Table 21

Average wage per month of private employees

WHOLE KINGDOM				
1977	616	1,044	1,193	956
1978	678	1,087	1,180	990
1979	780	1,232	1,385	1,138
1980	890	1,499	1,647	1,371
1981	922	1,663	1,968	1,481
1982	908	1,740	1,974	1,511
1983	1,018	1,927	2,160	1,700
1984	1,173	2,123	2,216	1,820
BANGKOK				
1977	-	1,191	1,386	1,307
1978	-	1,137	1,413	1,283
1979	-	1,393	1,628	1,515
1980	-	1,805	1,930	1,870
1981	-	1,932	2,255	2,101
1982	-	2,106	2,363	2,241
1983	-	2,206	2,634	2,439
1984	-	2,365	2,772	2,594

Source: NSO Labour Force Surveys, 1977-1984,
July-September

Table 22

Thailand: Remittances of technology fees classified by
type of payment

(\$US million)

type of Remittances	year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Total	
												\$US	฿
Royalties		5.16	7.68	9.67	12.06	12.82	18.01	17.12	22.59	28.42	37.23	170.76	67.39
Technical Fees		1.56	1.96	1.39	2.51	4.70	4.63	7.34	9.27	13.45	19.68	66.49	26.24
Trademark Fees		0.06	0.06	0.06	0.01	0.24	0.07	0.63	0.94	0.22	0.18	2.47	0.97
Management Fees <u>a/</u>		-	-	-	-	-	2.04	1.69	2.33	3.68	3.92	13.66	5.40
Total		6.78	9.70	11.12	14.58	17.76	24.75	26.78	35.13	45.77	61.01	253.38	100.00

Note: P = preliminary figure

a/ No record between 1972-1976

Source : Unpublished data of Bank of Thailand

Table 23

Thailand: Outward remittances of management, copyrights and patent royalties by country

Country	1973	1974	1975	1976	1977	1978	1979	1980	1981	Percentage)
										Average 1973 - 81
Japan	40.9	41.4	50.5	41.7	38.1	41.6	33.7	42.1	33.5	40.4
United States	34.4	27.0	22.3	32.6	33.9	29.6	27.4	28.1	43.4	31.0
United Kingdom	6.7	14.9	11.3	7.1	5.1	5.9	4.8	3.6	3.4	7.0
Hong Kong	1.5	2.6	2.7	1.6	2.6	2.0	2.5	5.3	2.0	2.5
Germany	2.4	-	1.7	3.6	1.9	3.0	3.2	2.7	3.5	2.4
Others	14.1	14.1	11.5	13.4	18.4	17.9	28.4	18.2	14.2	16.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Computed from the unpublished data of the Bank of Thailand.

Table 24

Cost of technology acquisition (millions of baht)

Electrical and electronics industry

	1982	1983	1984	1985	1986	1987
Technical assistance	37.1	64.2	56.3	56.6	47.9	50.9
Licences, royalties, copyrights	50.3	65.4	144.4	121.5	113.5	107.9
TOTAL	87.4	129.6	200.7	178.1	161.4	158.8

Source: Bank of Thailand.

Table 25

Electronics sector

Characteristics of projects approved by BOI
between January 1987 and June 1988

- Number of projects: 71
- Investment (machinery): 5.8 billion baht (240 million dollars)
- Total number of jobs: 39,087
- Local content (local purchases/local purchases + external purchases): 0.23
- Product destination: export (100 per cent in the great majority of projects)

Table 26

Electronics sector

Projects approved by BOI

Country of origin	Number	Investment in machinery (millions of baht)	Jobs	Local content
Japan	22	3 600	12 604	0.34
United States	8	1 030	8 733	0.06
Joint venture	14	385	4 924	0.27
United Kingdom	3	285	3 835	0.28
Taiwan	11	175	5 357	0.02
Hong Kong	3	143	1 650	0.13
Thailand	4	86	445	0.56
Korea	4	20	736	0.29
Fed. Rep. Germany	1	6	753	0.25
France	1	8	50	0
TOTAL	71	5 738	39 087	0.23

Table 27

Electronics sector

Projects approved by BOI

<u>Type of product</u>	<u>Number of projects</u>	<u>Jobs</u>	<u>Local content</u>
Components	43	21 672	0.16
Consumer electronics	12	8 783	0.61
Professional electronic equipment	14	8 152	0.23
Integrated circuits	2	460	0.13

Table 28
Electronics sector
Project size

Country of origin	Number of jobs			
	0-49	50-199	200-999	>1,000
Japan		6	11	5
United States		1	3	4
Joint Venture	2	6	5	1
United Kingdom				3
Taiwan		4	6	1
Hong Kong			3	
Thailand	1	2	1	
Korea		3	1	
Fed. Rep. Germany			1	
France	1			
TOTAL	4	22	31	14

Table 29

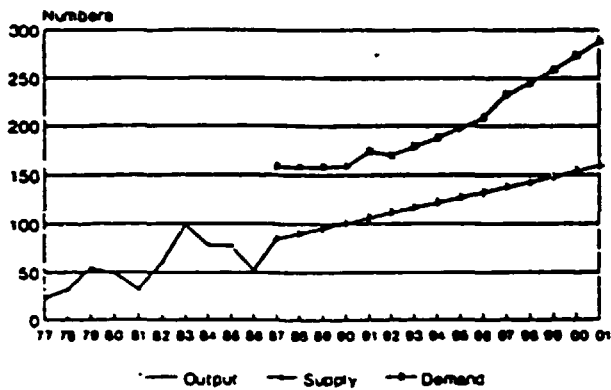
Projected demand for and supply of electronics engineers
and technicians during 1987-1991

		1987	1988	1989	1990	1991
Demand for Electronics Engineers	/ Low Growth	826	888	954	1,031	1,113
	\ High Growth	1,269	1,398	1,540	1,700	1,876
Supply of Electronics Engineers	/ Growth = 7.5%	892	959	1,031	1,108	1,191
	\ Growth = 10%	913	1,095	1,204	1,324	1,456
Demand for Electronics Technicians	/ Low Growth	2,959	3,190	3,434	3,716	4,018
	\ High Growth	4,237	4,671	5,144	5,678	6,265
Supply of Electronics Technicians	/ Growth = 19.3%	11,196	13,357	15,935	19,068	22,736
	\ Growth = 5%	9,854	10,347	10,864	11,047	11,617

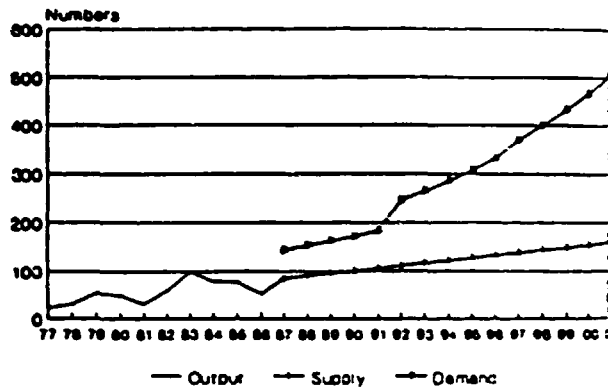
Source: NESDB (1986)

Table 30
Electronic technology manpower

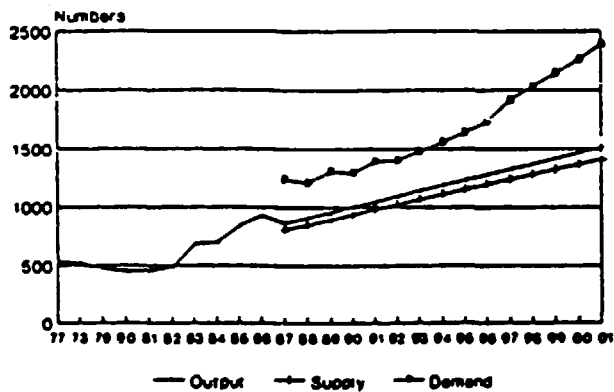
Postgraduate Degree, Base Scenario



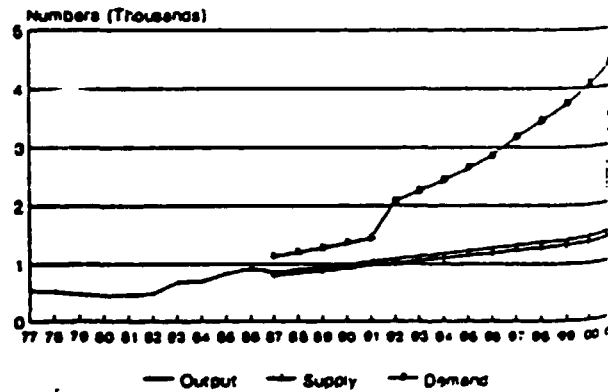
Postgraduate Degree, High Scenario



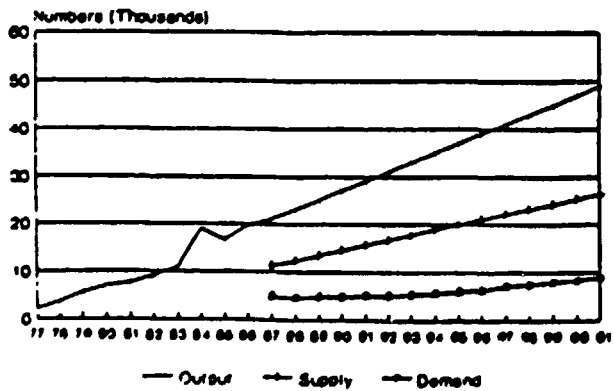
Bachelor's Degree, Base Scenario



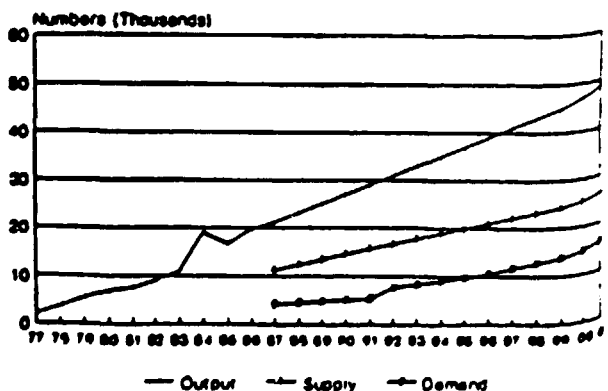
Bachelor's Degree, High Scenario



Below Bachelor Degree, Base Scenario



Below Bachelor Degree, High Scenario



Source: TDRI

Table 31

Relative position of technological personnel in selected countries

Country	Year	Total		Scientists and Engineers engaged in	
		Scientists & Engineers		Research and Development	
		Per 10,000 Population	Per 10,000 Labour Force	Per 10,000 Population	Per 10,000 Labour Force
Bangladesh	1979	8.5	15.2	0.2	0.4
China	1979	48.5	85.4	20.6	36.2
India	1979	11.6	21.0	0.4	0.6
Indonesia	1976	7.3	13.8	0.6	1.1
Japan	1979	49.6	77.6	29.4	46.0
Korea	1978	24.4	40.5	5.3	7.1
Malaysia	1978	17.5	28.0	0.6	1.0
Nepal	1979	1.8	3.4	0.4	0.8
Pakistan	1979	15.5	30.2	0.6	1.3
Philippines	1979	26.9	50.5	8.4	15.9
Sri Lanka	1983	5.8	10.0	1.0	1.7
Thailand	1975	4.8	9.1	1.4	2.7

Source: APCTT (1986a) as derived from ESCAP (1986)

Scientific and Technical Manpower Potential in Selected Countries

Country	Year	Type of Data	Total	Potential Scientists and Engineers	Potential Technicians	Potential Scientists and Technician
						Per 10,000 Populations
Brunei	1981	EA	6,515	2,214	4,301	330.7
Indonesia	1976	EA	1,217,874	95,339	1,122,535	78.6
Malaysia	1970	ST	35,415	n.a.	n.a.	25.3
Philippines	1970	ST	n.a.	1,083,724	n.a.	206.4
Singapore	1980	EA	64,179	38,259	25,920	256.7
Thailand	1975	EA	67,632	20,288	47,344	13.8
Burma	1975	EA	n.a.	18,500	n.a.	n.a.
Korea	1981	EA	2,025,639	94,171	1,931,468	524.8

Note: EA = Economically active qualified manpower.

ST = Stock of qualified manpower.

Source: Chee(1987) as derived from UNESCO(1984)

FIGURE 1 REAL GDP GROWTH: 1980-1987

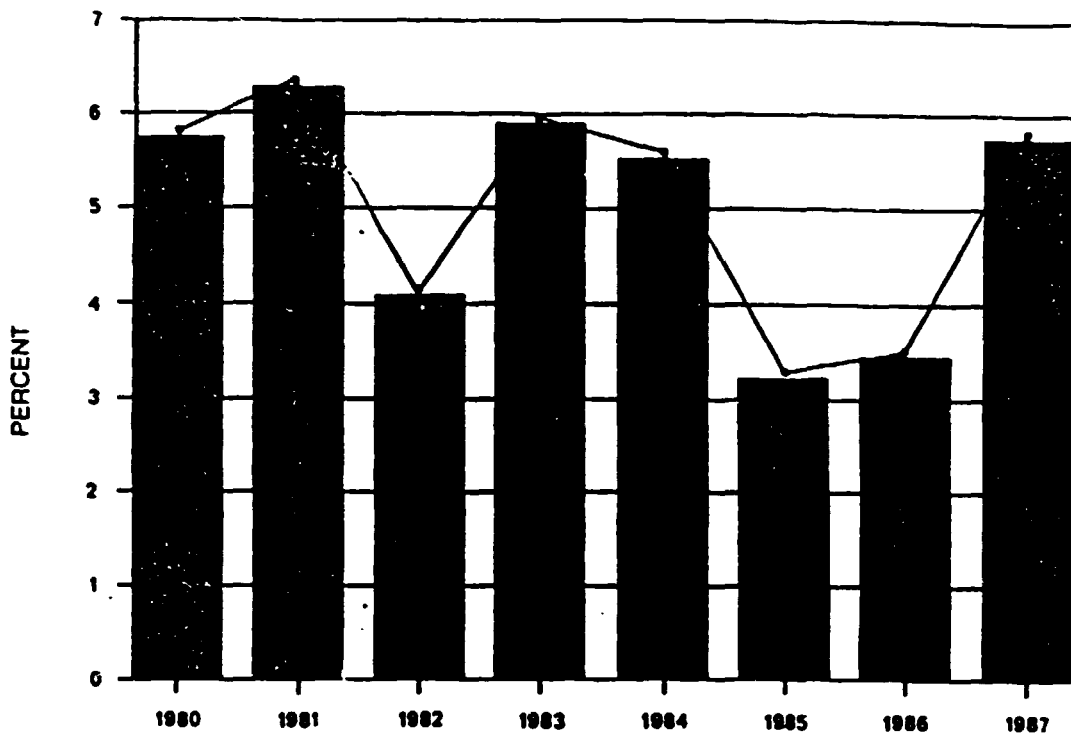
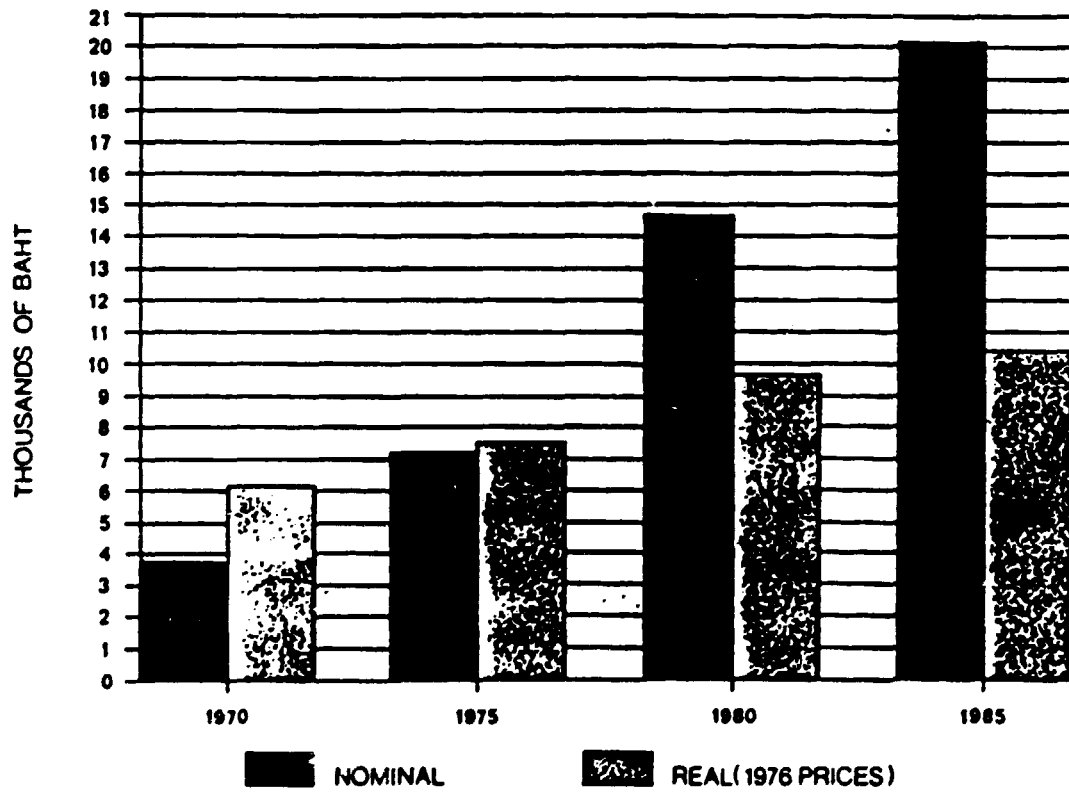
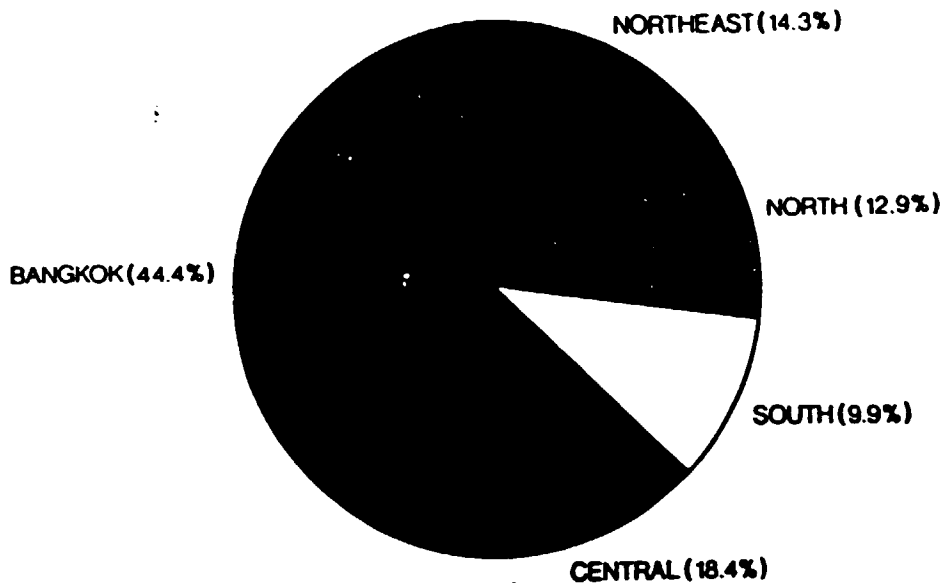


FIGURE 2 PER CAPITA GDP: NOMINAL AND REAL

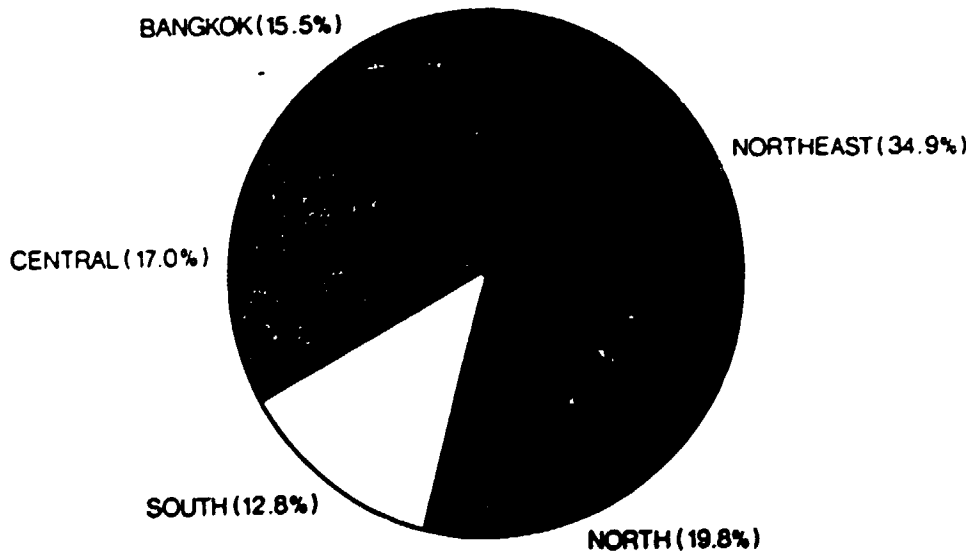


Source: TORI

FIGURE 3 SHARES OF GDP BY REGION. 1984

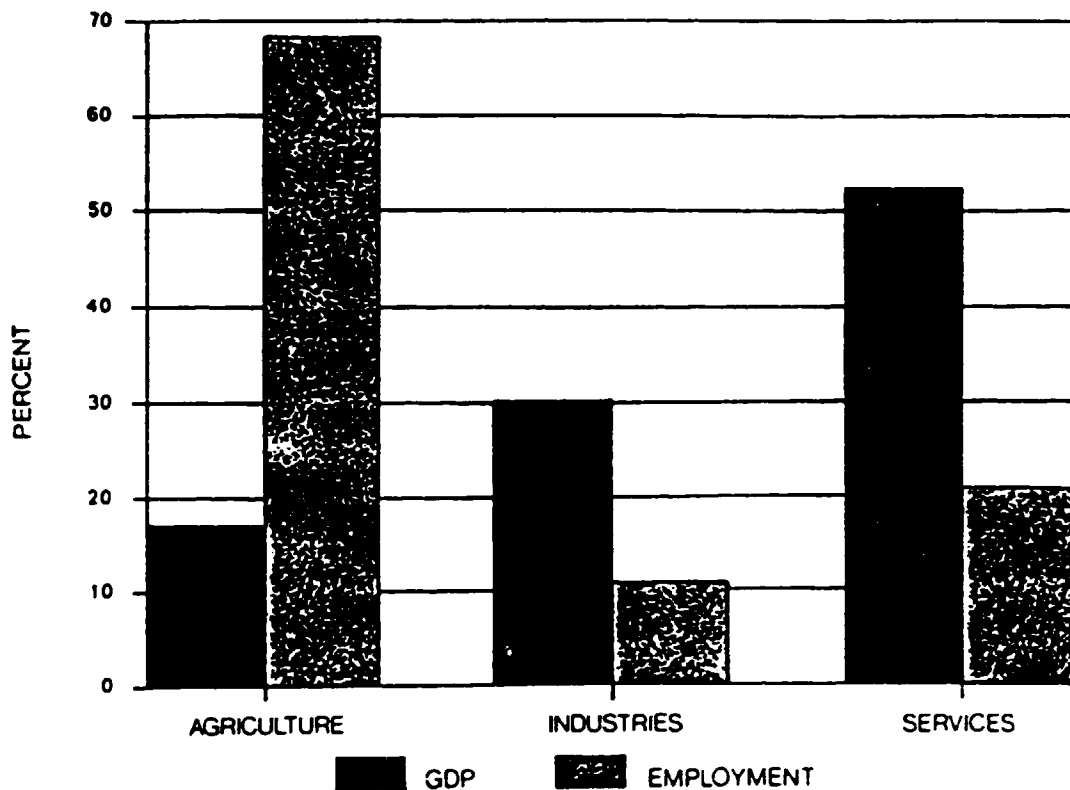


SHARES OF POPULATION BY REGION: 1984

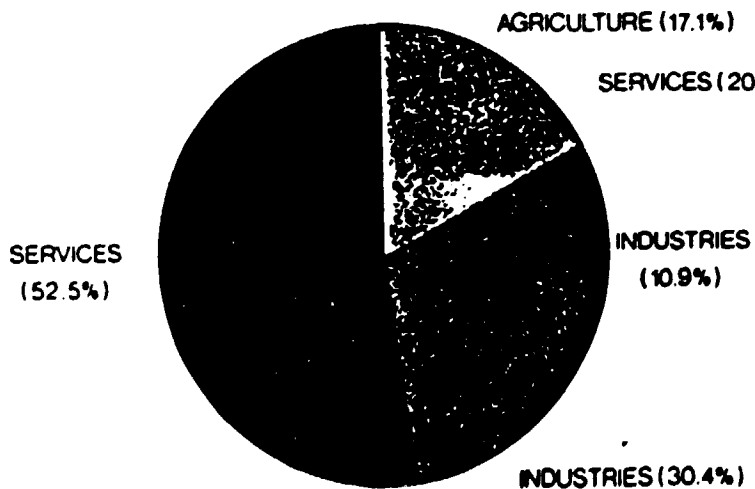


Source: TDRI

FIGURE 4 SHARES OF GDP AND EMPLOYMENT BY SECTORS 1985



SHARES OF GDP BY SECTOR: 1985



SHARES OF EMPLOYMENT BY SECTOR 1985

