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UNDP/UNIDO - NESDB

INDUSTRIAL RESTRUCTURING PROJECT

Thailand.

INDUSTRIAL RESTRUCTURING IN MACHINERY INDUSTRY.

Final Report.

Prepared by

Rachain Chintayarangsan,

Boonwa Thampitakkul,

Kovit Satawut,

Chatri Sripaipan,

in collaboration with

Eric J. Wightman

UNIDO advisor

1 April 1986

THE INDUSTRIAL MANAGEMENT CO., LTD.
BANGKOK,THAILAND

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ABBREVIATIONS

BOI	-	Board of Investment
BOT	-	Bank of Thailand
DIP	-	Department of Industrial Promotion
DSS	-	Department of Science and Services
ECC	-	Engineering Consultancy Centre
EIDI	-	Engineering Industry Development Institute
ERP	-	Effective Rate of Protection
NESDB	-	National Economic and Social Development Board
ICGS	-	Industrial Credit Guarantee Scheme
IMC	-	Industrial Management Co.,Ltd.
IPNs	-	Industrial Promissory Notes
IRF	-	Industrial Restructuring Fund
ISD	-	Industrial Service Division
SIFCT	-	Small Industrial Finance Corporation of Thailand
TISI	-	Thai Industrial Standards Institute
TISTR	-	Thailand Institute of Scientific and Technological Research

I. CURRENT STATE OF THE MACHINERY INDUSTRY

Overview

This report concerns some aspects of the machinery industry in Thailand. This industry covers a wide range of mechanical and electrical machinery. Specifically, the industry includes engines and turbines, agricultural machinery, wood and metal working machinery, special industrial machinery, office and household machinery, and electrical industrial machinery.

Historical Background

Industrial technology was introduced into Thailand by foreigners some 100 years ago. The first types of industry established included saw mills, rice mills and ice factories. All the machinery and equipment in these factories was brought into the country. Later, the Thai Government saw the necessity of modernizing the armed forces - the fire arms of all the forces, railway system for the army movement, steam fighting ships for the navy and later fighters for the army's air arm.

On the civil side, the government set up a sugar mill, a paper mill, a gunnysack factory and a cement factory. Unlike the foreigners whose interests were to exploit natural resources and markets in Thailand, the creation of industrial establishments by the government was in response to strategic needs.

Machines require repair and maintenance. Owing to the difficulties in obtaining spare parts and repair services from overseas (of which the nearest places were Singapore and Burma),

repair shops were born in Thailand to cater for these needs. A large number of the owners of these repair shops were former employees in factories and were trained by foreigners. Having achieved a certain level of skill, they left the factories and established their own workshops. They also recruited and trained young men to work as their assistants. On the government sector, technical skills were obtained by means of providing scholarships in the officers' level to study and to be trained abroad. The skilled labour level was obtained through local training by both foreign personnel and Thai personnel returning from abroad. The trainings by the government sector were generally more formal and theoretical than those provided by the foreign private sector. This is especially true for those being trained by the navy and the state railway workshops. Some years later the government established schools to provide formal technical education and the graduates normally became government officials or employees in large foreign owned enterprises.

Since 1960, the Board of Investment has taken a leading role in encouraging and regulating foreign and domestic investment. As a consequence, industrial activities in the private sector expanded rapidly. Four major trends were observed.

i) Some workshops, having repaired a number of machines of certain types before, realized that they had the technical capabilities to produce them. They then expanded their activities to include the production of these machines.

ii) Certain workshops undertook repair work in industries such as paper milling and sugar milling. The equipment was often bulky and some could not be bought due to obsolescence. These shops later expanded their work to include the production of spare parts and a few produced and supplied complete machines to those sectors. Unlike the first group whose products go to end users, the products of this group are used by factories.

iii) Some trading firms found it more profitable to manufacture the machinery they imported in Thailand. Joint venture companies were set up and the foreign partner normally supplied the technical know-how.

iv) Expansion of agro-industries resulted in factories which were often built under turn-key projects. The technology is normally brought in from abroad and the products are of international standard. The technical knowledge gained is in processing and control technology.

From the discussion above, it can be observed that before the introduction of the first plan of the NESDB, the creation of large-scale industries was in the hands of foreign-owned enterprises and the Thai government, the only two groups who possessed the required financial and organizational capabilities. Since the first plan of the NESDB, the Thai private sector began to play a more important role. However, in large

private enterprises, technical personnel were invariably recruited from governmental agencies. It may therefore be concluded that the government has played an important role in the creation of the technological capability in Thailand.

Among the four groups of companies described above, the first two groups are those which have had the most difficulty. They were started as small workshops and their owners lacked formal technical training. The last two groups are generally large and have access to foreign technology, albeit at a cost. It is obvious that the first two groups need a lot more assistance and therefore deserve a closer look. The firms in these two groups are prevalent in the machinery industry.

Production and Trade

The machinery sector represents a small fraction of the Thai economy in terms of its production or value added to the national income. However, its existence is more crucial to the economy than the number merely suggests since the modern economy cannot survive without machines and equipment to maintain its productive capacity and total dependence on imports of machinery is highly undesirable. The advancement in producing, accumulating and exploiting machinery and equipment is a crucial determinant of national economic development. Knowledge and skills accumulated in machine production have wide applications in most, if not all, of other industrial sectors.

In 1982, Thailand produced 19,566 million baht worth of the machinery that covered in this study, i.e. those products

covered by sectors 112 through 117 inclusive of the 180-sector Thailand's I-O table. The value added of this sector amounted to 2,269 million baht, contributing to about 0.3 per cent of the country's GDP. Export from these industries in the same year was only about 912 million baht representing 0.6 per cent of the country's total export earnings. On the other hand, import of machinery in 1982 amounted to 23,017 million baht, resulting in the trade deficit of 22,105 million baht which accounted for 60 per cent of the country's total trade deficit. More than half of the deficit in this category was accounted for by the special industrial machinery sector (sector 115). Another large contributor to this trade deficit was engines and turbines (sector 112). Breakdowns of the production and trade of machinery by sectors are shown in Table 1.1.

The country's self sufficiency in domestically supplying its need of machinery may be assessed by the self-sufficiency ratio and the import-consumption ratio as displayed in Table 1.2. The self sufficiency ratios range from as low as 16.4 per cent for engines and turbines to 52.9 per cent for the combine of agricultural machinery, special industrial machinery, and office and household machinery and appliances. Since export is relatively insignificant, the self sufficiency ratio and the import-consumption ratio can be seen to reflect each other. More than half of the domestic market is captured by imports, leaving only about 45 per cent of the market for domestic supply. The last column of the table indicates that nearly all of the domestically produced machinery was geared for local consumption

Table 1.1 : PRODUCTION AND TRADE IN 1982

(Thousand of baht)

	Sector	Production	Export	Import
112	Engines and turbines	1,029,808	96,357	5,355,821
113	Agricultural machinery		27,699	183,608
115	Special industrial machinery	16,765,085	497,836	13,703,447
116	Office and household machinery & appliances		241,481	1,786,914
114	Wood and metal working machines	342,839	20,945	607,768
117	Electrical industrial machinery & appliances	1,427,837	27,709	1,379,595
	Total	19,565,569	912,027	23,017,153

Source : NESDB,
Customs Dept.

as less than 5 per cent of the production could be exported.

As most of the machinery production in Thailand are merely assemblying, the industries are highly dependent on imports of parts and components. The dependence on imported inputs may be summarized by looking at the direct and indirect import contents of the industries' output. According to the 58 sectors I-O table of Thailand, the average import contents accounted for about 40 per cent of the output value of industrial machinery (the aggregate of sector 112 through 116 inclusive). Comparing to the rest of the economy, the import contents of the machinery sector is nearly four times the average.

Growth

Between 1978 and 1982, the consumption of machinery increased by only 43 per cent as measured in current value of baht. Deflated by the GDP deflator, the real value of machinery consumption in 1982 dropped slightly below that of 1978. However, due to aggressive import substitution and relatively good performance in export expansion, the industries managed to boost its growth over the period to 74.8 per cent as measured at current prices, or 18.9 per cent at constant prices. Comparing to the rest of the economy, the growth of the industries was yet less than the 82.7 per cent growth of GDP over the same period. Engineering industries are generally found to have the growth elasticity higher than unity which means their expansion should

Table 1.2 : SELF-SUFFICIENCY, IMPORT DEPENDENCE, AND EXPORT PRODUCTION RATIOS (1982)

(Percentage)

Sector	Production / Consumption	Import / Consumption	Export / Production
112	16.4	85.2	9.4
113 + 115 + 116	52.9	49.5	4.6
114	36.9	65.4	6.1
117	51.4	49.6	1.9
Total	47.0	55.2	4.7

Source : NESDB,
Customs Dept.

be more rapid than the national income. The relatively slow growth of the machinery industries over this period may indicate that they are probably more sensitive to economic fluctuation than average industries.

The growth performance over this period varied greatly among the subsectors of the machinery industries. The current baht value of output of electrical industrial machinery and appliances declined by 16 per cent while that of agricultural machinery, special industrial machinery, and office and household machinery and appliances increased by 95.4 per cent. The sources of growth were also greatly different among these subsectors. Import substitution was the major contributor to the growth of wood and metal working machines and engines and turbines. Domestic demand expansion produced the greatest impact on growth of the rest and was mainly responsible for negative growth of the electrical industrial machinery sector. Export expansion effect was positive in all sectors but its impact was relatively minor. (Table 1.3)

Table 1.3 : GROWTH AND SOURCES OF GROWTH 1978-1982

(Percentage)

Sector	Growth	Domestic expansion	Import substitution	Export expansion
112	42.7	8.6	72.8	18.6
113 + 115 + 116	95.4	73.4	24.7	1.9
114	94.4	-3.5	91.4	12.1
117	-16.8	-98.8	-5.6	4.4
Total	74.8	58.5	37.8	3.7

Source : NESDB,
Customs Dept.

Structure of Selected Industries

To grasp the present situation of the machinery industry, the following discussion will briefly review salient features of industrial structure and market pattern with particular reference to the inherent technological capabilities. The review may not be extensive but it intends to highlight certain points relevant to the formulation of policy recommendations for the machinery industries.

Intermediate production facilities[1]

i) Casting. According to a survey report by ISI, 250 casting shops had been found in Bangkok and the nearby provinces. The bulk of them are small cast iron works with an output of 25 tons a month. They use sand moulds for casting, have little or no pattern-making capacity, use manual method for shakeout and finishing, and pay little attention to quality control. Moreover, the practice of job works tends to disrupt any attempt to introduce smooth organization into the plant. In this field, the use of subcontracting is very active. In many cases, however, the quality level of their products is considerably inferior to the international level. As for the price conditions, their products are getting more competitive internationally. But

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[1] JICA, The Study on Promotion of Metal-working Industry in the Kingdom of Thailand, draft, 1984.

it will be a serious subject in the future how the quality can be improved with the price conditions kept unchanged.

ii) Forging. There are only two or three firms which can produce the forged parts to meet the needs from the modern industries. The rest are those using the traditional forging system just like village blacksmiths. One or two companies, of these, have already stopped the operation due to their bad financial standing.

iii) Sheetwork, Welding and Pressworks. These subsectors have been growing under stable increase in the domestic demand to become a solid industrial base. New entry into these fields is relatively easy as only small amount of capital investment is required. Therefore the number of firms in these subsectors is numerous. These firms generally need technical support to improve their product's quality.

iv) Machining and machine assembling. Machine shops with only a few lathes and drilling machines account for about 1/4 of all firms in the metal working industries. Of these, 28 per cent are engaged in machining of products that require precision, 18 per cent in machining that requires a fair degree of accuracy and 40 per cent in

machining that does not require much accuracy. The remaining 14 per cent seem to be engaged in machining of specialized parts (some of which require precision and some only a fair degree of accuracy.) For the time being, it would be advisable to place the emphasis of support for improvement of technical skill on the 28 per cent of the machine shops which are considered in the longer range to improve the potential of the industry as a whole, and then try to upgrade the other groups in turn. The current technical state of these workshops is further analyzed in Chapter II. The shops engaged in the assembly of machinery are smaller in number compared to those in the machining industry. In the process of modernization of the industrial structure, it is important to let them acquire the basics of the art of machining and machine assembling and to help strengthen these industries by introducing production control techniques.

v) Plating. The plating is one of the fields whose dependability on subconstracting is great. The most serious subject in this field is the plating quality.

Engine

Imports of engines, all kinds, was 139,057 units and valued at 1,090 million baht in 1982. Unfortunately the import figures do not discriminate engines into new and second-hand, nor distinguish according to capacity. The largest number is destined for use in vehicles. A few are for mounting in boats. The large category of 'other' engines, which has averaged around 200,000 units a year since 1976, includes mainly small engines for use in agriculture and industry. Diesel engines predominate.

The major source of demand for diesel engines has been in agriculture. The increase in farm mechanisation in the 1970s has centred around small diesel engines - portable units which can be hooked up to a pump, tiller, other agricultural machinery and small electricity generator. Demand for new engines is now running at over 100,000 units a year, and there is a further brisk trade in second-hand and reconditioned engines. Seven to ten H.P. is the most popular size.

In mid-1980, Kubota and Yanmar started production of small diesel engines in Thailand. Both have been promoted by the BOI, which has set a steep scale for local content: 20 per cent in the first year, rising by steps to 80 per cent in the fourth year. A third company, Siam Farming, prepared to produce the Korean Dae Dong engines, which are lower in quality and about 20 per cent cheaper than the two Japanese types. However, the joint venture has collapsed. Recently, the Siam Farming Co.,Ltd., has signed contract with Mitsubishi Heavy Industry and is supposed to

start operation by 1985.

Both Kubota and Yanmar have set up new factories fitted out with up-to-date equipment like NC finishing machines and electronic three-dimensional measuring apparatus. Siam Kubota aims to produce 6.5-11 H.P. engines with the capacity of 54,400 units a year. Yanmar produce engines ranging from 7-36 H.P. with the capacity of 54,000 units a year. Table 1.4 shows that the market demand for engines dropped drastically in 1983. The rate of capacity utilization was only 27 per cent in that year. The main reason lies in the influx of imported engine from Mainland China and Japan, so the Government had to impose import control on those products. The situation seems to improve subsequently. During the first half of 1984, the production of diesel engine was 51,236 units compared to 21,134 units for the same period in 1983.

The local content provision works on a part-for-part basis, and is calculated on the value of individual parts in a CKD kit. To qualify as part of the local content, the part must have at least 65 per cent of its value created in Thailand. Both companies are meeting the initial stipulations on local content by doing extensive pressing and machining work, and by using local subcontracting arrangements. Siam Kubota has subcontracted for the flywheel, bearing housing, some pressed sheet metal parts, aluminium pressure die castings and filters. Subcontracting work is distributed within the Siam Cement Group, which is its principal (41 per cent) shareholder; much of this

Table 1.4 : PRODUCTION AND SALES OF SMALL DIESEL ENGINES

(Unit)

	Siam Kubota		Yanmar	
	Production	Sales	Production	Sales
1981	50,185	38,580	49,631	54,807
1982	40,654	37,262	20,672	13,041
1983	23,400	29,725	5,660	11,424

Source : Board of Investment

subcontracting has gone to the Navaloha foundry. Both Yanmar and Siam Kubota have had difficulty getting the subcontractors to produce the parts to meet schedules and quality standards. It is clear that both will have difficulty meeting the later stages of the local content programme.

Formerly, the Board of Investment announced regulation on 80 per cent local content within 1 July 1983. This requirement was ruled out on 21 March 1984 due to the difficulty of getting qualified subcontractees. New local content requirement was then set at 62.5 per cent within 1 July 1984.

In the medium-term, the prospects will depend on the success of the companies in maintaining quality and restraining prices. The rural market for engines is competitive and very sensitive to prices. Yanmar and Kubota engines will compete with the second-hand engines and their advantage rests in their reliability. Both companies have set high standards for quality control in production, and are experiencing a high reject rate on many subcontracted parts. It can be expected that such problems will be smoothed out in time, but will recur at each step of the local content programme. The two manufacturers are hindered by the enormous inexperience of local firms and local technicians in producing precision parts for engines or similar applications. The companies find that the assembly workers are exceptionally good, but the quality of casting, forging and other metalworking processes carried out by subcontractors are below standard unless the two companies provide considerable technical assistance.

Agricultural Machinery

The need for mechanization was stimulated by the introduction of multiple rice cropping in the central plain. The time reduction between crops made it impossible to accomplish land preparation and harvesting by using buffalos and family labor resources. Other contributing factors were a steady growth of the Thai economy, the increased use of fertilizers and the introduction of higher yielding rice varieties. These developments enable farmers in the more productive areas to afford a higher level of investment in farm machinery, which in turn encourages local manufacturing of the machines. The number of various types of agricultural machinery in use was shown in Table 1.5. The locally made single axle power tiller with moldboard plow and harrow became established around the mid seventies, as a suitable low cost mechanical cultivation unit in the main rice areas, followed by a riding 4-wheel tractors which are similar in design features. The IRRI type axial flow rice thresher was introduced and successfully modified by local manufacturers to suit local conditions. In the late seventies, a notable expansion of farm machinery manufacturing capacity occurred, small scale provincial factories and workshops and subcontractor workshops grew to meet the increased demand by farmers and contractors for mechanical cultivation equipment, irrigation pumps, threshing machines and farm transport vehicles.

During 1981 and 1982 farm machinery production decreased due to less favourable economic conditions, low farm product selling price and increased competition from imported second hand

Table 1.5 : NUMBER OF AGRICULTURAL MACHINERY IN USE : 1975-1980

Equipment	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Power tillers	90,001	113,285	151,504	192,004	230,591
Small 4 wheel tractors	14,575	16,427	23,942	26,984	31,158
65 - 80 hp. tractors	13,338	17,569	22,826	28,987	33,285
Puddling machines	9,882	9,000	8,700	8,200	8,000
Sprayers	1,310,464	1,379,436	1,452,038	1,528,461	1,604,884
Chinese Dragon Dragon pumps with Engines	56,891	68,219	81,923	89,775	107,730
Pumps	251,288	277,084	317,328	359,308	473,975
Winnowers	42,342	47,423	53,114	59,488	66,806
Corn shellers	5,721	6,407	7,175	8,036	9,000
Rice threshers	3,955	4,430	4,962	5,557	6,224
Animal feed mill	374	419	469	525	588
Sugar Cane harvester	-	-	-	-	5
Small rice mill	24,658	24,914	25,170	25,426	25,682
Trans planter	-	-	-	-	65
Sugar Cane planter	15	65	135	185	245

Source : Office of Agricultural Economic, Ministry of Agriculture and Cooperatives.

tractors and implements. Indication at present is that manufacturing capacity exceeds farmer's requirements. However, a steady increase in farm mechanization is expected during the next 10 years. Therefore, this industry should be given due considerations.

A manufacturing survey undertaken by Agricultural Engineering Division in 1981 and 1982 indicated that there were 143 manufacturers in this business (Table 1.6). Most of these were family owned and could be grouped into the following categories based on the number of workers employed:

	No.of firms	Percentage
Small (up to 10 employees)	64	45
Medium (from 11 to 30)	49	34
Large (more than 30)	30	21
	143	100

It is estimated that medium and large manufacturers account for more than 60 per cent of the annual turnover. They concentrate on production of larger volume of fewer product types and are mainly located in the Central Plain and provinces around Bangkok which have ready access to the more productive rice cropping areas. Small size "up-country' manufacturers tend to serve their own farmers' regional and provincial needs, producing lower volume but wider range of machinery. Recent trends indicated that the up-country manufacturers are facing increasing competition from larger scale manufacturers located in the central region, especially on power-tiller and 4-wheel Thai

Table 1.6 : LOCATION OF THE AGRICULTURAL MACHINERY MANUFACTURERS IN EACH REGION

Type of Products	Number of Firms					Approximate Annual Production
	Total	N	NE	C	S	
Farm Tractors :						
1. 2-wheel tractor	32	4	2	23	3	50,000
2. 4-wheel tractor	14	1	-	13	-	5,000
Tractor Implements :						
1. disc plow, tiller	32	13	1	18	-	3,000
2. disc and comb harrow	1	-	-	1	-	n.a.
3. bulldozer	8	2	-	6	-	n.a.
Other Implements :						
1. threshers	37	5	4	20	8	6,000
2. corn shellers	19	6	4	9	-	1,500
3. winnowers	5	1	-	4	-	500
4. sprayers	n.a.	-	-	-	-	150,000
5. mowers	4	-	-	4	-	10
6. trucks	18	8	4	6	-	1,500
7. trailers	8	5	-	3	-	3,000
8. rice transplanter	5	1	1	3	-	230
9. seed drill	3	-	-	3	-	50
10. fertilizer distributor	1	-	-	1	-	10

Source : Agricultural Engineering Division, Ministry of Agriculture and Cooperatives.

tractor. This trend is expected to continue, as the economies of higher volume production, lower raw material and transportation costs, easier access to specialist subcontract services, and a skilled labor market, increasingly favour larger producers.

Two other surveys conducted by the Bank of Thailand[/1] in 1983 revealed the figures of capacity and actual production of various agricultural machinery and implements. (Table 1.7). In this regard, the small tractor industry is of major importance and therefore should be given special attention.

One interesting aspect of the tractor industry is the high degree of lateral integration. Very few firms attempt to cover all the processes involved in production. Many subcontract the casting work, or the metal cutting and pressing work. Several firms specialise in producing certain parts in excess of their own requirments, and sell the surplus to other firms. This parts trade is particularly active for specialised parts like sprockets, but extends even as far as complete body assemblies and wheel assemblies. Finally, only a few of the assemblers also provide and mount the engines. This is nearly always done by the distributors or dealers.

Excess capacity has spawned some tense competition, both on the production side and in marketing. This situation has

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/1 Bank of Thailand, Survey on Small Tractor Industry, 1982, and Survey on Agricultural Machinery and Implements, 1983.

Table 1.7: PRODUCTION OF THE AGRICULTURAL MACHINERY : 1980 - 1983

Unit : Units

	Production			
	1980	1981	1982	1983
2-Wheel walking tractor	50,075	66,750	33,659	39,644
4-Wheel tractors	6,853	8,450	3,901	4,489
Rice mill	3,412	3,087	3,238	3,100
Thresher	2,841	5,131	3,393	3,920
Pick-up vans	1,191	1,312	1,080	1,290
Harrows	215,600	220,000	475,200	492,000
Disc plow	13,043	32,723	35,335	40,600
Ploughs	78,400	91,840	117,920	124,000
Husking machines	1,066	1,328	1,550	1,900
Water pipes	8,160	18,462	13,872	16,100
Archard soil turner	4,874	7,614	8,101	8,800
Seeder planters, trans-planters	340	375	390	420
Blade to push soil	556	1,011	1,015	1,100

Source: Bank of Thailand

helped to propel the search for better designs and to keep prices down. The total employment in tractor firms in the on season is around 2,000 persons. Most of these are unskilled and in the smaller firms in particular a large number are young 'apprentices'. However, the quality of production has come to depend on the skills built up by a few craftsmen. Firms compete to secure the services of these men to run their operations, and these few earn good wages.

Many companies try to capture the market of reputable firms by the usual methods of imitating their logo, colour and other aspects of house-style. Such practices have made it difficult for the customers to discriminate on grounds of quality. However, customers find it difficult to differentiate between models; they therefore select on such matters as colour and, above all, price. This has led the producers to supply cheap, rather than good quality products.

The firms are located in four main clusters, although there is a scattering of firms in other places: (a) around Bangkok, principally in the Prapadaeng area and in Thonburi; (b) in Chachoengsao; (c) in Ayutthaya; and (d) a smaller cluster in Chieng Mai.

The capacity of these firms far exceeds market demand. However, it is not easy to calculate a meaningful figure for capacity utilisation, for several reasons. First, many of the smaller firms are virtually jobbing shops and take on tractor construction to customer order just like any other job. Second,

the business is very seasonal. The on season begins in January when the farmers receive their earnings from the previous crop, and ends in June when they just have completed their arrangements for the coming season. Many firms stop work completely in the off season, while others slow right down. Most firms simply cannot afford to build up an inventory during the off season.

Machine tool

In 1977 the Industrial Service Division (ISD) of the Ministry of Industry prepared a status report showing that 18 local companies' production of 1,000 metal-working tools or more a year met about 5 per cent of local demand in terms of quantity but almost 10 per cent by value. /1 Technical quality of metal forming tools had been found to be generally satisfactory, but that of metal-cutting tools was low. During 1979-80, Entwickslungberatung EB GmbH undertook an extensive study of the industry for the German Agency for Technical Cooperation Ltd. (GTZ), with which IFCT and BOI were associated: its July 1980 report /2 covers the technical context of machine tools manufacture in considerable detail, notes present Thai production, analyses demand, indicates the scope for development of the industry and identifies alternative production projects incorporating training facilities.

/1 ISI, Status of Machine tool Industry in Thailand, 1977.

/2 EB, Machine Tool Production in Thailand, July 1980. The EB consultants also undertook an overseas promotion exercise in association with the study.

The most striking fact we found in our survey is the vulnerability of the machine tool producers. In 1979, it was reported there were 18 firms engaged in this industry. The number was two in 1983, and then this year only one firm remains in the production line. The last survivor, Sekkee, is now producing universal lathe and shaper with the capacity of 30-50 and 10-20 units a month, respectively. The total workforce comprises 45 persons, mostly male, and mostly employs in the machine shop. The prospect is bleak in the light of import penetration. As for the rest, some firms closed down their plants, while some firms have shifted to another product line or servicing business.

The average value of each machine (lathe) was 100,000 baht and sales were typically 10-15/months. A range of sizes was offered from 1 metre bed length, 10 "chuck to 1 1/2 metre bed length, 24" chuck. Castings were bought from various foundries. Top speeds were relatively low by European Standards: 1,250 RPM max for 10" machine and 300 RPM for 24" machines. Drive motors, 10 H.P. normal, were bought from agents (The maximum power of Thai motors is only 5 H.P.- scope for development here). Direct drives, D.C. or A.C. were considered to be too expensive. Chucks were bought from agents but Mr. Boonyalithi, the managing director of Sekkee, considered that with relatively low investment in additional plant e.g. heat treatment, he could make chucks.

The machine shop was a mixture of classical machines (mostly British such as Butler plano mill, Archdale drill, Summeskill slideway grinder, various centre lathes of own

manufacture destined to be re-built and sold "as new") a gear cell comprising four hobbing machines, and special purpose machines of own manufacture for boring headstocks in one pass.

Mr. Boonyalithi commented modestly that his machines were not as good as Japanese equivalents. To improve quality he would like to start again with a new factory. Skill was a problem and attempts to train graduates had not been very successful because they appeared to lack stamina. He agreed however that they may have been the wrong choice for the job and a system of selection based on aptitude might produce a better result.

Machine tools output serves various activities within the metal and wood working industries, and on this depends the precision-level as much as the type of machine which may be demanded. For metal working tools, the main consumers in Thailand at present appear to be in light engineering, i.e., repair shops, household appliance and other electrical machinery producers. The EB consultants based their forecasts on inspection of customs documents, information from importers and data of other countries with comparable structures of metal-working industries. They estimated that the present demand in the five main categories was:

- Lathes: 90 per cent centre lathes;
- Boring and drilling machines: 85 per cent hand-operated and small table type;
- Milling machines: 90 per cent knee-type;
- Shaping and planing machines: 90 per cent shapers; and

- Grinding machines: 95 per cent bench-type.

Imports of metal-working machine tool together valued ฿ 655 million in 1980 and rose sharply to ฿ 1,395 million in 1984 (Table 1.8). Major suppliers were Japan and Taiwan.

Many of the machine tools in use in the small and medium scale industries in Thailand are the imported from Taiwan, China and East Europe, etc. These are the medium quality products. Localization of these items might be considered as a strategic element in the promotion of Thai engineering industries. A significant increase in domestic production will require: a sizable market for certain kinds, types and models of tools; availability of raw materials and components; and an adequate supply of qualified technicians and skilled labour. Machine tools with most promise are: universal centre lathes; shapers; bench type drilling machines; pillar drilling machines; radial drilling machines; hacksaws; bench grinders; horizontal milling machines. EB has designed several projects, with varying production mixes of tools, and preliminary costings give very satisfactory profit projections. The scope for effective competition against imports (without excessive or long-term protection) appears to lie more in the production of standard and precision/heavy duty tools of good quality, rather than of lighter, cheaper machines.

Table 1.8 : IMPORT OF METAL-WORKING MACHINE TOOLS : 1980 - 1984

V : ฿ million

Q : Units

	1980		1981		1982		1983		1984	
	Q	V	Q	V	Q	V	Q	V	Q	V
Drilling and boring machines	6,470	41	7,451	25	5,020	30	14,465	57	6,855	52
Planning, shaping and slotting machines	1,934	40	1,368	67	1,622	64	4,949	127	4,436	232
Lathes of all kinds	1,379	97	1,242	108	1,039	105	1,783	156	2,026	212
Milling machines	379	61	514	35	446	49	415	54	3,035	57
Sawing and cutting machines	3,614	46	4,203	54	2,676	53	3,977	72	2,412	73
Grinding machines	7,438	37	6,220	24	9,031	31	9,336	79	3,669	279
Riveting machines	17	1	57	4	33	1	118	3	22	2
Wire, drawing machines	42	24	24	22	29	9	34	14	34	36
Other machine tools	15,374	308	7,128	276	7,275	208	10,501	253	8,799	452
Total	36,647	655	28,207	615	77,171	550	45,578	815	31,288	1,395

Source : Department of Customs

BTN Code 844501 - 844509

Pumps

The Thai market for pumps falls into four segments:

- Pumps for domestic water supply. – At present this market is dominated by Japanese imports. These relatively simple units, with pump and integral electric motor, are mass-produced in Japan at relatively low cost.
- Pumps for agriculture. – The most popular type are end-suction centrifugal pumps with a diameter of 2" or thereabouts. Most of these are made in Thailand.
- Tailor-made, heavy-duty pumps for use in mining and other industries. – A large proportion of these are made in Thailand by several jobbing foundries, because the high transport costs provide implicit protection.
- Special industrial pumps. – The types are very varied depending on the application. Virtually all of these are currently imported, from the USA, Europe, Japan and India.

Large sized pumps are centrifugal pumps for tin mines, medium sized ones are for irrigation use and small sized ones are for households. The most serious problem in the pumps for tin mines is the short life caused by poor selection of the materials, and many of the pumps for irrigation use are the imported ones. Small pumps have a large quantity of demand, but they are manufactured so diffusely that the beneficial effect of

mass production cannot be realized.

An MOI study conducted in 1978 identified 26 firms manufacturing pumps. Most were only small machine shops (17 of them employed less than 10 persons while only 4 employed more than 50 persons). The small firms generally buy in castings and other parts, and specialise in final machining and assembly. Of the total production, 70 per cent was of the end-suction centrifugal type, mostly destined for agricultural use. The models are copied from imported types, but the quality is inferior and the efficiency is low. Such pumps are used mostly for raising water through a small height (up to one metre) in the paddy fields. The design is kept fairly simple, in order to facilitate local repair. The motor is not integral to the pumpset, and many farmers like to transfer a motor which is also used for other applications, for instance in a power tiller.

Such locally-made pumps do not have an exclusive hold on the rural market. Some farmers afford better quality imported types. The MOI study estimated that the local output of pumps had remained relatively static through the mid-1970s at around 55,000-65,000 units a year.

According to the MOI study, local firms have considerable spare capacity and could produce 20-30 per cent more units. But, as in the case of local small tractor manufacture, it is difficult to make any sensible estimate of capacity utilisation. The market tends to be very seasonal, and the production also. Most of the small firms are jobbing shops which

either produce different items in the off season, or else scale down their labour force and reduce production of pumps or even cease altogether. Similarly, like the tiller manufactures, the main difficulty experienced by the pump manufacturers concerns finance. In the on season, the competition between small producers is fierce and price margins get pared down. The firms have little working capital of their own and cannot afford to build up inventories during the off season and so attempt to establish a permanent labour force and a fixed flow of work. Banks are not impressed by the assets or prospects of these firms, and thus they cannot supplement their own financial resources with bank capital.

There seem to be good prospects for pump production of two sorts. First, there is a possibility of producing better quality pumps for the local agrarian market. At present the inefficiency of the pumps usually sold in the countryside by small local producers is such that they require a lot of fuel, and wear out quickly. Data on other forms of machinery used in agriculture suggest that while farmers initially select almost entirely on grounds of cost, at the time of making later replacement purchases they are inclined to take a more canny view of the real cost and amortisation rate of their investment and thus, wherever possible, buy a better product. The increase in imports of pumps, some of which at least must be destined for agricultural use, suggests that this upgrading of the market may already be happening among pumps. Second, there is a growing market for more specialised industrial pumps. One or two local

Table 1.9 : IMPORT OF WATERS PUMPS, 1980-1984

V : ฿ million

Q : Units

	1980		1981		1982		1983		1984	
	Q	V	Q	V	Q	V	Q	V	Q	V
Pumps for Fire Fighting	107	8	228	5	1,866	31	127	12	501	16
Reciprocating Pumps	138,132	250	106,268	180	99,514	250	219,907	311	220,545	402
Centrifugal Pumps	20,226	40	33,559	79	19,851	47	20,082	66	22,123	60
Rotary Pumps	782	32	225	3	569	3	1,155	5	488	2

Source : Department of Customs, BTN code 841010, 841021, 841022, 841025

producers have already entered this market, but the lion's share belongs to specialist imports.

Transformers

There are presently nine producers of transformers, two of which are promoted by the BOI. The experience of one wholly Thai company, Siriwiwat, may exemp. fy the nature of transformer firms in Thailand. Siriwiwat currently produces around 12,000 transmission transformers (up to 10 MVA at 33 KV) and is engaged in expanding its facilities to produce power transformers (up to 120 MVA at 230 KV). The company employs 600 persons and carries out all the processes involved in manufacturing transformers from basic ma' rials. It maintains a link with Westinghouse of the US, engineers are sent to Westinghouse for training, and the power transformers are being produced under a Westinghouse license, but on the whole the company tries to act as a standard bearer for Thailand's engineering capabilities. Four-fifths of Siriwiwat's output goes to the public sector generating and distributing concerns, and the remainder to private industry. The public sector concerns depend on Siriwiwat for 70 per cent of its requirement but have to import the rest, especially larger capacity equipment.

The other firms share Siriwiwat's experience in many respects. Irregularity in demand has resulted in the stiff competition in the market. The threat of imported products

exacerbated the situation. The high dependence on imported raw material is also one of the major hindrance to further growth of the industry.

The demand for transformers is very strong. The major consumers are Metropolitan Electricity Authority and Provincial Electricity Authority. Most of the big transformers (over 10,000 KVA) are imported. The total import value of transformers was 475 million baht in 1984 of which big transformers (over 50 KVA.) accounted for 380 million baht.

Table 1.10 : IMPORT OF TRANSFORMERS, 1980-1984

V : ฿ million

Q : Units

	1980		1981		1982		1983		1984	
	Q	V	Q	V	Q	V	Q	V	Q	V
Transformers Under 1 KVA.	1,112,131	45	5,220,900	85	2,291,372	66	1,947,645	79	5,114,653	48
Transformers 1-10 KVA.	24,723	37	82,529	31	7,736	18	10,766	25	4,726	17
Transformers over 10 to 50 KVA.	12,411	99	2,766	41	2,543	38	9,846	79	1,282	30
Transformers over 50 KVA.	5,870	297	1,367	184	443	80	838	404	3,340,870	380

Source : Department of Customs, BTN code 850130 - 850133

II. TECHNOLOGICAL CAPABILITIES

Introduction

This chapter seeks to assess the current technical conditions in the machinery industry in Thailand. This industrial sector refers to those classified under the following I-O Codes:

112 (Engines and turbines)

113 (Agricultural machinery)

114 (Wood and metal working machines)

115 (Special industrial machinery)

116 (Office and household machinery) and

117 (Electrical industrial machinery)

Studies on the technical capabilities of the engineering industries have been undertaken in the recent past. One of the more important of these studies is the report prepared by F.T. Moore and his team in 1980* in which the mission engineers visited a number of plants chosen in conjunction with the Industrial Service Division (ISD), of the Ministry of Industry. During the course of their visits, the engineers set up a standard guideline to help them evaluate the technical aspects of the plants. A seperate survey using a questionnaire on the economic and financial characteristics was also conducted.

Since the report prepared by Moore et al emphasized the engineering industries as a whole, and as the machinery industry

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* Moore, F.T., Development of the Engineering Industries in Thailand, World Bank, Report No. 2647-TH, May 1980.

has been chosen to undergo structural adjustment under a promotional programme embodied in the Fifth National Economic and Social Development Plan, it was deemed appropriate to carry out a more detailed study focusing on the machinery industry in Thailand.

Methodology of Obtaining Information

The method of collecting data is a personal (face-to-face) interview using a questionnaire and direct observation. The questionnaire consists of two parts; the first part covers technical aspects, and the second part deals with the economic and financial condition of the firms. Each part begins with identification data such as the name, address, phone number of the plants, etc.. The information sought in the technical part includes the products made, employees, training, machinery and manufacturing processes, quality control, production planning and control, working environment, materials handling, safety and maintenance. The information acquired in the economic and financial part includes products made, market share holding, orders obtained, competition, financial data, taxes, government policy, subcontracting system, problems encountered, exports, etc..

Direct observation was also carried out to supplement the personal interview, the manager normally guiding the interviewers to various sections of the plant. As the ability or the willingness of some managers to answer some questions accurately was doubtful, direct observation was often beneficial.

In addition to the procedure described in the previous paragraphs, the consultants also paid personal visits to some firms. These visits were undertaken to provide a control guideline with which to assess the overall view obtained from the questionnaire and also to discover whether there was any change in the condition of the firms since the previous studies.

In each plant visit, the data collection team was composed of two members: one interviewer who is an official with technical background from the Industrial Service Division (ISD); and was responsible for the technical part of the questionnaire; and one graduate with an economics background recruited by the IMC who was responsible for the economic and financial part. Altogether five teams were employed. In certain visits, a team was further accompanied by one or more engineering consultants.

The data collection teams visited about 70 plants. The selection of plants was agreed upon by the Industrial Services Division, the Industrial Management Co.,Ltd. and the consultants. Owing to limited time, and from previous experience, more than 85 per cent of the plants chosen were located in and around Bangkok, the remainder being typical plants in the provinces. The conditions in these plants were considered to be representative of the current state of the art in this industry. Foreign or joint-venture firms were omitted, except in special cases, as they normally have access to production know-how from their foreign counterparts. They do not, therefore, really need technical assistance from the government.

The assessment of the capabilities of the machinery industry was based on the judgement of the engineering consultants and on the results of the data analysis. As the engineering consultants were educated and trained in Western countries for a considerable period of time, their standards of evaluation of the capabilities should be quite similar to that of engineers from Western countries. As a significant number of owners/managers of the small and medium-sized plants in Thailand lack university education, misunderstanding of terminology was obviously possible. It is therefore essential that the interpretation of the questionnaire is not made purely on the basis of the results of the data processing. An example will illustrate this point. Forty-six percent of the respondents indicated that interchangeability applies to the majority of the parts made in their plants. What they really means was that the removal of metal of certain dimensions by a file may be necessary. Further interpretation by the consultants was needed to give an accurate picture.

It is important to note that the picture of the machinery industry to be presented is a generalisation and thus does not apply in each and every case. There are important variations in same aspects so that it is somewhat difficult to say that there is a model or representative plant in every case. The general picture presented is, however, considered to be broadly applicable in all cases.

It should be noted that the data obtained from the formal survey did not include the plants in the engine and turbine sector (I-O Code 112). This is because there are only two manufacturers in this sector and both have access to foreign technical know-how. Technical conditions and production practices in these plants are up to good international standard. It is therefore considered appropriate to describe very briefly the general characteristics of these two firms.

Since these two manufacturers are the only two engine producers in Thailand and have access to foreign expertise, there is no need for technical assistance at the moment. It is, however, advisable to offer some encouragement for them to initiate local research and development of their own.

Plant Layout and Material Handling

The layout or the physical arrangement of the production facilities (machine tools, materials handling equipment, etc.) in small and medium-sized plants in Thailand is poor in most cases. Generally the activities in these plants can be divided into two categories: production of component parts and assembly work. The layout of facilities to produce components will be discussed first. In small plants, virtually no effort or attention has been given to layout. Machine tools are normally located close to the walls and no consideration is given to which machines should be located close to each other. In other words, no attention is given to the flow of work. New machines are placed wherever space is available. In medium-sized plants, there are often

several machines of the same type and it is common practice to group the same types of machines together. In other words, the machines and work centres are grouped according to the function they performed. All the lathes will be sited in one section, as well the milling machines, drilling machines and shapers, etc. This type of plant layout is known as a process or functional or job shop layout. No attention is paid to the flow of the various components produced. No one appears to make use of even a simple device such as the travel chart to help determine the appropriate location of each functional department.

Fixed-position layout is normally found in the assembly of the products. This is because the products of the machinery industry are generally heavy and bulky and it is therefore not feasible to move the products. Normally a skilled worker, with the assistance of a few unskilled labourers, sets up the major part of the machine. Tools, equipment and other components are then brought to the job to perform the appropriate stages of buildup. Product layout or a combination of product layout and process layout are only found in a few of the larger plants. In product or line layout, machines or work centres are arranged in a line according to the sequence of operations to produce the product or part. In the plants visited, management did not seem to care much about balancing the line.

Gangways in many plants, especially the smaller ones are not marked and are full of obstructions. Often raw material and work in progress is stored in gangways simply because no specific

space is set aside for it. In other cases, such disorders are due to a deficiency or lack of production planning. In larger plants, especially those which use fork lift trucks, gangways are marked and free of obstruction. These plants are often equipped with store rooms-one for tools and measuring devices and another for materials. Work in process is often left in a container on the production floor.

A main cause of this poor plant layout is that most of these plants originated as small workshops. The owners are invariably machinists without formal training. Some larger plants hire industrial engineers but few assign them to solve plant layout problems. In some cases the rapid expansion of the firm's business creates a need for more space. As the plants are sited in more or less urban areas, it is difficult to acquire the land nearby. This results in a poor plant layout which creates an inefficient flow of work.

Common types of material handling equipment found in many plants are hand-operated transporting equipment and electric-powered hoists. A hoist is used to lift or lower objects suspended from a hook on the end of retractable chains or cables. It can be used for intermittent moves and varying loads. Hoists are primarily used for serving a machine tool or work place. The use of material handling equipment in the plants is due to necessity rather than the desire to increase productivity. Cases can be cited where higher efficiency could be attained if some appropriate material handling equipments were used in place of the current manual handling methods. Fork lift trucks are used

when the plant is large enough and/or production processes spread over several buildings. As long as labour remains comparatively inexpensive and the plant manager is not aware of the significance of the increase in productivity and the safety of their workers, manual methods will remain the primary means of material handling. (See Table 2.1)

The Working Environment

The working environment, which includes such factors as temperature, humidity, noise, and light, can produce marked effects on productivity as well as affecting health and safety. A review of this aspect is essential for a better understanding of the machinery industry.

Illumination requirements depend on the nature of the general work area under consideration and the specifics of the task being performed. The illumination problem may be considered as two seperate problems: general lighting and localized lighting. General lighting is the general uniform level of illumination provided throughout the plant area and is considered acceptable in approximately 90 per cent of the plants surveyed. (See Table 2.2). Localized lighting in these plants is, however, generally not adequate. Work stations or limited areas such as tool making and highly accurate machining require additional illumination but this is not generally provided.

Ventilation of the buildings is generally good. Most of the buildings were built with high roof and windows close to the

Table 2.1:METHODS OF MATERIAL HANDLING

Methods	I-O Code					Total
	113	114	115	116	117	
1. Manual handling	19 (73%)	11 (61%)	17 (85%)	-	3 (60%)	50 (69%)
2. Hand-operated transporting equipment	13 (50%)	12 (67%)	9 (45%)	3 (100%)	2 (40%)	39 (54%)
3. Trucks and Electric hoists	9 (35%)	10 (56%)	4 (20%)	-	3 (60%)	26 (36%)
4. Conveyors	2 (8%)	1 (6%)	-	-	-	3 (4%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

Table 2.2: QUALITY OF GENERAL LIGHTING

Level of Illumination	I-O Code					Total
	113	114	115	116	117	
1. Poor	3 (12%)	1 (6%)	1 (5%)	-	1 (20%)	6 (8%)
2. Good	23 (88%)	17 (94%)	19 (95%)	3 (100%)	4 (80%)	66 (92%)

Source: Survey

roof to cope with the very high temperatures in summer. Electric fans are provided for employee comfort by half of the plants but a large number of these fans lack protective guards. None of the plants surveyed uses air conditioning to control the temperature and relative humidity. A few plants in the agricultural machinery and equipment seem to pay little attention to this factor and it was found that the temperature and humidity in these plants was too high for workers to work effectively (See Table 2.3).

In the plants with a lot of hammering operations, the noise level is excessively high. Even though the noise effects on work performance such as output, errors and quality levels are not significant as the works performed do not required high accuracy, hearing loss due to such high noise exposure should be expected. There appears to have been no attempt to control noise and plant managers do not isolate the source of noise by constructing proper enclosures or by means of plant layout. No workers in these severe noise situations appear to be provided with or enforced to wear earplugs.

Machine Tools and Machine Shop Practice

The materials most commonly used in machining processes are simple carbon steel, cast iron and aluminium alloy. (See Table 2.4)

Seventy-three percent of the firms in agricultural machinery and equipment machine components which weigh between 6 and 100 kilogrammes. A significant portion of the plants in the wood and metal-working machines group (I-O Code 114) can machine

Table 2.3: QUALITY OF VENTILATION

Level of Ventilation	I-O Code					Total
	113	114	115	116	117	
1. Poor	3 (12%)	-	-	-	-	3 (4%)
2. Good	23 (88%)	18 (100%)	20 (100%)	3 (100%)	5 (100%)	69 (96%)

Source: Survey

Table 2.4:MATERIALS USED IN MACHINING PROCESSES

Material	I-O Code					Total
	113	114	115	116	117	
1. Carbon steel, Cast iron, Aluminium alloy	24 (92%)	14 (82%)	18 (90%)	1 (100%)	3 (100%)	60 (90%)
2. Hardened steel, Malleablecast iron	6 (23%)	7 (41%)	8 (40%)	- -	1 (33%)	22 (33%)
3. Stainless steel, Cast steel	1 (4%)	3 (18%)	7 (35%)	1 (100%)	1 (33%)	13 (19%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

components which weigh more than 1 ton. Most plants in special industrial machinery have the capacity to machine components which weigh more than 100 kilogrammes. (See Table 2.5)

Turning is the most commonly seen machining operation in Thailand. Center lathes of the gear box type can be found in virtually every plant. This is because most plants surveyed produce components and parts and do a limited quantity of final assembly. Capstan and turret lathes, and copy lathes were rarely found. Even add-on automatic gadgets which can turn a center lathe into a small-volume production machine are virtually nonexistent. (See Table 2.6). Most plants are equipped with simple standard vertical drilling machines and horizontal shapers. The most commonly found drilling machines are vertical fixed type. (See Table 2.7). Milling and boring machines are not often found in the agricultural machinery and equipment sector, and they are rare in a significant portion of plants in the wood and metal-working machines industry as well as in the special industrial machinery industry.

Pressworking or stamping includes a wide variety of chipless processes by which workpieces are shaped from metal sheets. Straight-blade shearing is a very common process found in the plants visited. It involves moving a knife or blade in opposition to a table or bed. Equally common are blanking and piercing processes. Blanking involves cutting flat sheet metal to the predetermined shape and size of the finished part. Piercing or punching is a process of cutting a shaped hole in a sheet

Table 2.5: WEIGHT OF WORK PIECE

Weight Range	I-O Code					Total
	113	114	115	116	117	
1. Less than 0.5 kg.	-	-	-	-	-	-
2. 0.6 - 5 kg.	3 (12%)	1 (6%)	-	-	-	4 (6%)
3. 6 - 100 kg.	19 (73%)	4 (24%)	2 (10%)	-	1 (33%)	26 (39%)
4. 101 - 1,000 kg.	3 (12%)	3 (18%)	8 (40%)	1 (100%)	2 (67%)	17 (25%)
5. More than 1,000 kg.	-	7 (41%)	8 (40%)	-	-	15 (22%)
6. No response	1 (4%)	2 (12%)	2 (10%)	-	-	5 (7%)

Source: Survey

Table 2.6: TYPES OF LATHE USED

Types of Lathe	I-O Code					Total
	113	114	115	116	117	
1. Gear box type	25 (96%)	16 (94%)	20 (100%)	1 (100%)	3 (100%)	65 (97%)
2. Belt driven	9 (35%)	2 (12%)	2 (10%)	1 (100%)	-	14 (21%)
3. Turret	1 (4%)	3 (18%)	1 (5%)	-	-	5 (7%)
4. With copying attachement	-	4 (24%)	-	-	-	4 (6%)
5. Automatic/Computer Controlled (NC)	2 (8%)	1 (6%)	-	-	-	3 (4%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

Table 2.7: TYPES OF DRILLING MACHINE USED

Types of Drilling Machines	I-O Code					Total
	113	114	115	116	117	
1. Standard Vertical	18	15	20	1	3	57
	(70%)	(88%)	(100%)	(100%)	(100%)	(85%)
2. Portable	15	9	13	1	1	39
	(58%)	(53%)	(65%)	(100%)	(33%)	(58%)
3. Multiple Heads	6	10	8	-	1	25
	(23%)	(59%)	(40%)		(33%)	(37%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

stock. Basically the two processes are similar except that in piercing the desired piece is the work metal and the slug that is cut out is the scrap whereas in blanking the desired outcome is not a hole, but is a trimmed or sized product.

Pressworking in the plants surveyed is done mainly on steel sheets (see Table 2.8). Most of the presses found are of the inertia cranking or fly wheel type (see Table 2.9). Few presses in these plants are of over 300 tons capacity (See Table 2.10). The feeding of material in most cases is done manually (see Table 2.11). Slightly more than half of these plants make use of sheet metal with thickness not more than 5 millimetres. (See Table 2.12)

Bending is another common metal forming process of presswork consisting of uniformly straining flat sheets or strips of metal around a linear axis. The shape that is formed on the metal sheet or strip depends on the shape of the punch and die used to produce the workpiece. Other pressworking processes such as deep drawing or spin forming exist in a few factories. Their products include kitchen utensils such as stainless and aluminium cups, kettles, pots and dishes. There are only a few small plants which produce such parts as radiator cowlings and the like.

Generally medium-sized plants in machinery industry possess a powered press operated as a straight-blade shearing machine and another as a bending machine. In small factories, either several small piercing or blanking machines can be seen. Most of these new small presses are generally made to order by

Table 2.8: TYPES OF MATERIAL PRESSED

Materials	I-O Code					Total
	113	114	115	116	117	
1. Steel	14 (100%)	4 (100%)	1 (100%)	-	1 (33%)	20 (87%)
2. Other materials	-	-	-	1 (100%)	2 (67%)	3 (13%)

Source: Survey

Table 2.9: TYPES OF PRESS

Types of press	I-O Code					Total
	113	114	115	116	117	
1. Two column or friction	-	-	1 (100%)	-		1 (4 %)
2. Fly wheel	13 (93%)	4 (100%)	-	1 (100%)	2 (67%)	20 (87%)
3. Preumatic/Hydraulic	2 (14%)	-	1 (100%)	1 (100%)	2 (67%)	6 (26%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

Table 2.10: CAPACITY OF THE LARGEST PRESS IN A PLANT

Capacity range	I-O Code					Total
	113	114	115	116	117	
1. Less than 10 tons	3 (22%)	1 (25%)	-	-	-	4 (17%)
2. 10 - 50 tons	7 (50%)	1 (25%)	-	-	-	8 (35%)
3. 51 - 100 tons	2 (14%)	1 (25%)	1 (100%)	-	1 (33%)	5 (22%)
4. 101 - 300 tons	1 (7%)	1 (25%)	-	1 (100%)	1 (33%)	4 (17%)
5. More than 300 tons	1 (7%)	-	-	-	1 (33%)	2 (9%)

Source: Survey

Table 2.11: MATERIAL FEEDING METHOD TO A PRESS

Methods	I-O Code					Total
	113	114	115	116	117	
1. Manually	14 (100%)	4 (100%)	1 (100%)	1 (100%)	2 (67%)	22 (96%)
2. Semi - automatic	-	-	-	-	1 (33%)	1 (4%)
3. Automatic	-	-	-	-	-	-

Source: Survey

Table 2.12: THICKNESS OF SHEET METAL PRESSED

Thickness of sheet metal	I-O Code					Total
	113	114	115	116	117	
1. Less than 1 mm.	-	-	-	-	-	-
2. 1 - 2 mm.	2 (14%)	1 (25%)	1 (100%)	-	1 (33%)	5 (22%)
3. 2 - 5 mm.	3 (22%)	2 (50%)	-	1 (100%)	1 (33%)	7 (30%)
4. More than 5 mm.	9 (64%)	1 (25%)	-	-	-	10 (44%)
5. No response	-	-	-	-	1 (33%)	1 (4%)

Source: Survey

local machine shops.

Welding is the process of permanently joining two or more pieces of material together by the application of heat, pressure or both. While there are over 40 seperate welding processes in the world, only a few processes are industrially important. Three types of welding processes are commonly found in the plants surveyed. They are arc welding process, oxyacetylene gas welding and spot welding. (see Table 2.13) However oxy-liquid petroleum gas welding and cutting is being well accepted in several factories visited by the consultants after the formal survey. This is partly due to the promotional campaign of the LPG uses to the industry in response to the local natural gas seperation plant becoming operative at the end of 1984.

Sawing operations are performed primarily for cutting material to length for use as workpieces or blanks in other machining or forming processes. Reciprocating sawing machines or power hacksaws are found in virtually all the plants visited. Circular sawing machine and band sawing machine are more common in wood working factories.

Casting is the process of producing objects by filling a mold cavity by gravity or pressure with molten metal and allowing it to cool and solidify. Heat treatment is the process of changing or modifying the properties of a material by controlled heating and cooling. Both processes are important in engineering industries. However most of the plants surveyed have the components cast and/or heat treated by subcontractors.

Table 2.13: TYPES OF WELDING PROCESS

Welding processes	I-O Code					Total
	113	114	115	116	117	
1. Arc welding	24 (100%)	13 (100%)	11 (92%)	2 (100%)	3 (100%)	53 (98%)
2. Oxyacetylene welding	18 (75%)	9 (69%)	11 (92%)	2 (100%)	1 (33%)	41 (76%)
3. Spot welding	5 (21%)	4 (31%)	4 (33%)	-	2 (67%)	15 (28%)
4. Other processes	1 (4%)	-	2 (17%)	-	1 (33%)	4 (7%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

The use of jigs and fixtures is not common in machine shops. A jig is a device that holds the work in position and guides the cutting tool. A fixture is a device for holding work in a machine tool although it does not guide the cutting tool. In Thailand, the term "jig" is used to mean either of the two. In rough work and structural steel construction, rudimentary fixtures are sometimes used. The absence of jigs and fixtures means that marking out and measurement of the work piece is needed and more skilled workers are required. As there is a shortage of skilled workers in engineering industries, the quality and repeatability of products are often doubtful which is unfortunately often not taken note of by the owners themselves.

Many of the machine tools found are out of date and in poor condition. It could be safely estimated that more than half of the machine tools used in Thailand are second-hand machines which have been imported. Most owners of the plants have no knowledge of proper acceptance tests. They measure the accuracy of the machines in the way that they think appropriate and have no fixed accuracy standards to go by. Worn spindles and bearings as well as worn slideways and machine beds are found on many machine tools in use. All these factors make it difficult to achieve accuracy and a good quality finish on the work piece.

Thai industry generally uses the metric system of measurement. The measuring instruments most widely used are vernier calipers and calipers. (See Table 2.14) A vernier caliper is a direct measuring instrument consisting of a graduated beam

Table 2.14 : MEASURING INSTRUMENTS USED

Types of Instrument	I-O Code					Total
	113	114	115	116	117	
1. Vernier caliper	25 (96%)	17 (94%)	20 (100%)	2 (67%)	3 (60%)	67 (93%)
2. Caliper	23 (88%)	16 (89%)	18 (90%)	1 (33%)	3 (60%)	61 (85%)
3. Steel rule	23 (88%)	9 (50%)	12 (60%)	1 (33%)	3 (60%)	48 (67%)	
4. Micrometer	8 (31%)	13 (72%)	20 (100%)	3 (100%)	3 (60%)	47 (65%)
5. Slip gauge	-	-	2 (10%)	-	-	2 (3%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

and stationary jaw, on which slides the moving jaw complete with vernier scale. It can achieve outside, inside and depth measurement. In certain plants visited, a dial reading device has been attached to it to increase the ease of reading the measurement with no loss of accuracy. A caliper is an indirect measuring instrument consisting of two legs. It is used to pick off a diameter or a distance from a piece of work. This setting can then be measured with a direct reading instrument such as a scale, a vernier caliper or a micrometer. Micrometers are rarely used in agricultural machinery and equipment industry. In the special industrial machinery and the electrical industrial machinery industries, micrometers are reported to be widely used. But experience suggests that they are used only by a few people for certain measurements.

Slip gauges or gauge blocks are accepted all over the world as standards of accuracy for all types of manufacturing. They are manufactured from a special high grade carbon steel hardened throughout and processed to relieve all stresses. They are then lapped to a superfine finish and measured by interferometry and selectively graded into sets. In a few plants visited where they were seen, it appeared that they were rarely used. The use and care of slip gauges in these plants needs to be improved.

In virtually all the plants visited, gauging was not seen even when certain individual parts were manufactured in large number. Gauging differs somewhat from measuring. Measuring require the skillful use of precision measuring tools to

determine the exact size of the piece; whereas, gauging simply shows whether the piece is made within the specified tolerances. The concept of tolerances is not well known among the machine operators not even among the owners of most small and medium-sized plants.

According to the survey, approximately 90 per cent of the plants use high speed steel tools. (See Table 2.15). The majority use tip tools although very few make use of throw-away tips. In industrialized countries, throw-away carbide tools are very common. These tools are harder and can take larger cuts. They can be used at higher cutting speeds and do not require regrinding. The re-sharpening of tools found in the survey is done on redistal grinders and the machine operators have little knowledge of the correct tool angles.

Approximately three quarters of the plants surveyed reported that they assigned an operator to do a job by showing a copy of the components to be produced, by a sketch or by explaining verbally (See Table 2.16). This indicates that there is a lack of engineering drawing knowledge in the machine shops. An engineering drawing is used to tell a craftsman what to make and how to make it. Standard symbols, lines and special figures are employed to give meaning to a drawing. In a good engineering drawing, necessary dimensions in proper relation, the materials to be used, the surface finish required, the tolerances to be allowed and the quantity of units should be clearly indicated. However, as the majority of machine operators in Thailand

Table 2.15 : CUTTING TOOL MATERIALS

Types of Material	I-O Code					Total
	113	114	115	116	117	
1. High speed steel	23 (88%)	16 (94%)	17 (85%)	1 (100%)	3 (100%)	60 (90%)
2. Reusable tip tool	24 (92%)	14 (82%)	13 (65%)	1 (100%)	1 (33%)	53 (79%)
3. Throw-away tip tool	-	4 (24%)	2 (10%)	-	-	6 (9%)
4. High carbon steel	-	1 (6%)	3 (15%)	-	1 (33%)	5 (7%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survev

Table 2.16 : MEANS OF COMMUNICATION WITH MACHINE OPERATORS ON PRODUCTION DETAILS

Means of Communications	I-O Code					Total
	113	114	115	116	117	
1. Example of component, sketch	21 (81%)	14 (78%)	14 (70%)	3 (100%)	3 (60%)	55 (76%)
2. Simple drawing (with component dimensions only)	13 (50%)	13 (72%)	13 (65%)	-	2 (40%)	41 (57%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

finished only primary school and are not fully trained in many aspects of machine shop practices by a good machinist, communication by using an engineering drawing is virtually impossible. Moreover, the owners of many small and medium - sized plants also lack technical or tertiary education and many of them do not understand an engineering drawing themselves.

Electric discharge machining (EDM) and the numerical control (N/C) process were found in a few plants visited. Electric discharge machining removes metal by the process of controlled spark erosion. It can be used to machine cavities or intricate configurations in very hard materials. It is therefore very useful for machining blind cavities in dies used in die casting, stamping, forging and injection molding. Since it does not set up the high cutting forces and mechanical strains often associated with conventional machining, the process is well suited for cutting tubing, honeycomb, and other thin-wall, fragile structures. Numerical control (N/C) is a technique for automatically controlling machine tools, equipment or processes. An estimate reveals that there are over 40,000 numerically controlled devices presently in use in the United States. This total does not include any N/C machines and equipment installed in plants outside the metal working industries. There are probably hundreds of N/C machines and devices in Thailand. The application of N/C operations can be found in turning, boring, drilling, milling, cutter grinding and machining centres. These machines require skilled setters which are rarely available in Thailand. Another problem is the servicing of these machines. The

service personnel lack formal training of the electro-mechanical nature. It is therefore not surprising to see a number of these machines laying idle much of the time due to the absence of skilled setters and/or service personnel.

Maintenance

The ability of a plant to operate at optimum efficiency depends to a large extent on the ability of the maintenance function to provide services at the time required and in an efficient manner. As equipment becomes more complex and gets older, the importance of this function increases. Unfortunately it is one of the most neglected aspects found in the plants surveyed. They rarely follow the advice given in the instruction manuals accompanying the equipment (See Table 2.17). Records of breakdowns of the machines and equipment are not kept. It is therefore difficult to determine whether or not it is economical to anticipate a breakdown and replace the critical components before they fail or simply wait and let it happen, replacing the component at that time. Normal practice in Thailand is to replace the component at the time of the breakdown.

Major causes of machine breakdowns in these plants include the lack of proper lubrication and the misuses of the machines. The reason for the former is that machine operators are not well educated and normally no specific operators are assigned to lubricate the various machines in the shop. A formal maintenance crew does not really exist. In the case of the misuses of the machines, often the owners of the plants overuse their equipment. This is because a large number of the owners of

Table 2.17 : MAINTENANCE PRACTICES

Methods Used	I-O Code					Total
	113	114	115	116	117	
1. When breakdown occurs	22 (85%)	15 (83%)	12 (60%)	3 (100%)	1 (20%)	53 (74%)
2. As convenient	9 (35%)	7 (39%)	4 (20%)	1 (33%)	2 (40%)	23 (32%)	
3. Arbitrarily set routine schedule	4 (15%)	3 (17%)	8 (40%)	-	2 (40%)	17 (24%)
4. As suggested in instruction manual	1 (4%)	-	-	-	1 (20%)	2 (3%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.

Source: Survey

small and medium size plants lack capital and cannot afford to buy different machines to perform various functions. The machines available are therefore used in certain operations eventhough they are not really designed to perform them. More often is the case that the local suppliers exaggerate the capacity of their machines. For instance, a shearing machine may be designed to cut steel plate of no more than a certain thickness. When asked if the shearing machine could cut a thicker steel plate, the supplier, for fear of the loss of sales, tends to give a "yes" answer.

A significant percentage of the machines are old or second hand. In most plants, machines of various countries are found. Some machine tools were built by the work shops themselves. These result in great diversity of machines of the same type and the same capacity being present in any one plant. Every breakdown becomes unique because the parts are not always interchangeable or the control logic is different, and since skilled maintenance crew are in limited supply, it is therefore difficult to achieve speedy repairs.

Labour Use and Productivity

The majority of the work force in small and medium industrial enterprises in Thailand is either unskilled or semi-skilled. Most plants employ young men with primary education. The most apparent reason is that these young men accept low wages because they want to learn the trade. Usually they begin with general cleaning of the work shop and tools. Later they serve as

helpers to more experienced workers and in return they are taught the trade. In a number of plants, especially those in electrical industrial machinery and appliances industry (I-O Code 117) new workers are assigned to work under and are taught by a foreman (See Table 2.18). After a few years of such in-service training, they became semi-skilled workers. Most of their work is routine-operating machines and equipment and/or assembling the various manufactured parts into a single final product. They also inspect and test the manufactured items to determine whether the items operate satisfactorily. There is little chance for these people becoming skilled workers without additional study and proper training.

Less than ten percent of the plants surveyed employ young men with formal vocational education but with limited experience (See Table 2.19). The owners of the plants suggested that these young people could perform no technical work without one or two years of practical training in the work shop, and yet they demanded high wages at the outset. More often than not, these vocational school graduates do not mix well with those who finish only primary school. In one plant visited, the owner finished only part of the secondary school and was in wood working industry before settingup the plant to produce an industrial machine. He refuses to employ vocational school graduates on the reason that some of them talked to him unpleasantly on technical matters. Vocational school graduates tend to leave small and medium-sized plants to join large companies after gaining practical experience. The reason

Table 2.18: TRAINING OF UNSKILLED WORKERS

Training practice	I-O Code					Total
	113	114	115	116	117	
1. By more experienced workers	15 (58%)	16 (89%)	16 (80%)	2 (67%)	2 (40%)	51 (71%)
2. By foremen	13 (50%)	8 (44%)	8 (40%)	1 (33%)	4 (80%)	34 (47%)
3. By engineers	-	-	3 (15%)	-	-	3 (4%)

Note: As more than one choice can be applicable to any one plant, the total tmay exceed 100 per cent

Source: Survey

Table 2.19 TRAINING BACKGROUND OF MACHINE OPERATORS

State of formal training	I-O Code					Total
	113	114	115	116	117	
1. With vocational school certificate	2 (8%)	3 (17%)	1 (5%)	-	-	6 (8%)
2. Without vocational school certificate	24 (92%)	15 (83%)	19 (95%)	3 (100%)	5 (100%)	66 (92%)

Source: Survey

frequently given is better wages and fringe benefits. Other reasons include better working environment and the pride of belonging to a large and well known company.

Most of the companies surveyed do not send their work force for further training in training centers provided by the government such as the ISD (See Table 2.20). Some plants in electrical industrial machinery and appliances industry and a few in special industrial machinery industry send some of their employees to be trained in the parent company or in the partner of the joint venture company in foreign countries. The training is in technical field. A reason for not sending the workers to be trained in technical training centers is that after training, these workers tend to leave the work shop to seek a better paid job. In some plants, the owners with considerable technical experience deliberately avoid teaching more advanced skill or know-how to their employees for fear that the employees may go to work in other competing plants for higher wages or leave the workshop and become competitors themselves.

Foreign visitors often have the impression that Thai work force appear well disciplined and are willing to work. This impression could be due to the fact that the visitors were guided around the plant by the owner. Seeing that the owner is coming, it is natural that the workers would do their jobs industriously. The discussions with various owners of the plants revealed that the work force required constant supervision. Some owners complained that some of their workers were sleepy because they took another job in the evening. Some enjoy going out and take

Table 2.20: PROVISION OF EXTERNAL TRAINING FOR MACHINE OPERATORS BY EMPLOYERS

Provision of External Training	I-O Code					Total
	113	114	115	116	117	
1. Yes	2 (8%)	1 (6%)	4 (20%)	-	2 (40%)	9 (13%)
2. No	24 (92%)	17 (94%)	16 (80%)	3 (100%)	3 (60%)	63 (87%)

Source: Survey

alchoholic drinks. Without sufficient rest in the evening, they tend to be sleepy during the normal working hours and this sametimes results in accidents.

No one seems to dispute that lagging productivity is a serious problem in Thailand. The shortcomings of labour are part of this problem. Many cases were seen where a few workers operate a machine designed for single operator. In most plants, the use of the human hands and body, and the use of tools are inefficient. There are many non-productive parts of the work such as handling and delays. The application of principles of motion economy and process analysis can improve productivity.

Industrial safety needs to get more attention in Thailand (See Table 2.21). Industrial accidents result in direct and indirect costs. Direct costs include medical expenses and worker's disability compensation as provided for by laws. Indirect costs represent the money value of damaged equipment and materials, production delays and time losses of other workers not involved in the accidents. In most plants, lack of sufficient safety precautions and devices for operator protection is evident (See Table 2.22). Very few shield guards are used to eliminate the possibility of accidental contact with the moving parts such as fans, belt and pulley, gear mechanisms, etc. The handling of large and heavy parts by crane and fork lift truck are sometimes carried out in careless manner. The lack of protective footware is prevalent. Most workers including many owners of the plants wear sandals while they are working in the workshops. Some owners

Table 2.21: EXISTENCE OF FORMAL SAFETY PERSONNEL

Seperate Safety Personnel	I-O Code					Total
	113	114	115	116	117	
1. Yes	8 (31%)	1 (6%)	-	-	3 (60%)	12 (17%)
2. No	18 (69%)	17 (94%)	20 (100%)	3 (100%)	2 (40%)	60 (83%)

Source: Survey

Table 2.22: TYPES OF PROTECTIVE EQUIPMENT AVAILABLE

Types	I-O Code					Total
	113	114	115	116	117	
1. Simple devices such as partitions	20 (77%)	2 (25%)	1 (11%)	-	2 (67%)	25 (51%)
2. Personal protective gear such as gloves, goggles, etc.	8 (31%)	7 (88%)	8 (39%)	3 (100%)	2 (67%)	28 (57%)

Note: As more than one choice can be applicable to any one plant, the total tally may exceed 100 per cent.
Not enough protective equipment is usually available and enforced wage is rare.

Source: Survey

of the plants visited indicated that they prefer not to have a safety device fitted to their machines such as power presses because their workers could work faster and they could reduce the waste better.

Improvement of safety in these plants is essential to raise productivity and morale of employees. Educational activities for accident control, safety standards legislation and enforcement are required to ensure an improvement of safety in Thai plants.

Product Quality

The quality of the products produced by small and medium size plants for local markets tend to be lower than international standards. The prices of these products are significantly, sometimes three to five times, lower than those imported brand new from industrialized countries. A large number of local manufacturers purchase new machines from industrialized countries for large volume production or for higher quality products. When accuracy in machining is not an important factor or when a small volume of products are required to test the market, Thai manufacturers have the tendency to buy locally made machines.

The quality of many machines produced in Thailand compare favourably with those imported in the first two to four years. After this period, the performance of these machines drops signicantly. However, certain Thai manufacturers do not accept this view. They argue that as their machines cost much less than

those imported, the users tend to pay less attention to their machines. As a consequence, the wear and tear of their machines is faster.

A simple check of quality of the products exists in the majority of the plants surveyed. Some inspection and testing are made when purchased parts are received or components are produced. The finished products are normally tested to see whether they function. If a shear press is designed to cut a steel plate of 0.5 cm. thick, the manufacturers will feed a steel plate of that thickness to and press the button. If the plate is cut, then the machine is accepted.

Statistical quality control, in the strict sense, rarely exists in Thai plants. The finished products of many plants are 100 per cent inspected. Some of the purchased parts and manufactured components are often chosen for inspection. However no random number or procedure to determine randomness were observed during the plants visits. The sample size and the acceptance number (the maximum allowable number of defectives) are arbitrarily established. It is therefore not possible to give definite assurance that the average outgoing quality will not exceed certain limits.

Engineering Design, Research and Development

Engineering design in a strict sense is not well developed in the plants surveyed. In most small firms, the designs are virtually direct copies of foreign machines. The modification frequently found is that these firms tend to use

larger shafts, thicker materials, etc. They fear that using identical dimensions as the foreign machines will result in failure. In larger firms, even though copy is the norm, technical considerations of performance are well understood. In certain firms, a new product can be designed and produced to meet a customer's specification.

When approached by a customer to produce a really new machine which the plant manager knows nothing about, some will ask an academician to do a research and design the machine for him. The plant manager will then go on to build the machine for the customer.

Management Systems

Management systems include forecasting, production planning and control, inventory control and management information system. This is perhaps the weakest part of the management capabilities of the plants surveyed.

In any production system, it is essential to consider future events that might be critical to operations. Most of the plants surveyed are concern with customer demand for their products but not many can estimate the orders accurately. Very few plants keep past data in a systematic way and no one seems to adopt a formal forecasting procedure. Those who forecast adopt the intuitive approach which is based on experience. It is essentially a summary of a manager's guesses, hunches and judgements concerning future events.

Production planning and control of most of the plants surveyed are based an intuitive or informal approach. In general the overall production rate and the overall number of workers to be employed during each month are not established. On receipt of an order for products, the plant manager decides when work is to be done. He then assigns the job to a machine operator and may explain to him how to do it. No schedule of production is formally prepared. As long as the operator works and finishes the job in a reasonable length of time, the owner is satisfied.

Even though some plant managers of the plants visited suggested that they were conscious of the cost of their products, cost control procedures were not observed. One critical cost of operations is investment in raw materials, work-in-process, and finished products not yet shipped. If this investment is excessive, the results are high capital costs, high operating costs, and decreased production efficiency when too much space is used for inventory. Most plants have no plan specifying desired levels for inventory. They tend to carry too much or too little inventory.

III. DEVELOPMENT STRATEGY

In formulating the development strategy for the machinery industry, the importance of this industry to the rest of the economy must first be realized. The high degree of dependence of the Thai economy on imports can be largely explained by the dependence on imported machinery and their components and parts as well as on the technology associated with the production and applications of this machinery. Without greater effort to reduce the import dependence of the machinery sector, the country's development opportunities will (indefinitely) remain highly dependent on foreign supply of production technology, machinery and equipment.

The machinery industry is technology intensive, and sometimes requires large scale investment and high capital intensity. Promotion of the development of this industry thus requires extra effort to overcome the difficulty and complexity involved with it. The extra effort should be expected to be paid off in terms of greater self reliance, productivity increase as a result of the development of machinery that are more compatible with domestic conditions, and the technology spill over effect from machinery production. The basic strategy for the machinery industry should thus be the adoption of this industry as one of the top priority sectors. The development of the machinery industry should be aided by various supportive measures to be discussed below.

Technology Promotion

Manpower Supply. Over 1978 to 1982, the number of engineering graduates from Thai universities averaged about 2000 per year. Graduates from technical schools in 1982 numbered 11,973 for diploma level and 33,745 for vocational level. Acute shortage of university engineering graduates is in the fields of production engineering and metalurgy. Graduates from technical vocational schools generally lack practical skills. Only large enterprises find it worthwhile to employ these graduates and are able to provide them with on the job training. Small firms generally prefer to hire workers with low level of formal education as they are dissatisfied with the practical skills of vocational school graduates. The owner-managers of these firms themselves mostly have low educational level and cannot appreciate the values of sophisticated technology.

Training and Extension. Major institutions which contribute significantly to upgrade technical skills of workers are the Industrial Services Division (ISD), Thailand's Management and Productivity Development Centre (TMPDC) and the Technology Promotion Association (TPA Thai-Japan). In 1983, the ISD offerred 32 training courses relating to engineering industries, involving 1,177 trainees and 3,142 man-days. In the same year, the TPA offerred 84 courses to 8,355 workers with the total man-days of 11,230 and the TMPDC provided 14,000 man-days of training. The courses offerred by the ISD and the TPA are generally in basic technical skills while the TMPDC is specialized in managerial

courses.

The TPA is funded by aid from the Japanese Government. In 1983, it had 15 million baht of revenues, consisting of 7 million baht from the Japanese grant and 8 million baht which was earned from its operation. The ISD is the key agency of the Thai Government for industrial extension. However, its activities are constrained by small amount of budget and inadequate staff. In 1983, it obtained the annual budget of 15 million baht. Its staff of 39 persons is not only too small to cope with the industry's needs, but the good ones have constantly been bid away by the private firms who are willing to pay much higher salary than the government. The manpower development of the agency itself has thus been plaqued by high turnover rate.

R&D and Consultancy. Industrial research and development in Thailand are mostly confined to a few institutions such as universities, the Thailand Institute of Scientific and Technological Research (TISTR) and a few other government agencies. The R&D budget of the country in 1982 represented only about 0.39% of GDP which is extremely low. The survey of TISTR revealed that in 1982, large scale enterprises allocated only about 0.11% of their sales to R&D. For small enterprises, their R&D budgets are virtually nonexistent. This situation is readily understandable since Thailand is still in the phase of producing products for import substitute, and manufacturers almost invariably utilise imported production know-how or directly copy the imported machines. On the product designs, they are also

normally the copy of the imported ones. Even among the large scale enterprises, they widely adopt the notion that importing complete technical production know-how is the only sure means of producing the required product and this is with a high degree of truth. But it is also a sure way of preventing any chance of developing local know-how. At present the majority of local development work in the engineering industry sector is in the form of some modification of existing production machinery.

TISTR is the only institution which is officially recognized as the major agency actively involves in R&D and provide engineering consultancy services. However, the strength of manpower in R&D and consultancy is presently concentrated in universities but their activities are not adequately encouraged. University professors are even discouraged from taking commissioned R&D from or providing consultancy to private firms.

Recommendations

Manpower Supply

One of the most serious problems in the engineering industries in Thailand is the lack of educated personnel in the small enterprises. This problem is the main source of poor operating practices generally observed in most of the small plants and also the major obstacle to any technical improvement. Part of the reasons for the absence of educated technical personnel in these plants is the lack of formal tertiary education of the owner-managers of the firms. Their decision on

hiring workers seems to be based mainly on the worker's skills which are judged by their own standards of practices. The lack of formal education is also a major constraint for these entreprenuers to adopt sophisticated concepts and sometimes is the source of conflicts between them and the well educated employees.

The resistance of the entreprenuers to hiring technical school's graduates would be greatly reduced if they are satisfied with the skills at work of the latter. Graduates from the technical schools with strong skill training such as the KMIT-North Bangkok and Don Bosgo are well accepted by industry. Once the ability of a graduate is accepted, there is a good potential that he can later on apply the more advanced concept to the plant's operation. The mismatching problem of the firms' requirements and the technical schools' supply of manpower should be corrected not only to solve the unemployment problem for technical school graduates and the waste of resources in providing technical education, but also to equip the plant with knowlegeable personnel who can put modern concepts of engineering into practice.

Since a good example of the venue to producing technical and vocational industrial skilled workers has been shown by the result of the KMIT-North Bangkok and the vocational school Don Bosco, it is logical to look more closely at the operations of both institutes and have these good practices duplicated in other similar training programmes. From a personal interview, the direct expenses, excluding overhead cost, salaries

and depreciations of equipment, for KMIT-North Bangkok and the Don Bosco school, appeared to be about the same, that is, approximately 20,000 baht per head for a technical student. The same type of interview conducted with the fully government run technical institutes and vocational schools showed that the expense allocated by the government is approximately 1,000 baht per head on materials. Taking other expenses such as equipment repair and utilities into account, the figure works out to approximately 4,000 baht per head. On the actual skill training time, KMIT and Don Bosco claimed that a student received 24 to 35 hours per week and this represents 95-100 per cent of targetted number of hours for each semester. By way of comparison the figure for Bangkok Technical Institute which can be taken as a typical fully government run institute is approximately 14 hours per week and this is 80-90 per cent of the targetted number of hours for each semester. All of the said training institutes earn extra money by working for outside orders. Both KMIT-North Bangkok and Don Bosco claimed that they could not fulfil the demand for their services. Other reasons for the poor performance of other training institutes both the fully government run and the privately owned include the lack of quality on the part of the staff and/or the prevailing working situation whereby many of the instructors have to work double shift to accommodate the number of graduates allocated by the government or the owner of private schools. Another reason for working double shift is also for earning more money. The consequences of all these factors, i.e. the under budgetted

direct expenses, the low quality instructors, the overworked situation and the low number of training time all add up to the poor showing of the graduates from these institutes.

The recommendation here is for the government to up-grade by stages technical and vocational institutes along the line of the KMIT-North Bangkok and Don Bosco. The government should be prepared to upgrade the equipment and staff of a few institutes a year to the same level of the KMIT-North Bangkok and Don Bosco. There is nothing wrong with exactly duplicating both the equipment and the training programmes. The government should also be prepared to spend the same amount of money for these training programmes and graduate quality should be more important than quantity which means nothing if it only adds up unemployment figures.

For the university level of education and training, engineers graduated from Thai universities are on the whole fully competent in the basic scientific and engineering concepts. What is lacking most is the knowledge in production engineering. It would be appropriate to sum up that the engineers trained from the universities are competent enough to design machine elements but lack knowledge of the elements of machine design. Areas which should be given more attention during their professional trainings concerning the engineering industry are:

(a) appreciation of production drawings including type of material, dimensional accuracy and testing standards; etc.;

etc.;

(b) good basic knowledge of metrology, machine tools, jigs and fixture principles;

(c) sound basic knowledge of metallurgy essential for foundry work, heat treatment and welding.

Multi-disciplinary engineering courses of electro-mechanical control and numerical control nature should also be set up in anticipation of modern complex machinery systems. These courses can be offered ir the form of package programme of further study for engineers or as basic courses for engineering students. It might also be the appropriate time to reconsider a change for the system of present education whereby engineering students are channelled into specialized field from the very beginning to a more general form of engineering training in the first two years of education.

Training and Extension

The ISD is the main extension arm of the government to assist the development of the technical capability of small and medium firms in the machinery and other engineering industries. At present, the ISD's capacity is still limited to a small proportion of firms in and around Bangkok. The limitations of the ISD are due to several reasons such as inflexibility of being a part of bureacratic system, limited amount of budget, and high turnover rate of its staff. The agency has recently proposed a scheme to reorganize its Technical Operation Subdivision to

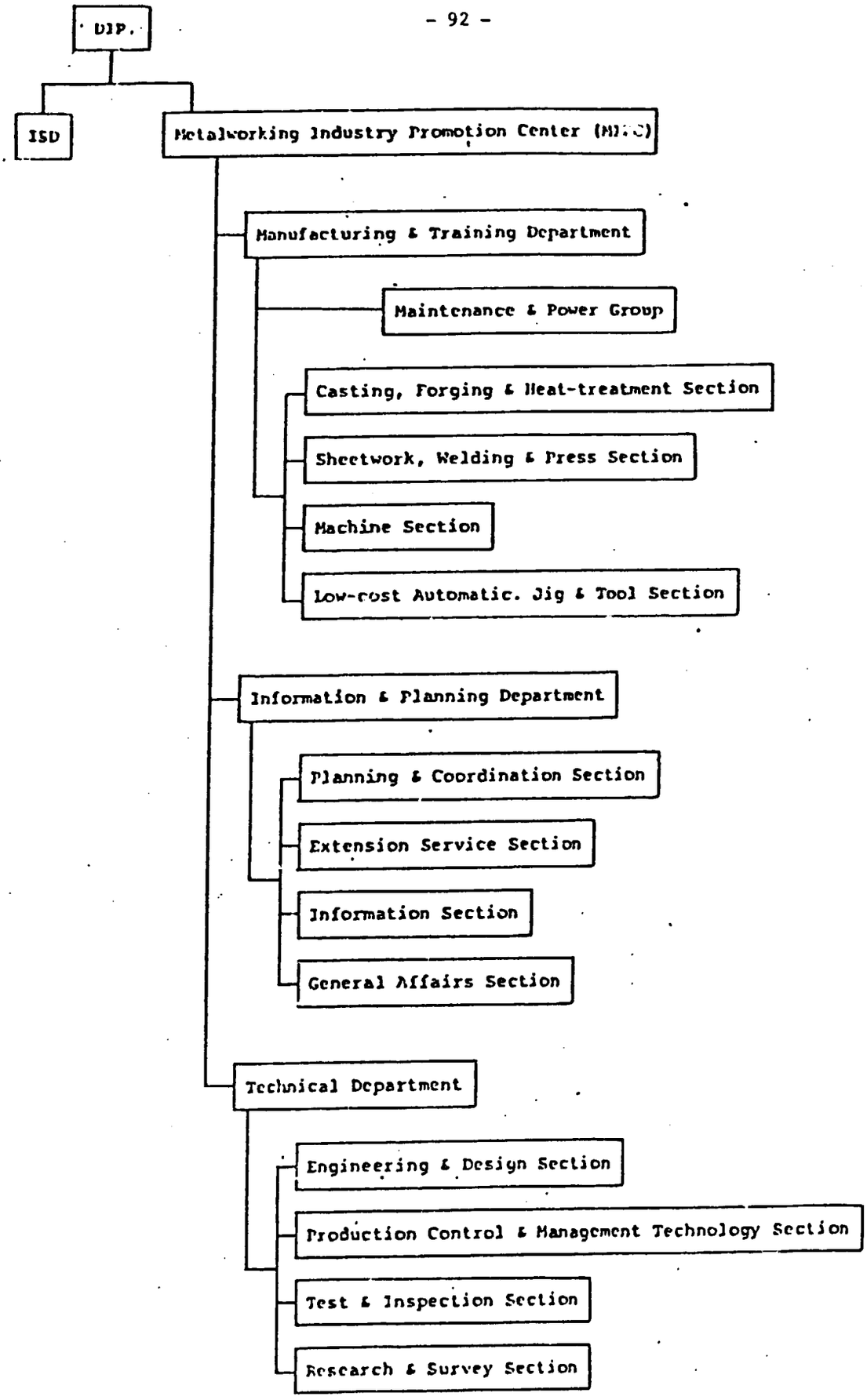


Figure 1 : ORGANIZATION STRUCTURE OF MIPC AS PROPOSED BY THE DEPARTMENT OF INDUSTRIAL PROMOTION

Table 3.1: FUNCTION AND ROLE OF NIPC

Purpose	Function and Roles by Time Elapse		
	PHASE-1 (Founding-3rd Year)	PHASE-2 (4th Year-6th Year)	PHASE-3 (7th Year-10th Year)
(1) Training and Education of Personnel	Symposium (for enterpriser, top-managements) Seminar (for middle managements) Workshop, training course (for patrol instructors, middle managements)	Symposium (for middle managements) Seminar (for patrol instructors, middle managements) Workshop, training course (for field foremen, etc.)	Symposium (for patrol instructors, middle managements) Seminar (for field foremen) Workshop, training course (for skilled workers)
(2) Transmission and Spread of Information	Patrol guidance (short period), Issue of circular (at three months interval)	Patrol guidance (short/middle period), Diagnosis of enterprises (short period), Issue of circular (at one month interval), Transfer and interchange of engineering (within Thailand)	Patrol guidance- (short/long period), Diagnosis of enterprises (short/middle period), Statistic/publishing, Transfer and interchange of engineering (within ASEAN territory)
(3) Introduction and Improvement of Engineering	Production control (process, quality, cost, etc.) Design engineering Test and Inspection Working under consignment and trial manufacture	same as left, and management engineering	same as left, plus market research, feasibility study, development
(4) Planning and Adjustment	Organizing Fields, etc.	Promotion of high precision metal-working, specializing of enterprises, and promotion of special metal working	Standardization, approval of type, development of qualification and certification system

become the Metalworking Industry Promotion Center (MIPC) which will provide expanded services to the metalworking industries. The activities of the MIPC have been programmed into 3 phases covering the period of 10 years as shown in table 3.1. This proposal can be viewed as a modest step to mitigate the limitations of the present organizational structure. With more fully equipped facilities and bigger staff as proposed, it is expected that the MIPC will make greater contribution to the industries. It is also recommended that the MIPC should be allowed to retain its earnings to finance its operations more flexibly. This arrangement would make the MIPC less dependent on government budget and be more imaginative in marketing its services.

The services provided by the MIPC will be concentrated in small and medium enterprises. To cater for the demand of larger firms for consultancy and manpower training, another institution should be independently created. Unlike the EIDI which must rely on government budget to support its activities, the other institution to be referred to as the Engineering Consultancy Centre (ECC) can be made financially self-sufficient as the large enterprises have the ability to pay for its services. The ECC should thus be modeled as a semi-public agency like the IFCT or established as a branch of the IFCT.

The main purpose for establishing the ECC is to supply engineering services currently unavailable due to the non-existence of engineering consulting firms in the area of production technology. The main activities of the ECC should be

in providing consultancy services and training courses in specialized technology aiming at satisfying the needs of medium and large engineering industries. These activities should enable the ECC to be self-financed. As a semi-government agency, the ECC may include extended roles such as digesting imported technology, conduting its own research and development, and designing projects of potential benefit to the country. The ECC may collaborate with the BOI in supervising imports of technology and formulating policy guidelines in the area of technology transfer.

Development of Subcontracting System

Subcontracting system breaks the organization of machinery production into various different enterprises, each concentrates its effort in certain stage or component of the production. It allows each firm to develop its own specialization and make full use of scale economy. The measures relevant to promoting the subcontracting system are:

(a) revision of business tax rates to reduce the bias against subcontracting.

(b) local content requirement to stimulate localization of parts and components.

(c) technical and financial support to help local parts producers to improve their productivity and product quality.

The production of machinery generally involves various stages of production thus offering wide opportunities for

subcontracting. A properly arranged system of subcontracting will allow each producer to concentrate his effort in the area of his specialization. For example, an assembler of power tillers may specialize only in assembling works and marketing while leaving the production of components and parts to other specialized producers. The part producers may in turn subcontract certain processes such as casting and electroplating or some sub components to other firms.

Promotion of subcontracting may be justified by the following considerations:

(a) Subcontracting provides greater opportunity for new entry into business as it requires only specific know-how relevant to a particular stage of production and less amount of capital investment as compared to more vertically integrated production system.

(b) Production tends to be more efficient under subcontracting since inefficient firms will be eliminated by competition. In vertically integrated firms, inefficient production units may exist under the umbrella of the firms' overall profitability.

(c) As each producer is concentrating his effort in just a particular stage of production, technical improvement can be more easily achieved.

(d) Subcontracting allows firms with limited amount of capital to attain scale economy more easily.

To promote subcontracting in machinery production, the following approaches are of special relevance:

(a) Revision of business tax rates

(b) Local content requirements

In addition, the technical assistance as discussed in the previous section, the financial assistance and products standardization to be discussed in the subsequent sections should be supportive for the subcontracting system.

Revision of Business Tax Rates

An obstacle to the subcontracting system in Thailand is the business taxes which are imposed on every transaction of products from one stage of fabrication to another. The business tax is based on gross value of sales and ranges from 1.5 per cent for hire of work to 40 per cent for manufacture of some luxury goods. Products in the machinery group are mostly taxed at 5 or 9 per cent depending on whether they are considered as intermediate or finished products and the dividing line is by no means unambiguous. The same products may thus be taxed at different rates. The business tax rates on some major types of machinery are shown in Table 3.2.

As the business tax is applied at every transaction, vertically integrated firms have an advantage over

Table 3.2 : BUSINESS TAX RATE ON MACHINERY (1984)

I/O Code	Industry Name	Business Tax Rate (%)
112	Internal combustion piston engines	12.0
113	Agricultural Machnery & Equipment	5.0
116	Office & Household Machinery Appliances	
	- calculator	9.0
	- air condition	20.0
	- typewriting	9.0
	- refrigerator	9.0
117	Electrical Industrial Machinery Appliances	
	- transformers, generators motors	5.0
	- electrical hand tools	5.0
	- electrical welding machine	5.0
112	Internal combustion piston engines	
	- spar parts	5.0
113	Agricultural Machinery & Equipment	
	- components, accessories and spare parts	5.0
116	Air conditon	
	- components	9.0
117	Electrical hand tools	
	- components, accessories and spare parts	5.0
	Electrical welding machine	
	- components, accessories and spare parts	5.0

Source: Ministry of Finance

those who concentrate in only a certain stage of production by having to pay less tax. The business tax thus creates a disincentive for subcontracting. As products in the machinery group typically involve more stages of production than others, the cascading effect of business tax is more pronounced. The burden of business tax on locally produced machinery thus tends to be greater than the imported ones since the latter is taxed just once.

The revised business tax rates should be as follows:

(a) The tax rates on intermediate products such as those shown in the lower groups in Table 3.2 should be at minimum, e.g. 1.5%.

(b) The tax rates on finished products should be at varying rates depending on whether a particular product is primarily used in production or consumption. Production machinery should be taxed at low rates such as around 3 to 5 per cent. For revenue purpose and other considerations such as income redistribution, the business tax rates may be as high as desired for machinery used primarily for consumption purpose especially the luxurious ones.

Local Content Regulations

The Thai Government started to pay attention to local content policies in 1969 when it set up a committee to formulate the local content requirements for motor vehicles. The policy came into effect in 1977 when a 50% local content requirement was imposed on motorcycles. In the following year a programme was set out to raise the local content of passenger cars to 35 per cent by August 1980. The local content requirements have been gradually elevated to the present levels of 45 per cent for passenger cars, 45 per cent for commercial vehicles and 70 per cent for motorcycles.

Other than motor vehicles, the local content requirements on machinery are implemented by the Board of Investment as the preconditions for promotional status. The BOI currently applies local content requirements on five kinds of machinery, namely small diesel engine used in agriculture, diesel engine for vehicles, transformer, motor compressor, and telephone set. The promotional privileges were granted to 3 producers of small diesel engines in 1978 on the following conditions:

local content not less than 20% by June 1981
local content not less than 40% by June 1982
local content not less than 60% by June 1983
local content not less than 80% by June 1984

Two promoted firms, namely the Siam Kubota Diesel and the Thai Yanmar started their operation in 1980 with the combined capacity

of 162,360 units per annum. The third company, Thai-Dae Dong, was operated in 1981 but the plant was closed down shortly afterward. Siam Kubota and Thai Yanmar also experienced greate difficulties in 1982 as sales dropped off sharply and it became more difficult to meet the local content requirements set for 1983 and 1984. The two firms had to request for the postponement of the third and the fourth phases of local content requirement. The latest requirement set by the BOI is that between July 1st, 1984 and June 30th, 1985, the minimum local content must be 62 per cent. The maximum reduction of import duties and business taxes for imported inputs (90 per cent of the amount of duties and taxes) will be granted if the local content reaches 72 per cent.

Promotional status was also granted to 3 producers of diesel engines for motor vehicles in 1978. The conditions were set as follows:

local content not less than 20% by April 1983
local content not less than 30% by June 1984
local content not less than 40% by June 1985
local content not less than 60% by June 1986
local content not less than 80% by June 1987

After a long period of delay in the implementation of these projects, the promotional certificates to the three firms have been revoked. The BOI is now reformulating the measures to attract investors to produce diesel engine for pick-up trucks.

The local content requirement for transformer was set at 80% beginning from the first year of operation. It is also

set at 80 per cent for motor compressor to be achieved by the end of the third year of operation. Only one firm was granted the promotional status for producing the air compressor to be used in refrigerator.

Thailand's experiences with the local content requirements appear to have two common problems. First, in alomost every case, the producers fail to reach the required percentage of local content at certain levels. This reflects the difficulties involved in determining an appropriate and feasible degree of local content for each product. In general, unit cost tends to escalate with the degree of local content as some components and parts cannot be economically produced locally. Second, the real local contents are generally substantially lower than apparent since some local parts use high proportions of imported inputs. It is estimated that the true level of local content of motorcycles is about 50 per cent while the assemblers claim to have attained the 70 per cent level.

Localization of parts has led to about 50 per cent of the parts of motorcycle being supplied from subcontractors. Subcontracting in automobile parts is estimated to involve more than one hundred parts producers. The local content requirements may be extended to a number of other products particularly electrical appliances. While the local content requirement is potentially an effective instrument to promote subcontracting and reduce dependence on imported parts, it also raises the cost of production and reduces the incentive to invest in the finished

products. The local content requirement should thus be accompanied by compensating incentives. A flexible approach in setting the local content requirement and offerring tax incentives should be more appropriate than a rigidly set level of local content. For each product, varying levels of tax incentives should be assigned to different percentage of local content. This approach would allow each firm to find its own optimum solution in sourcing inputs for its production. The cost of raising the local content by each percentage can be easily analysed under this scheme, which would be useful in reviewing the requirement when necessary.

Industrial Standards.

Standardization of machinery, especially in the parts and components, makes possible mass production to exploit scale economy. It also assures the machine's quality and interchangeability of its components. The issuance of product standards by TISI should be speeded up to support the development of the industry.

It is well known in the technical production profession that the approach to an efficient industrial production with high quality and high productivity can be summarized around 3S's. They are

(a) Simplification: this is the reduction in variety of products or product components. It is best illustrated in the modern design of machinery in which only a few sizes of

components of similar function are chosen. This is prefered to using or designing each individual component in a tailor made fashion. Fewer varieties of components result in also simplification of inventory operation and thus a reduction in production cost. Besides fewer varieties means a higher volume of each component which should result in lower unit cost whether it is purchased or produced in house.

(b) Standardization: this is a logical further step from simplication. Once simplification policy has been adopted. Components or sub assembly of machinery can be produced as standard parts for assembling into different finished products. On the industrial scales, basic unit component such as bolts and nuts are now standardized and made in large quantity. With thus sort of availability, the difficulty of manufacturing these parts in plant is eliminated with accompanying advantages in cost and burden. Standard complex machinery can also be standardized for example, electric motors, gear motors, light bulbs, hydraulic valves, etc. This method of standardization can also be implemented in side each manufacturer. This is best illustrated by the automobile

industry where in a few car bodies with few attachments in trims and a few engine variant can offer a huge variety of car models. Electronic industry is probably the ultimate example of this approach where standard i.e. circuits are link together to form banks of electronic circuitries of virtually unlimited complexity.

(c) Specialization: this is a situation where a certain number of manufacturers concentrated in producing standard components or subassemblies for other manufacturer to put together with or without their own designed component. The resulting finished product will thus carry the brand name of the assembler. Specialization enables each manufacturer in this industry to concentrate their research and development effort in only a few areas of production technology with corresponding good results.

On the national and international level, industrial standards have been accepted as one of the most effective steps in promoting in the engineering industry sector.

(a) setting quality levels of material or product which is compatible to the accepted norm;

(b) setting dimensional accuracy needed for certain degrees of interchangeability and engineering performances;

(c) setting guidelines for methods of testing and sampling for various materials and machine;

(d) disseminating technical know-how resulting from publication of the above mentioned standards.

For Thailand the first move towards international standard in measurement is in the form of the Weight and Measurement Act 1923. This Act was aimed at introducing the Metric System into the kingdom and enabled Thailand to trace her primary weight and measurement standards to the international prototype in Paris. The responsibility for the enforcement and maintaining of this Act is pact under the Ministry of Commerce in the Department of Commercial Registration.

Successive Bills and Acts pertaining to the national standards can be summarized as follows:

(a) the weight and Measurement Act 1983 as an amendment to the first one promulgated in 1923 which incorporates major amendments:

- the SI system with six basic units of measurement pertaining to dimensions, mass, time, electrical charge, temperature and illumination.

(b) The Export Standards act 1960 under Ministry of Commerce which requires standard certificate for standardized commodities.

(c) The Thai Industrial Standards Institute Act 1968 under Ministry of Industry. Under this Act, the Industrial Products Standards Committee formed to recommend various standards for any industrial products. A decree can also be issued to enforce mandatory standards for those products deemed as safety risk or essential for the industry or the national economy.

(d) The Exportation and Importation of Goods Act 1979 under the Ministry of Commerce. Under this Act the Foreign Trade Committee is set up to advise the Minister of Commerce to prescribe the classification, type, quality, standard, standard mark, certificate of origin and standard certificate for goods to be exported or imported.

The Thai Industrial Standards Institute (TISI) is the main agency responsible for the preparation of the Thai Industrial Standards. These standards are issued in the form of government publications. Up to this moment (1985), some 600 Thai National Standards have been issued of which some 62 are for basic metals, 75 for industrial machinery and more than 45 for electrical products. In the engineering industry sector the most

recent emphasis is on those standards which concern components in automotive and motorcycle manufacture. The aim is apparently on promoting the locally produced product content of the automotive industry.

To obtain TISI Standard Marks, materials and products will have to pass tests specified in the standards documents. These license holders of TISI Standard Marks will be periodically visited by TISI certification officers from the Division of Standards Control to ensure the standard of quality control. Testing of samples drawn from finished products or raw materials will be conducted from time to time. Tests for products for conformity to compulsary standards as imposed by a Royal Decree are paid for by the TISI.

At present all the tests are normally performed by laboratories in the public sector and state enterprises. Very few cases are performed by personnel of the private sector using the factory equipment and observed by TISI or authorized laboratory officials. TISI has tried some form of accreditation of private sector testing without good result with the industry people. The present situation is that the DSS and TISTR are the principal testing agencies supported by a few laboratories in the universities and a few state enterprises. Both DSS and TISTR are very much overloaded.

The weakness of the present situation concerning the preparation of standard documents, the maintaining of standards of measurement and the testing services of material and

products for certification purpose can be grouped into the following areas:

(a) lack of local basic engineering material and machining industries.

(b) lack of in-plant quality control system to meet the expected draft standards.

(c) lack of appreciation of quality of product on the general public and industry sector.

Recommendations

Although TISI is as active as it can be under the present structure, it still needs much greater support on the part of qualified personnel and operation budgets. Apart from preparation and maintaining of standards, TISI can do very well by providing training and understanding of the role of industrial standards. Many standards documents should contain basic guideline for manufacturers to comply with the level of quality required. For a great number of small and medium size manufacturers standards books can be one of their major sources of technical know-how since Thailand has no alternative sources of knowledge such as ASTM, SAL, ect.

The present practice of draft standards is by setting up technical working committees comprising of representatives from various sectors in volved to work out the detail. This committee is coordinated by a representative of TISI working as the secretary. It has been found that due to the

limited number of personnel in TISI to handle the secretariate and technical drafting work for these committees and also due to the present government policy of limiting the number of government employees, TISI may also consider in addition to the present practice, the contracting out of jobs of drafting some industrial standards leaving the role of revising the finished drafts to the technical committee.

Protection

The present protective structure which is biased against the production of machine's components and production machinery should be corrected by tariff rates revision. The repercussion effect of tariff rates among industries will have to be taken into account. The revised tariff structure should aim at more uniformity of protection and the discrepancies among them should be in favor of the machinery and component parts that can be produced domestically.

Protection of an industry may be due to the divergence between the domestic price and the free trade price of the product or from the difference between the two prices of any input used by the industry. The differences of the domestic prices of inputs and output from the free trade prices result in the difference between the domestic value added and the value

added under free trade of the product. Higher domestic value added in a protected industry stimulates more production in that industry by offering greater return to investment than it would be otherwise under free trade.

The instruments effecting the level of protection are import duties and surcharges, export taxes, business taxes, subsidies, and quantitative restrictions. Among these, the most influential instrument in the protective structure of Thailand's industries is the import duties. Thailand's tariff structure has evolved partly as a result of deliberate policy and partly as ad hoc reactions to changing circumstances such as balance of payments difficulties or inflationary pressure. Tariff rates are set at relatively low levels for capital goods and raw materials and at high levels for consumption goods. Tariff rates also escalate with the degree of fabrication particularly in consumer durables.

Tariff rates on most manufacturing products range between 15 and 80 per cent with the rates on machinery generally on the low side. Low tariff rates on machinery lead to low levels of the nominal rates of protection and the effective rates of protection for these products. The nominal rate of protection is the measure of the difference between domestic price and free trade price of the product resulting from various protective instruments. The effective rate of protection incorporates the effect of input prices in the calculation. A positive effective rate of protection indicates that the value added of the industry under the existing protective structure exceeds that under the

Table 3.3 : EFFECTIVE RATE OF PROTECTION BY ENGINEERING INDUSTRY

I/O CODE	INDUSTRY NAME	WEIGHTED NRP	EXISTING ERP :B	EXISTING ERP: C
105	IRON AND STEEL	0.02	29.71	20.72
106	SECONDARY STEEL PRODUCTS	0.14	74.60	61.62
107	NON-FERROUS METAL	0.13	-390.02	835.52
108	CUTLERY AND HAND TOOLS	0.29	98.68	67.57
105	METAL FURNITURE	0.58	680.11	231.99
110	STRUCTURAL METAL	0.25	74.50	47.49
111	FABRICATED METAL	0.36	101.40	76.47
112	ENGINES	0.15	28.52	18.79
113	AGRICULTURAL M/C	0.15	47.70	25.54
114	WOOD AND METAL WORK M/C	0.15	19.84	13.22
115	SPECIAL INDUSTRIAL M/C	0.17	65.54	31.77
116	HOUSEHOLD APPLIANCES	0.51	523.07	134.91
117	ELECTRICAL M/C	0.21	68.65	40.06
118	RADIO,T.V ETC	0.36	192.19	99.62
119	HOUSEHOLD APPLIANCES	0.36	141.62	73.83
120	WIRE AND CABLE	0.30	90.24	47.04
121	BATTERIES	0.36	205.25	91.31
122	ELECTRICAL APPARATUS	0.41	5.86	3.85

Note: NRP = Nominal rate of protection
ERP:B = Balassa's ERP
ERP:C = Corden's ERP

Source : The Industrial Management Co.,Ltd.

free trade system at the official exchange rates. The exchange rates may be overvalued if most industries have positive effective rates of protection thus an industry with low positive level of effective rate of protection may not be better off than it would be under free trade.

In a recent study on protection in Thailand, /1 the effective rates of protection for 170 sectors out of the I-O table's 180 sectors were calculated. Some of the results of this calculation are presented in table 3.3. Most of the industries in the table are seen to have positive effective rates of protection. Industries with negative ERPs are apparently penalized under the existing regime except those with ERPs less than -100 per cent. An ERP of less than -100 per cent means that the industry is so excessively protected such that its value added under the free trade regime would be negative.

The highly differential tariff rates have led to the highly disperse values of ERP implying a highly distorted protective structure. The distortion created by this tariff structure allows many inefficient industries to survive and prosper. It is thus recommended that tariff rates should be modified by decreasing the degree of dispersion. More uniformity of the tariff rates will reduce the degree of dispersion of ERPs. A more uniform degree of protection will induce reallocation of productive resources from high cost industries to the more efficient ones.

/1 The Industrial Management Co.,Ltd. "Tax System for Industrial Restructuring", Report prepared for the NESDB, April 1985.

The existing tariff rates on major types of machinery are shown in table 3.4 Most of these are subject to the tariff rate of 15 per cent which is relatively low as compared to most manufacturing products. Since tariff rate is a major factor determining the nominal rate of protection which in turns affecting the effective rate of protection, the ERPs of most machinery are relatively low. Comparing to the median ERP of 59.6 per cent for the average ERPs of 92 manufacturing sectors, five sectors out of the six machinery sectors have the average ERPs lower than the median. These average ERPs range from 18.8 per cent for engines and turbines (sector 112) to 40.1% for electrical industrial machinery and appliances (sector 117). The only sector whose ERP is higher than the median is office and household machinery and appliances (sector 116) which consists mostly of consumer durable goods.

Increasing the degree of protection for machinery may be justified not only by the infant industry argument, but more importantly also as these industries are the major carriers of technology. The existing tariff structure has been seen to be generally unfavorable to machinery production. To remedy this situation, the following two steps are recommended.

(a) Narrowing the range of tarifff rates,

(b) Readjustment of tariff rates on selected types of machinery.

Step one is an overall revision of the tariff structure. The main objective is to bring the whole protective

Table 3.4: TARIFF RATE ON MACHINERY (1984)

I/O Code	Industry Name	Import Duty
106	Secondary Steel Products	
	- steel bar	20
	- Billet	20
	- Galvanized sheet	15
	- Tin plate	15
	- Iron & Steel Wire (Tinned or Galvanized)	30
	(other)	20
	- Pipe	30
107	Non-ferrous Metal	
	- Aluminium Extrusion	25
	- Aluminium sheet	30
108	Cutlery & Hand Tools	
	- Cutlery	15
	- Ag-hand tools	15
	- Lock set	30
	- Other hand tools	15
	- Razors and razor blades	30
109	Metal Furniture & Fixtures	
	- Furniture	60
110	Structural Metal Products	
	- Compressed gas cylinders	15
111	Other Fabricated Metal Products	
	- Filing cabinets, racks	30
	- Welding electode	30
	- Plumber brass goods	30
	- Spring Surface (Automobile's spare parts)	30

I/O Code	Industry Name	Import Duty
112	Engine & Turbines	
	- Steam engine	20
113	Agricultural Machinery & Equipment	30
	- Pump	15
114	Wood and Metal Working Machine	20
115	Special Industrial Machinery and Equipment, except Electrical	20
116	Office & Household Machinery & Appliances	
	- calculator	30
	- air condition	60
	- typewriting	30
	- refrigerator	60
117	Electrical Industrial Machinery & Appliances	
	- transformers, generators motors	30
	- electrical hand tools	15
	- electrical welding machines	15

Source: Customs Department

structure to become more uniform in order to minimize the inefficiency in resource allocation. A tentative general schedule may be as follows:

tariff rates on:

(a) raw materials 20%

(b) machinery 25%

(c) intermediate products 30%

(d) final products 35%

Under this scheme, the average ERPs for each of the machinery subsectors will be as shown in table 3.5. For the machinery sectors, the average ERP of office and household machinery and appliances will be reduced to 64.98 per cent while the average ERPs of the other five sectors will increase moderately. The relative degrees of protection for these five sectors are still lower than average, but the gaps become narrower.

The second step is a fine tuning in which tariff rates will be readjusted on a product by product basis. Types of machinery may be categorized into 3 groups as follows:

(a) Productive machinery which are not domestically produced, the tariff rates should be among the lowest, i.e. at 20 per cent or lower.

(b) Productive machinery which Thailand can produce fairly competitively, the tariff rates should be about 25 per cent to 30 per

Table 3-5 : EFFETIVE RATE OF PROTECTION BY ENGINEERING INDUSTRY

I/O CODE	INDUSTRY NAME	PROPOSE3 TARIFF	PROPOSE3 ERP: B	PROPOSE3 ERP : C
105	IRON AND STEEL	0.20	88.45	61.15
106	SECONDARY STEEL PRODUCTS	0.27	101.70	83.80
107	NON-FERROUS METAL	0.23	-411.49	880.53
108	CUTLERY AND HAND TOOLS	0.35	80.84	55.24
109	METAL FURNITURE	0.35	215.59	72.78
110	STRUCTURAL METAL	0.35	66.60	42.37
111	FABRICATED METAL	0.34	61.14	45.88
112	ENGINES	0.25	36.87	24.52
113	AGRICULTURAL M/C	0.25	62.30	33.71
114	WOOD AND METAL WORK M/C	0.25	31.75	21.60
115	SPECIAL INDUSTRIAL M/C	0.25	62.58	30.19
116	HOUSEHOLD APPLIANCES	0.34	251.27	64.98
117	ELECTRICAL M/C	0.25	85.41	50.06
118	RADIO, T.V. ETC	0.33	238.31	123.67
119	HOUSEHOLD APPLIANCES	0.34	141.86	73.94
120	WIRE AND CABLE	0.30	63.50	32.78
121	BATTERIES	0.31	142.08	62.62
122	ELECTRICAL APPARATUS	0.34	-36.77	-27.99

Note: NRP = Nominal rate of protection
ERP:R = Balassa's ERP
ERP:C = Corden's ERP

Source : The Industrial Management Co.,Ltd.

cent. To help minimizing the cost to domestic users, the business tax rates on these products and their parts and components should be kept at the lowest possible levels.

(c) For nonessential machinery such as consumer durables, the tariff rates should be among the highest. These products are such as office and household machinery and appliances. Tariff rates on components and parts of these products should be raised to encourage local production of the components. Otherwise, the assemblers will be excessively protected while local parts producers be discriminated.

Changes of tariff rates will alter the prices of the products involved. This may lead to undesirable relative price structure. For example, the increase of tariff rates on agricultural machinery will raise its prices which is contradictory to the policy of promoting farm mechanization. On the other hand, the reduction of tariff rates on luxurious products may encourage consumption beyond the desired level. This effect on relative prices should be corrected by an associated scheme of business tax revision.

In the previous chapter, it was recommended that the business taxes on products that are clearly used as industrial inputs should be subject to minimum business tax

rates. The reduction of business taxes on these products, particularly parts and components of machinery will offset the tendency of price increase of machinery from increasing tariffs. At the same time, the tariff increases will also offset the revenue forgone from the business tax reductions. Therefore the tariff rates and business tax rates should be revised simultaneously.

Investment Incentives

Special emphasis should be laid on the promotion of investment in the machinery and related sectors. This is due to the external economies of the machinery industry, particularly in its leading role in technological development. The complexity of the industry in terms of its strong internal and external linkages as well as in terms of technological interconnections necessitates a systematic development plan for this industry by competent experts to guide the scheme of investment promotion for this particular industry.

Since the establishment of the BOI in 1960 up to the end of 1983, there have been 1,323 firms granted BOI promotion. Out of this total, 160 firms are those classified as mechanical and electrical equipment. The privileges offerred by the BOI to promoted firms consist of the exemption of tariffs and business taxes from imports of machinery and raw materials, exemption of corporate income taxes; guarantee against nationalization, competition from new state enterprises, price controls, etc., special protection measures such as imposition of

surcharge on imported products, special permissions such as to bring in foreign technicians and to remit abroad foreign currency.

The power and activities of the BOI are regulated by the Investment Promotion Act 1977. A broad guideline has been stated in the Act such that the BOI is almost free to choose any set of criteria it deems appropriate for granting promotional privileges. Such flexibility has resulted in the difficulty to identify a coherent set of objectives it tries to pursue. A project may be granted promotional status by being consistent with one objective while contradicting with a few others. In the past, the BOI seemed to adopt the import substitution strategy. Many import substitution industries later on became export oriented. However, a greater proportion appear to remain internationally uncompetitive. Worse still, a lot of them are greatly dependent on imported inputs. In recent years, the BOI has given greater effort in promoting export oriented projects. Export promotion now appears to be the BOI's top priority.

The BOI's exemption of tariffs and business taxes on imports of machinery without equivalent subsidy for the use of local machinery has been biased against local machinery producers. Since the last couple of years, the BOI has attempted to correct this bias by not granting this privilege if it is known that the machinery can be locally supplied. However, it is quite difficult in practice to identify correctly whether the machinery in question can be supplied locally or not. The effectiveness of this policy is thus doubtful. An alternative to

eliminate this bias is to offer tax credit of the amount equivalent to the exempted tariffs and business taxes as the subsidy to promoted firms that choose to use locally produced machinery.

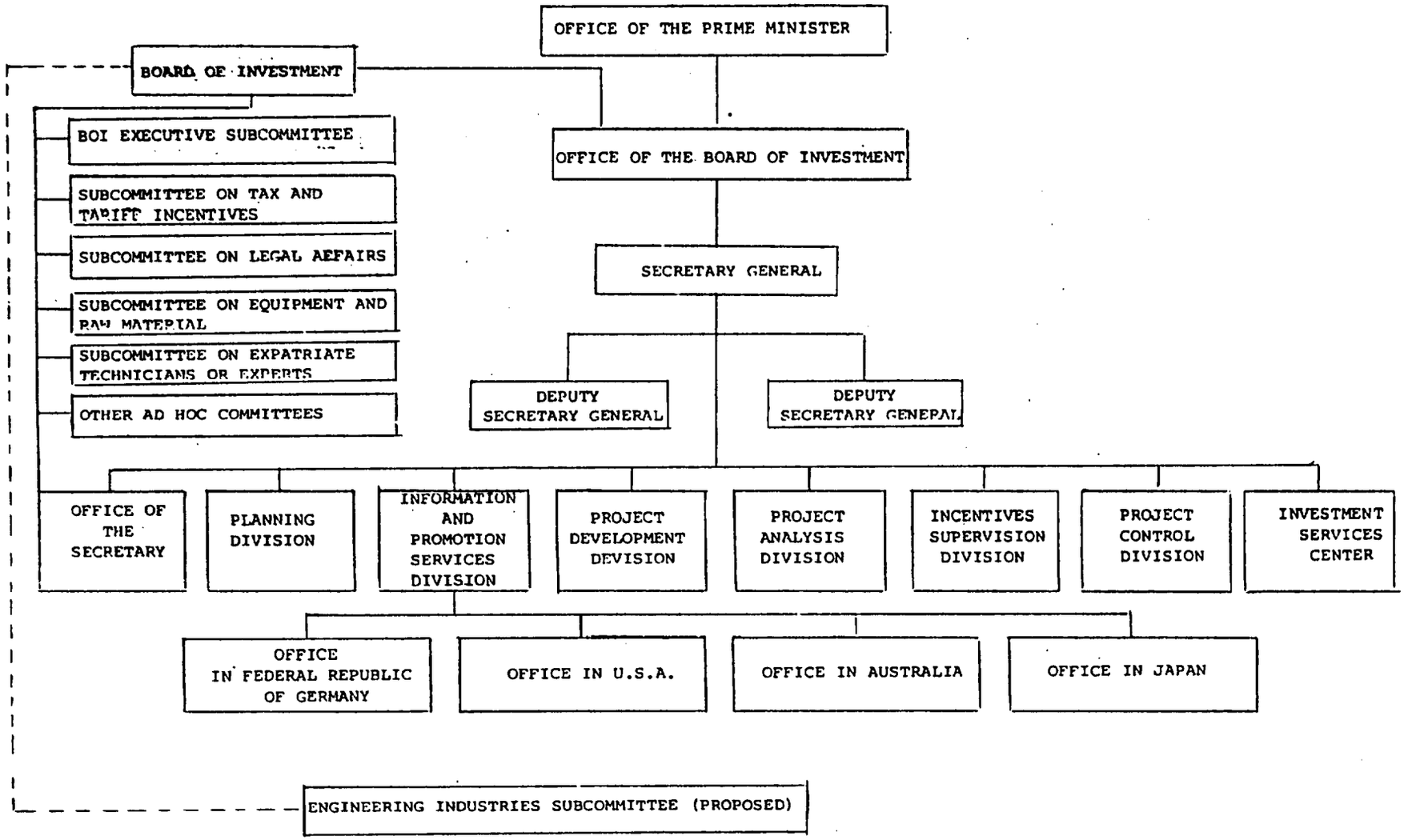
Promotion of the machinery sector may be justified for various reasons:

(a) The sector is a major carrier of technology. The know-how and skills involve in this sector is among the foremost in engineering industries. The technology accumulated in this sector has a broad range of applications beyond the engineering industries' boundary.

(b) This sector has extensive linkages within itself and with all the rest of the economy. More importantly, the machinery used by any sector is often the most crucial determinant of its productivity. Without a strong domestic machinery technology base, the country's productivity progress will be heavily dependent on foreign supply of machinery, which can only be suboptimum as long as there is no local adaptation by the domestic machinery industry.

(c) Value added in machine production normally increases significantly as the technology

Figure 2 : ORGANIZATION CHART OF THE BOI



involved moves up from one stage to another. The progress of the machinery sector necessarily requires commensurate increase in human capital.

The significance of technology embodied in machinery production and the intricate relationships of this sector with all others require that the promotion of this sector must be guided by a comprehensive and long range perspective of the desired pattern of its development. Under the organization structure of the BOI as shown in figure 2, a long range planning may be accomplished under the supervision of a special subcommittee to be established permanently. The subcommittee should consist of one of the deputy secretary general as chairperson, the Chief of the Planning Division as secretary, the Chief of Project Development as a member, and about five to ten other members invited from industry, academic, and relevant government agencies. As the machinery sector is tightly intertwined with others in the engineering industries, the roll of the subcommittee should thus be extended to cover the whole engineering sector. This subcommitee will be referred to in this paper as the subcommittee on Engineering Industry.

The tasks of the Engineering Industries Subcommittee should consist of:

(a) Supervising the long range planning for the development of the engineering industries. The planning process should be carried out by knowledgeable consultants from local and

foreign experts with the Planning Division and the Project Development Division as major counterparts. The plan should be updated at intervals with continuous monitoring to assure the compatibility of the plan with changing environment.

(b) Supervising and coordinating the tasks of the Planning Division and the Project Development Division. Planning by the former should indicate areas of relevance for the latter to pursue the matters in more details such as in carrying out project prefeasibility studies in areas of strategic importance. The subcommittee should also exert influence on improving the technical capabilities of the divisions' staff in matters concerning engineering industries.

(c) Issueing policy guidelines and formulating appropriate incentive measures in promoting the engineering industries. These tasks should be aided by the long range plans, industry specific studies, and other short term analyses. The various levels of studies, should be well coordinated and require expertise from specialists outside the BOI.

(d) The subcommittee may step beyond the conventional measures of the BOI by initiating a special incentive package for technology promotion aiming at inducing engineering firms to devote greater effort to upgrade their technological capability.

The following set of products and related suggestions are proposed for special attention in promoting investment in the machinery sector.

Engine Block

The current demand for pick-up trucks in Thailand is estimated to be between 70,000 and 100,000 units per year. The demand is met by a few manufacturers under 6 brand names, namely Toyota, Nissan, Isuzu, Mazda, Mitsubishi, and Peugeot. Products from all these manufacturers are similar in the basic design with virtually the same quality and performances. All of them are small trucks of about one ton capacity powered by a four cylinder diesel engine of approximately 2000-2400 c.c. capacity.

Technically speaking an engine is built up from two main groups of parts: the lower end or the engine block group and the upper end or the cylinder head group. The lower end group consists of the cylinder block, crankshaft, connecting rods, piston assemblies, bearing assemblies, flywheel, pulley and some

ancillaries such as water pump, camshaft driving gears etc. Camshaft can also be in the engine block in the case of a push-rod valve mechanism engine. The main function of this lower end part of the engine is to serve as the expansion chamber of the fuel combustion process and to transmit the resultant energy via the connecting rods crankshaft, flywheel, and hence to the clutch assembly for the useful work from the engine. The upper end or the cylinder head assembly mainly consists of the valve assembly, fuel injection nozzles and part of the combustion chamber. In some modern engine design a camshaft or camshafts can also be incorporated in the cylinder head. An engine with its camshaft located in the cylinder head is called an overhead camshaft engine. The main function of the cylinder head is to incorporate valve system and part of the combustion chamber which is formed partly in the cylinder head and partly on the piston head. It is the valve timing controlled by the camshaft profile, valve systems and the shape of the combustion chamber which have the greatest effect in imparting uniqueness in an engine efficiency and performance characteristics. It can be said that in the present state of engine design technology, the most significant engine component group which differentiate one make of engine from another make is the cylinder head and camshaft profile design. Taking this veiw, it should be possible to have a basic engine for all makes of truck with all the different engine characteristics each truck manufacturer would require for matching with their particular transmission gear train.

The domestic production of diesel engines for pick-up trucks is under consideration by concerned government agencies as well as industry. The current level of demand is great enough for a single plant to achieve efficient scale of production. However, consumers' preferences and the manufacturers' marketing strategies require distintions in the characteristics among different makes and models.

The proposed scheme to produce a unified engine for various engine makes is to select an engine block group i.e. complete with all the component such as connecting rod assembly, crankshaft assembly flywheel, pulley, pump etc. This engine block group shall be manufactured as a compulsory standard part for all pick-up truck engines manufactured in Thailand. On this standard engine block group each individual manufacturer can design and manufacture their own cylinder head assembly, camshaft profile and piston to impart their particular adventage in engine efficiency and performance characteristics.

(a) Under the present state of engine design technology, the differences in the engine performance is primarily determined by the cylinder head and camshaft profile design. The manufacturers thus can maintain desired degree of variations in the engine characteristics by having their own designs of the upper parts of the engine while using the common design of the engine blocks.

(b) Scale economy is more significant in the production of the engine block than the upper part. The use of common engine block allows mass production to achieve the required scale economy.

If this approach is adopted, the BOI may hold discussions with the manufacturers to set up the scheme of engine block production project. This project may be participated by all of the existing pick-up truck manufacturers.

Agricultural Machinery

There are four groups of agricultural machinery that should receive special attention owing to their significance to major economic crops of Thailand and demand potential, these are:

(a) power tillers

(b) small tractors

(c) chemical sprayer

(d) seed drills.

Power tillers and small tractors are produced by about 150 domestic manufacturers of the size ranging from less than 10 workers to about 100 workers. The products have gained wide consumers' acceptance for their durability, designs suitably adapted to local conditions, and affordable prices. However, there has been no significant progress in the production technology after the initial success in local adaptations of foreign prototypes. The producers generally lack knowledge of

modern technology and do not recognize the need for production engineer to manage the production system. This has resulted in uncontrolled product quality, lack of interchangeability of the parts among different brands and high reject rates of the machine's parts. As farmers are getting more acquainted with the products and becoming more quality conscious and competition among producers mounted, inefficient manufacturers are expected to be eliminated in the years to come. The BOI's role in contributing to this development process should be in activity promoting investment in the production of standardized parts. This promotion scheme will have to be supported by the issuance of mandatory standard parts by TISI. The BOI should also restrain from promoting the power tiller and small tractor production project as this would disrupt the existing producers.

For chemical sprayer and seed drill, large volumes of these products are currently imported and demands are expected to grow healthily. Promotion for projects to produce them by modern technology is recommended.

Machine Tools

By definition, machine tools are the machinery that can produce themselves and all other machinery. Machine tools production requires a very high state of production technology, the highest state of the art in control engineering and the highest manual skills of workers. There are a lot of spillover benefits to be expected from the existence of the machine tool industry. The accumulation of engineering know-how, particularly

in design, production and control, from this industry is of great value to other engineering sectors. By on-the-job training, the manual skilled workers of this industry are of the highest grade. Once the machine tool industry is well established, manufacturing of all kinds of production machinery can be easily achieved.

On commercial ground, machine tool manufacturing is generally an unprofitable venture. Within only eight years, the number of machine tool producers in Thailand has been reduced from eighteen to just one. In other countries, the machine tool industry generally receives subsidy of one form or another. Without its own machine tool industry, the technological independence of the country is seriously jeopardized.

The startling trend of the machine tool industry in Thailand should be reversed to provide a strategic support for the engineering industries. Fiscal and financial incentives should be offerred to attract investors into the production of precision grade of general purpose machine tools and special purpose or production machines. For the special purpose machine tools, foreign joint venture should be sought to bring in advanced technology. The BOI should lend support to the arrangement between local investors with a world leading manufacturer of special purpose machines. To exploit the comparative advantage of each partner, the local partner may concentrate in manufacturing the basic machining part of the machines while leaving the controlling part to the foreign partner. This scheme should aim primarily at the export market to exploit scale economy.

The BOI may at the same time encourage the existing producer to invest in retooling the production facilities in order to upgrade its products by adding low cost automation to convert the general purpose machines into production machines. Special incentives above the normal level should be available.

Financial Assistance

Formal channels of credits available to manufacturer currently consist of:

1. Commercial banks

Commercial banks are the largest financial institution accounting for nearly 70 per cent of the total credits in organized financial market. In 1982, the total credit extended by commercial banks was about 300,000 million baht, of which about 65,000 million baht went to the manufacturing sector. About 6,700 million baht or 10.3 per cent of the outstanding loans to manufacturing was shared by basic metals, metal products, and nonelectrical machinery, and about 7,200 million baht was shared by electrical machinery. There are three major methods of lending by commercial banks, namely overdraft, term loan, and discounts of bills, cheques and promissory notes. Over 50 per cent of the total credits provided by the commercial banks are in the form of O/D. Term loans account for only about 24 per cent of the total lending reflecting relatively low proportion of medium and long term financing.

2. Finance companies

The total outstanding credit extended by finance companies in 1982 was about 80,000 million baht, representing about 18 per cent of the total amount of credits by all financial institutions. About one quarter or 20,000 million baht of these loans were extended to the manufacturing sector. Only about 1,000 million baht or 5 per cent of the total credits to manufacturing sector was allocated to the metal, metal products, and nonelectrical machinery industries, and 3,200 million baht went to the electrical machinery sector.

3. Industrial Finance Corporation of Thailand (IFCT)

The IFCT is a specialized financial institution whose main function is to finance industrial projects. The loans extended by the IFCT are mostly in financing fixed assets with maturity of up to 15 years. The IFCT loans to all manufacturing enterprises in 1982 were about 4,900 million baht, about 400 million baht of which was lent to the machinery and transport equipment industries. To help small scale industries, the IFCT opened a special window to offer long term loans to them in March 1984. The amount of loans approved by this window after the first 6 months of operation was about 120 million baht.

4. Small Industries Finance Office (SIFO)

The SIFO is another specialized financial institution created to provide long term loans for small scale

industries. The average lending of SIFO over the last 20 years was only about 20 million baht per year.

5. Bank of Thailand's Industrial Rediscount Facility

The amount of credits in the form of the BOT's IPNs was about 6,790 million baht in 1982. Most of these credits were allocated to large scale industries such as textiles, garments, cement, construction materials and steel bars. Only 2.7 million baht was lent to the manufacture of machine, equipment and consumer electronics. The benefit of this facility to the machinery sector is thus negligible. The allocation of the IPNs is done by commercial banks. Not surprisingly, this low cost financial facility is used to benefit large scale enterprises as the commercial banks naturally try to do favor to their prime customers.

The short review of the existing financial facilities indicates two major problems in industrial financing. First, the medium and long term credits are relatively scarce. Second, the access to organized market credits by small manufacturers is quite limited. To remedy these problems, the following schemes have been proposed in a recent study: /1

1. Expansion of credits to small manufacturers under the existing institutional set up. This includes:

/1 The details of this proposal is in "Financial Strategies for Industrial Restructuring",

(a) moral suasion to induce commercial banks to set up special programs of credits for small industries,

(b) expansion of the Bank of Thailand's fund for its rediscount facility,

(c) expansion of the IFCT special credit program for small industries.

2. The IFCT is encouraged to pursue its plan to establish the Industrial Credit Guarantee Scheme (ICGS). The ICGS will improve the accessability of small firms to institutional credit by transferring the risk of lending from the creditors to the ICGS's fund.

3. Transformation of the SIFO to become the Small Industrial Finance Corporation of Thailand (SIFCT). The SIFCT is proposed to have a similar legal status to the IFCT. The success of the IFCT should be duplicated by following the same strategy.

4. Establishment of a new financial institution to be referred to as the Industrial Restructuring Fund (IRF). The main objective of this institution is to facilitate the implementation of the industrial restructuring programme as envisaged in the Fifth National Economic and Social Development Plan. The restructuring process of the machinery sector can potentially be facilitated by financing from the IRF. A special programme for the machinery sector may be initiated by the IRF and contain the following:

(a) A technical and financial package to assist priority subsectors in modernizing their production techniques. The subsectors of high priority are machine tools and agricultural machinery. The technical capability of these two sectors needs to be greatly upgraded. They also have difficulty in obtaining credits from institutional financial market.

(b) Loans provided for new projects in machinery production should insist on the employment of efficient production techniques. Special consideration should be given to the projects that contain technological development programmes such as in:

- digestion and adaptation of imported technology,
- modernization of plant and equipment,
- quality improvement and quality control programme,
- energy saving programme,
- allocation of budget for R&D programme or for acquiring technical consultancy,
- supplying essential products to strengthen the linkage within the machinery sector or with other sectors.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. Current State

Production and Trade

Production of machinery (I-O sectors 112-117) in Thailand in 1982 was worth 19,566 million baht in terms of output value or 2,269 million baht in terms of value added. Export of this sector in the same year was 912 million baht while import was 23,017 million baht which accounted for 55 per cent of apparent consumption.

The sector is also highly dependent on imported input as revealed by the average import content of 40 per cent in the machinery production which is about four times the average import content of all sectors.

Growth

Between 1978 and 1982, the real value of machinery consumption in 1982 dropped slightly below that of 1978. However, the industries managed to boost its production growth over this period to 14.8 per cent as measured at current prices, or 18.9 per cent at constant prices. Comparing to the rest of the economy, the growth of the industries was yet less than the 82.7 per cent growth of nominal GDP over the same period.

Structure of Selected Industries

Supporting Industries

a) Casting

There are about 250 casting shops in Bangkok and the nearby provinces. The bulk of them are small cast iron works with output of about 2.5 tons a month. They use sand moulds for casting, have little or no pattern making capacity, use manual method for shakeout and finishing, and have little knowledge in quality control. The practice of job works tends to hinder the introduction of smooth organization of the plant's production. Subcontracting is very active in this field. Production cost is quite competitive internationally but on the average, product quality is considerably inferior to the international standard level.

b) Forging

There are only two or three firms that can produce the forged parts meeting the needs of the modern industries. The rest of the forging shops are those using the traditional technique such as black smiths in the village.

c) Sheetwork, Welding and Pressworks

This industry is building up steadily and backed up by stable domestic demand. Competition is tense due to easy entry into the field as it requires only small capital investment. Subcontracting of press-formed parts is the main business of many of these firms.

d) Machining

It is estimated that as much as one fourth of the firms in the metal working industries are small machine shops with only a few lathes and drilling machines. About 28 per cent of these machine shops are engaged in precision works, 18 per cent are capable of a fair degree of accuracy and 40 per cent are in machining products which do not require much accuracy. The remaining 14 per cent are engaged in machining specialized parts.

e) Plating

The plating industry greatly relies on subcontracting business. Technical assistance is needed to overcome its problem of low plating quality.

Engine

Demand for engines in Thailand is concentrated in agricultural uses and automobiles. At present, there are only there engine producers, namely Siam Kubota, Thai Yanmar and Thai Diesel Development. The total capacity is 133,400 units a year. These engines are used by farmers to generate power for pumps, tillers, other agricultural machinery and small electricity generator. Imports of small engine, particularly from China and Japan, were surged in 1982. The situation led the government to impose import control on small engines. The Board of Investment has set a steep scale of local content requirement to boost local manufacturing.

Agricultural Machinery

It is estimated that there are more than 200 manufacturers of farm machinery, most of them evolved from small repair shops. Demand for farm machinery has become stagnant since the early 1980s due to the economic slow down, low prices of farm products and increased competition from imported second hand tractors and implements. The industry is now undergoing the process of consolidation due to the tense competition in recent years. It is anticipated that farm machinery production will become more concentrated in the Bangkon within the 200 km. radius.

Machine Tools

Imports of metal-working machine tools into Thailand increased sharply from 655 million baht in 1980 to 1,395 million baht in 1984. In contrast the number of domestic producers has shrunk from 18 in 1977 to just one at present. Sekkee, the only surviving producer, is now producing universal lathes and shapers with the capacity of 30-50 and 10-20 units a month respectively. It has 45 employees. Serious consideration should be paid to modernization and improvement of this strategic industry.

Pump

There were 26 firms producing pumps. Most were only small machine shops which generally buy in castings and other parts and specialize in final machining and assembly. Of the total production, 70 per cent was of the end-section centrifugal type. The models are copied from imported types. But the quality is inferior and the efficiency is low.

Transformer

There are presently nine domestic producers of transformers. Irregularity in demand coupling with oversupply has resulted in the stiff competition in the market. The major customers were from the public sector. The threat of imported products exacerbated the situation. The high dependence on imported raw materials is also one of the major hindrance to further growth of the industry. The domestic producers do not have capability to manufacture big transformers.

II. Technical Capability

Plant Layout and Material Handling

There is a wide scope for improving the plant layout of small and medium sized plants in Thailand. In small plants, virtually no effort or attention has been given to layout. Machine tools are normally located close to the walls and no consideration is given to the flow of work. New machines are placed wherever space is available. In medium sized plants, there are often several machines of the same type and it is a common practice to group the same types of machines together. The use of even a simple device such as the travel chart to help determining the appropriate location of each functional department has not been found.

In product assembly, fixed-position layout is normally found. This is because the products of the machinery industry are generally heavy and bulky and therefore not feasible to move the products. Product layout or a combination of product layout and process layout are only found in a few larger plants.

Gangways in many plants, especially the smaller ones are not marked and are full of obstructions. Often raw materials and works in progress are stored in gangways simply because no specific space is set aside for it. In other cases, such disorders are due to a deficiency or lack of production planning. In larger plants, especially those using fork lift trucks, gangways are marked and free of obstruction. These plants are often equipped with store rooms-one for tools and measuring

devices and another for materials.

A main cause of this poor plant layout is that most of these plants originated from small workshops. The owners are invariably machinists without formal training. Some larger plants hire industrial engineers but few assign them to solve plant layout problems. In some cases, the rapid expansion of the firm's business creates a need for more space. As the plants are sited in more or less urban areas, it is difficult to acquire the land nearby.

Common types of material handling equipment found in many plants are hand operated transporting equipment and electric powered hoists. The use of material handling equipment in these plants is due to necessity rather than the desire to increase productivity.

Working Environment

General lighting is considered acceptable in approximately 90 per cent of the plants surveyed. Localized lighting in the plants is, however, generally not adequate. Ventilation is generally good. Noise level is excessively high in the plants with a lot of hammering operations. Labor productivity can be improved if more attention is paid to improved the working environment.

Machine Tools and Machine Shop Practice

It could be safely estimated that more than half of the machine tools used in Thailand are imported second hand machines. Many of the machine tools at work are out of date and in poor condition. Most owners of the plants have no knowledge of proper acceptance tests. Worn spindles and bearings as well as worn slideways and machine bed are found on many machine tools in use. These factors make it difficult to achieve accuracy and good quality finish on the work piece.

The use of jigs and fixtures is not common in machine shops. The absence of jigs and fixtures means that marking out and measurement of the work piece is needed and more skilled labors are required. As there is shortage of skilled workers in the engineering industries, the quality and repeatibility of products are often doubtful which is unfortunately often not taken note of by the owners themselves.

In virtually all the plants visited, gauging was not seen even when certain individual parts were manufactured in large number. The concept of tolerances is not well known among machine operators and not even among the owners of most small and medium sized plants. The use of engineering drawing is also uncommon. Many owners of the plants do not understand an engineering drawing.

There are probably hundreds of N/C machines and devices in Thailand. These machines require skilled setters and service personnel with good training in electromechanical

engineering. These personnel are rarely available in Thailand, it is therefore not surprising to see a number of these machines laying idle in much of the time due to the absence of skilled setters and/or service personnel.

Maintenance

Maintenance is one of the most neglected aspects found in the plants surveyed. The advices given in the instruction manuals accompanying the equipment are rarely followed. Machine breakdowns often occur due to the lack of proper lubrication and the misuses of the machines.

In most plants, machines of various origins are found. Some of them were built by the workshop themselves. These result in great diversity of machines of the same type in any one plant. Every breakdown becomes unique because the parts are often not interchangeable or the control logic is different. Speedly repairs are difficult to achieve since skilled maintenance crew are in limited supply.

Labour Use and Productivity

The majority of the work force in small and medium industrial enterprises in Thailand is either unskilled or semi-skilled. Most plants employ young men with primary education. Usually they begin with general cleaning of the workshop and tools. Later they serve as helpers to more experienced workers. After a few years of such in-service training, they become semi-skilled workers. Most of their work is routine-operating machines

and equipment and/or assembling the various manufactured parts into a final product. There is little chance for these people to become skilled workers without additional study and proper training.

Less than 10 per cent of the plants surveyed employ young men with formal vocational education with limited experience. The owners of the plants suggested that these young people could not perform technical work before gaining one or two years of practical training in the workshop, yet they demanded high wages at the outset. Vocational school graduates tend to leave small and medium-sized plants to join large companies after gaining practical experience. The reasons frequently given are better wages and fringe benefits as well as better working environment and the pride of belonging to a large and well known company.

Product Quality

The quality of many machines produced in Thailand compares favorably with imported ones in the first few years. After this period, their performance drops off significantly. However, it is argued that the cost of locally built machines is much lower than those imported, therefore the users tend to pay less attention to them. Consequently, the wear and tear of these machines are faster.

Statistical quality control rarely exists in the small and medium plants. Sample size and acceptance number are

set arbitrarily.

Engineering Design, Research and Development

Engineering design in a strict sense is not well developed in the plants surveyed. In most small firms, the designs are virtually direct copies of foreign machines. In larger firms, even though copy is the norm, technical considerations of performance are well understood. In certain firms, a new product can be designed and produced to meet customer's specifications.

When approached by a customer to produce a really new machine which the plant manager knows nothing about, some will ask an academician to do a research and design the machine for him.

Management System

Production planning and control of most of the plants surveyed are based on intuitive or informal approach. In general, the overall production rate and the overall number of workers to be employed during each month are not established. On receipt of an order, the plant manager decides when work is to be done. He then assigns the job to a machine operator. No schedule of production is formally prepared.

Cost control procedures are not generally observed. Most plants have no plan specifying desired levels for inventory.

III. Development Strategy

Technology Promotion

Manpower Supply

To overcome the resistance of the employers in hiring technical school's graduates, the graduates must demonstrate sufficient working skills to the employers as this is the major criterion in their employment decision. Once the ability of the graduate is accepted, he can later on apply more advanced concept to the plant's operation. There are two technical schools whose reputation in supplying well trained technicians is widely recognized, namely the KMIT-North Bangkok and Don Bosco. The approach of these schools should be followed by other technical schools to upgrade the quality of their students. Necessary increase in budget to upgrade training facilities as well as incentives for competent staff should be sufficiently provided.

For the university level of education, engineering graduates are on the whole fully competent in the basic scientific and engineering concepts. What is lacking is the knowledge in production engineering. Areas which should be given more attention during their professional trainings are:

a) appreciation of production drawing,

b) material, dimensional and testing standards,

c) good basic knowledge of metrology, machine tools, jigs and fixture principles,

d) good basic knowledge of metallurgy essential for foundry work, heat treatment and welding.

Multidisciplinary engineering courses of electro-mechanical control and numerical control nature should be set up in anticipation of modern complex machinery systems.

Training and Extension

The Industrial Service Division, Department of Industrial Promotion (DIP), is the main extension arm of the government in assisting the technological development of small and medium engineering plants. The proposal of establishing new institution, the Machinery Industry Promotion Centre, under DIP is strongly advocated. It is also recommended that the MIPC should be allowed to operate more flexibly.

Development of Subcontracting System

Two measures relevant to the development of subcontracting system in the machinery industry are revision of business tax rates and local content regulations.

a) Revision of Business Tax Rates

As products in the machinery group typically involve more stages of production than others, the cascading effect of the business tax on them thus creates the incentive for the producers to try to integrate their production system vertically and limit the scope of subcontracting. The present

rates of business tax on machinery are mostly in the range of 5 per cent to 9 per cent. If the transaction is identified as hire of work, the business tax on it is lowered to 1.5 per cent. However, the classification of products for calculation of business taxes and the definition of "hire of work" are often ambiguous.

Revision of business tax rates is recommended as follows:

1. The tax rates on parts and components of machinery, particularly those of production machinery should not be higher than 1.5 per cent whether or not the transaction considered as hire of work.

2. The tax rates on production machinery such as those classified into the I-O sectors 112 to 116 should not be higher than 5 per cent. Consumption machinery such as air conditioner and refrigerator may be taxed at higher rates.

b) Local Content Requirement

At present, the Ministry of Industry is regulating the local content requirement for passenger cars (45 per cent), commercial vehicles (45 per cent) and motorcycles (70 per cent). The

Board of Investment also imposes the local content requirement on selected machinery as a precondition for granting promotional privileges. The BOI's local content requirement is currently applied to five kinds of machinery, namely small diesel engine used in agriculture, diesel engine for vehicles, transformer, motor compressor and telephone set.

Local content requirement, while accelerates the speed of localization of parts and components, must be trade off with the escalation of unit cost of production. The new approach of the BOI which allows firms to choose each own level of local content within a specified range and rewards those who can achieve higher degree of local content by greater tax incentives is more appropriate than the old approach. This flexible approach should be applied to other cases as well.

Industrial Standards

The Industrial Standards Act was promulgated in 1968. It is administered by the Thai Industrial Standards Institute (TISI). Up to the present, TISI has issued about 600 national standards, 75 of which are for industrial machinery. The current problems pertaining to industrial standards are:

a) The rate of issuance of standards does not keep in pace with the need,

b) Testing facilities are inadequate,

c) Many producers lack the knowledge to bring their products to meet the required standards.

The recommendations on improvement of industrial standards system are:

1) Basic guidelines for manufacturers to comply with the level of quality required should be contained in the standards documents. As Thailand has no sources of knowledge required to maintain product quality like ASTM, SAL, etc., the guidelines attached to the standards documents will greatly help the manufacturers.

2. TISI should consider, in addition to the present practice, the contracting out of the task of drafting some industrial standards in order to accelerate the rate of issuance of standards documents.

Protection

Calculation of the effective rates of protection (ERP) by I-O sectors based on the present tariff and tax structure reveals that:

1. There is a wide dispersion in the degree of protection among products which arises from the wide range of tariff rates on these products.

2. Since tariff rates are low in intermediate products and production machinery, the degrees of protection on production machinery and its parts and components are relatively low. Except the office and household machinery sector which is more consumer goods oriented, all of the other machinery sectors have substantially lower rates of effective protection than the median ERP of the manufacturing sectors.

A general revision of tariff and business tax structure is recommended to produce more uniformity in the degrees of protection. Calculation of the ERPs based on a simplified tariff schedule which limit the range of tariff rates within 20 per cent up to 35 per cent shows that the relative degrees of protection on the machinery sectors improve moderately. Under this schedule, the tariff rates on all production machinery are set at 25 per cent compared to the existing rates of around 15 per cent. The tariff rates may be raised further up to, say 30 per cent, for production machinery which Thailand can produce fairly competitively. To help minimizing the users of these kinds of machinery, the business tax rates on them as well as on their parts and components should be kept at the lowest possible level.

Investment Incentives

The significance of technology embodied in machinery production and the intricate relationships of this sector with all other industries require that the promotion of this sector must be guided by a comprehensive and long range perspective on the desired pattern of its development. The BOI is recommended to establish a special subcommittee which will be referred to as the subcommittee on Engineering Industries. The tasks of the Engineering Industries Subcommittee should consist of:

a) Supervising the long range planning for the development of the engineering industries.

b) Supervising and coordinating the tasks of the Planning Division and the Project Development Division in matters relating to the engineering industries.

c) Issuing policy guidelines and formulating appropriate incentive measures in promoting the engineering industries.

d) Initiating a special incentive package for technology promotion aiming at inducing engineering firms to devote greater effort to upgrade their technological capability such as in offering special tax privileges for R&D activities.

While the long range plan is not yet in existence, the BOI may pay special attention to promotion of the following industries:

Engine Block

The current level of demand for pick-up trucks is just enough for a single plant to achieve the efficient scale of production of the engine. However, consumers'preferences and the manufacturers marketing strategies require distinctions in the characteristics among different makes and models. A compromizing approach could be a single design for the engine block and leave the cylinder heads being freely chosen by each manufacturer. The manufacturers thus can maintain desired degree of variations in the engine characteristics by having their own designs of the upper parts of the engine while using the common design of the engine block.

If this approach is adopted, the BOI may hold discussions with the manufacturers to set up the scheme of engine block production project. This project may be participated by all of the existing pick-up truck manufacturers.

Agricultural Machinery

There are four groups of agricultural machinery that should receive special attention for their significance to major economic crops of Thailand and demand potential, these are:

1. power tiller
2. small tractor
3. chemical sprayer
4. seed drills

Promotion of standardized parts of 2-wheel and 4-wheel small tractors will contribute significantly to the development of this industry. The promotion scheme should be supported by the issuance of mandatory standard parts by TISI. The BOI should also restrain from promoting projects on power tiller and small tractor production as it would disrupt the existing producers.

For chemical sprayer and seed drills, large volumes of these products are currently imported and demands are expected to grow healthily. Promotion for projects to produce them by modern technology is recommended.

Machine Tools

The number of machine tool producers in Thailand has been reduced from 18 eight years ago to just one at present. This trend should be reversed to provide a strategic support for the Thai engineering industry. Fiscal and financial incentives should be offered to attract investment in the production of precision grade of general purpose machine tools and special purpose or production machine tools. For the special purpose machine tools, foreign joint venture should be sought to bring in advanced technology. The BOI should lend support to an arrangement between local investors and a world leading

manufacturer of the special purpose machine tools. To exploit the comparative advantage of each partner, the local partner may concentrate in manufacturing the basic machining part of the machine tools while leaving the controlling part to the foreign partner. This scheme should aim primarily at the export market to exploit economy of scale.

The BOI may at the same time encourage the existing producer to invest in retooling the production facilities in order to upgrade its products by adding low cost automation to convert the general purpose machines into production machines. Special incentives above the normal level should be available.

Financial Assistance

The major problems in industrial financing in Thailand can be identified as:

1. Scarcity of the medium and long term credits.
2. Limited access to organized market credits by small manufacturers.

To remedy these problems, the following schemes have been proposed:

1. Expansion of credits to small manufacturers under the existing institutional set up. This includes:

a. moral suasion to induce commercial banks to set up special programs of credits for small industries,

b. expansion of the Bank of Thailand's fund for its rediscount facility,

c. expansion of the IFCT special credit program for small industries.

2. IFCT is encouraged to pursue its plan to establish the Industrial Credit Guarantee Scheme (ICGS). The ICGS will improve the accessibility of small firms to institutional credit by transferring the risk of lending from the creditors to the ICGS's fund.

3. Transformation of the SIFO to become the small Industrial Finance Corporation of Thailand (SIFCT). The SIFCT is proposed to have a similar legal status to the IFCT. The success of the IFCT should be duplicated by following the same strategy.

4. Establishment of a new financial institution to be referred to as the Industrial Restructuring Fund (IRF). The main objective of this institution is to facilitate the implementation of the industrial restructuring programme as envisaged in the Fifth National