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UNDP/UNIDO - NESDB

INDUSTRIAL RESTRUCTURING PROJECT

INDUSTRIAL RESTRUCTURING IN METAL AND METAL PRODUCT INDUSTRIES.

Final Report

Prepared by

Rachain Chintayarangsan,

Attakorn Klankwamdee,

Chaw Niamsorn,

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in collaboration with

F.A.M.Vlemmings

UNIDO advisor

1 April 1986

THE INDUSTRIAL MANAGEMENT CO., LTD.
BANGKOK,THAILAND

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I. CURRENT STATE OF THE METAL AND METAL PRODUCT INDUSTRIES

Definition

The metal and metal product industries in this paper refer to the following sectors in the I-O classification:

I-O code 105 : iron and steel

I-O code 106 : secondary steel products

I-O code 107 : nonferrous metals

I-O code 108 : cutlery and hand tools

I-O code 109 : metal furniture and fixtures

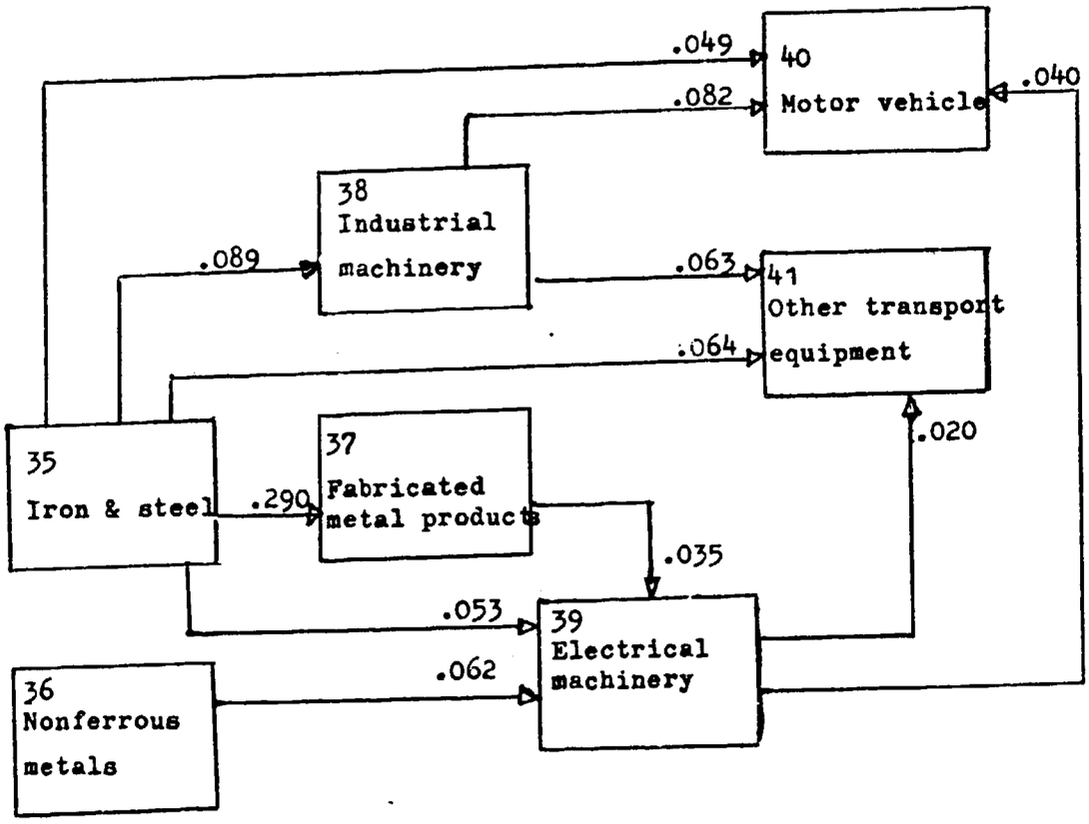
I-O code 110 : structural steel products

I-O code 111 : other fabricated metal products

Industrial Linkages

The metal and metal product industries may be regarded as the substructure of a broader group of industries in which machinery and transport equipment form the superstructure. A simplified version of the relationship among the subsectors of the metal, metal product and machinery sector is displayed in figure 1. This diagram is extracted from the 58-sector I-O table of Thailand and highlights the direct linkages among the subsectors by showing only those linkages of significant values (having the input coefficients greater than .02). The relationship is essentially oneway flowing from iron and steel, and nonferrous metals to fabricated metal products, industrial

Figure 1 : DIRECT LINKAGES AMONG SECTORS IN THE METAL, METAL PRODUCT AND MACHINERY INDUSTRIES



Note: Figures above the arrows are the input coefficients for each pair of sectors.

machinery, and electrical machinery and then to motor vehicles and other transport equipment.

The importance of the metal and metal product subsector in the national economy can be seen as the major feeder of key inputs for the rest of the broader sector whose products consist essentially of tools, machinery and equipment to be used in every production process. The metal, metal product and machinery sector is specially important to construction, transportation and communication, public utilities and manufacturing in general. Its uses in mechanization of the agricultural sector is also a crucial determinant of the development of the economy. The extensive roles of the metal, metal product and machinery sector are reflected in its extraordinarily high forward linkage which also tends to escalate with the degree of industrialization. According to the 16-sector I-O table of Thailand, the forward linkage index of this sector in 1975 was 1.74 which was second only to the chemicals, rubber and petroleum product sector.

When the imported components are taken out of the input-output relationship, the forward linkage of the metal, metal product and machinery sector falls drastically from 3.53 to 2.12, resulting in the decrease of the index from 1.74 to 1.27. These figures reveal a serious weakness of this sector in its capability to satisfy domestic demand. What this means is that instead of 3.53 units of output to be generated out of this sector for the production of one unit of the final demand for

each of the 16 sectors, only 2.12 units are actually produced domestically. The potentially strong linkages within this sector and with the other sectors are much weakend by leakages to imports. As shown in the last column of table 1.1 the import leakage, defined as the difference between the row sum of the $(I-A)^{-1}$ and the $(I-A)^{d-1}$ matrices, of the metal, metal product and machinery sector is the highest among all 16 sectors of the I-O table.

Production and Trade

Production of metals and metal products in 1982 amounted to 33,415 million baht. In terms of value added it contributed to about 0.6 per cent of the country's GDP or 4,855 million baht in absolute terms. Export from these industries in 1982 was 10,146 million baht, representing 6.4 per cent of the total export earnings. Tin alone accounted for 7,773 million baht or 76.6 per cent of the total export receipts of this category. Import of metals and metal products in 1982 amounted to 21,022 million baht, resulting in the trade deficit of 10,876 million baht in this product category which accounted for 29.5 per cent of the country's total trade deficit. The greatest contributor to this deficit is secondary steel products whose deficit was 11,092 million baht exceeding the total deficit of this product group. The sectors that managed to have trade surplus were nonferrous metals, metal furniture and fixtures, and structural metal products. The values of production and trade by sectors in 1982 are shown in table 1.2.

Table 1.1: FORWARD LINKAGES AND IMPORT LEAKAGE OF 16 I-O SECTORS

Sector	Forward linkage $(I-A)^{-1}$	Forward linkage $(I-A^d)^{-1}$	Import leakage
1. agriculture	3.00	2.70	0.30
2. mining & quarrying	2.63	1.31	1.32
3. food, beverage & tobacco	1.86	1.76	0.10
4. textile & textile products	2.28	2.01	0.27
5. wood & wood products	1.27	1.24	0.03
6. paper & paper products	1.68	1.30	0.38
7. chemicals, rubber & petroleum	3.77	2.59	1.18
8. nonmetalic mineral products	1.24	1.19	0.06
9. metal, metal product & machinery	3.53	2.12	1.41
10. other manufacturing	1.19	1.13	0.06
11. public utility	1.45	1.38	0.07
12. construction	1.20	1.16	0.04
13. trade	2.59	2.33	0.26
14. transportation & communication	1.64	1.54	0.10
15. services	1.98	1.82	0.16
16. unclassified	1.22	1.14	0.08

Source: Input-Output Table of Thailand, 1975, for Analytical Uses, NESDB.

Table 1.2: PRODUCTION AND TRADE PATTERN (1982)

	Sector	Values in millions of baht		
		. Production.	Export .	Import
105	Iron & Steel	10,206.807	182.998	1,964.962
106	Secondary Steel Products		567.109	11,658.946
107	Nonferrous metal	14,189.073	7,994.663	4,106.645
108	Cutlery and hand tools	3,571.044	194.704	937.182
109	Metal furniture and fixtures	1,474.400	372.582	35.218
110	Structural metal products	1,843.253	216.673	84.538
111	Other fabricated metal products	2,130.709	667.238	2,234.804
	Total	33,415.286	10,145.96,	21,022.265

Sources: NESDB,

Customs Dept.

As a rough indicator of the production capability of the industries relative to domestic demand, the self-sufficiency ratios by sectors of the metal and metal product industries are shown in the first column of table 1.3. The self-sufficiency ratio of the whole group of industries in 1982 was .754 indicating that domestic production fell short of domestic consumption by approximately one fourth. The sectors that exert greatest influence on the over - sufficiency ratio were iron and steel, secondary steel products, and nonferrous metals since they are the three largest sectors and their self-sufficiency ratios were the most extremes.

The high self-sufficiency ratio of the nonferrous metal sector is due primarily to tin smelting. Because of the abundance of tin ore deposits in the country, much in excess of domestic need, more than 95 per cent of tin is exported, while most of other nonferrous metals have to be imported. The self-sufficiency ratio exceeding 100 per cent thus does not mean that the country is actually self-sufficient import dependence is better indicated by the import-consumption ratios which are shown in the second column of table 1.3 where it can be seen that nearly half of the country's demand for metals and metal products had to be satisfied by import. The reliance on import is relatively insignificant in metal furniture and fixtures, and structural metal products, but very crucial in iron and steel, secondary steel products and other fabricated metal products.

Table 1.3: SELF SUFFICIENCY, IMPORT DEPENDENCE, AND EXPORT-PRODUCTION RATIO (1982)

(Percentage)

Sector	Production/ Consumption	Import/ Consumption	Export/ Production
105 and 106	44.2	59.0	7.3
107	137.1	39.7	56.0
108	82.8	21.7	5.5
109	129.7	3.1	25.3
110	107.7	4.9	11.8
111	57.6	60.4	31.3
Total	75.4	47.5	30.4

Sources: NESDB,
Customs Dept.

The import-consumption ratio reflects only one side of the dependence on import of the industries, that is, the dependence on the product side. Another side of the dependence on foreign supply is the dependence on imported inputs. This may be measured in terms of the import contents of the products. According to the 58-sector I-O table, the direct plus indirect import contents of the metal and metal product industries are as follows:

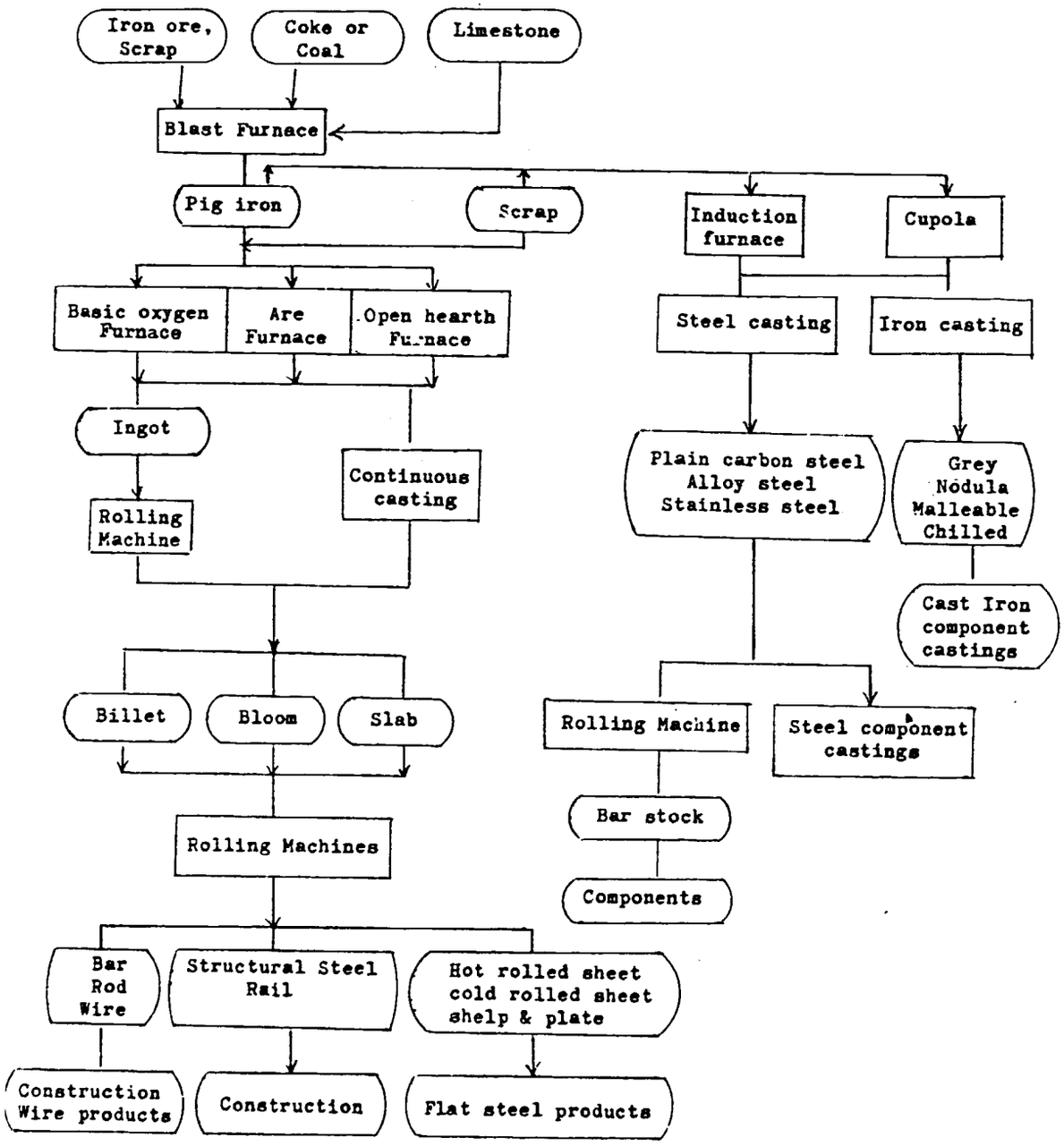
I-O code 35 :	iron and steel	40.4 per cent
I-O code 36 :	nonferrous metals	14.6 per cent
I-O code 37 :	fabricated metal products	35.0 per cent

These are significantly higher than the average import content of the whole economy of 11.3 per cent. High import contents of the metal and metal product industries are attributable to the lack of domestic supply of original steel and many other basic metals, and the inability to produce various kinds of secondary and fabricated metal products and various chemicals and chemical products.

Production Processes

Production of iron and steel products involves several interconnecting processes as illustrated in figure 2. The major primary process involves the use of blast furnace to produce pig iron from basic raw material consisting mainly of iron ore, limestone and coke or coal. The secondary stage may be

Figure 2: FLOW DIAGRAM OF IRON AND STEEL PRODUCTS



divided into 3 major branches. In the first branch , pig iron and/or sheet scrap are transformed into steel ingot by electric arc furnace or other kinds of furnaces such as basic oxygen furnace. The steel ingot may be rolled into basic shapes as bloom, billet, or slab and further into various final shapes such as bar, rod, wire, sheet, plate, and other geometric sections. The second branch involves using the induction furnace to produce cast and alloy steel and the third branch uses the cupola to produce cast iron. Products of cast steel/iron are such as general machine parts, crank shafts, pipe fittings and rollers. Each product requires certain physical properties such as hardness, ductility and strengths, which in turn are determined by the chemical composition and micro structure of the processed materials.

Products of the secondary stage generally go further into various downstream industries especially fabricated metal products, machinery, transport equipment and construction. In fabricated metal products, a number of processes are added to transform the basic shapes of products from the primary and the secondary stages into the required configurations. These consist of casting, forging, metal forming, heat treatment, machining, welding, pressing and electroplating. Nonferrous metal products generally involve similar or related production processes such as smelting, refining alloying, casting, rolling and extrusion.

Market Structure /1

General

As of 1983, there were 5,852 firms registered with the Department of Industrial Works as producers of metals and metal products. Out of this total, 4,200 firms were located in Bangkok, representing more than 70 per cent the firms in these industries. The rest are distributed over the country as follows. 962 firms in the other provinces of the central region, 196 firms in the North, 200 firms in the South, and 294 firms in the Northeast and the East. The concentration of the industries in Bangkok is attributable to several reasons. First, Bangkok is the supplying center of most basic raw materials particularly the imported steels and other metals. Secondly, it is the largest market for the products as well as the main channel for nationwide distribution and for the export market. Thirdly, the specially strong linkages of the industries create strong incentives for the producers of the related products to gravitate into the same area.

Official statistics generally classify firms by types of their products while firms which registered in different product categories may actually do the same type of business as they can easily shift from one product line to another that involves the same process technology and requires no or minimal

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/1 This section is mainly based on the work of Dr.F.A.M. Vlemmings, Report on the Iron and Steel Industry, prepared for the Thai Government, UNIDO, Vienna, December 1984, Chapter IV.

reorganization of the production facilities. Classification of producers by product types thus may not accurately reflect the actual situation. On the other hand, official data on firms classified by types of process are not available.

The types of firms that are most commonly found are those specialize in machining, electroplating, press work, and metal fabrication. According to a leading expert in this field, the number of small firms specializing in each of these processes is in the order of a few thousands. These firms generally employ less than 20 workers. Competition among the producers in each of these processes can be expected to be at a high degree especially those located in the high density area of Bangkok and its surrounding provinces.

The Steel Mills

With a total capacity of about 700,000 tons in 1983, steel making companies produced only 340,000 tons, a capacity utilization of less than 50 per cent. The main reason for this unsatisfying performances has been the recession in the building industry since 1979. Although a recovery started in the middle of 1983, causing the imports of bars and sections to go up by 65 per cent, production of bars and sections by the steelworks did not increase at all. The strong competition of the re-rollers was quoted as the main reason for the bad performance. Production of this category is unknown, but based on the import of scrap the estimated production probably has increased by 37 per cent.

Table 1.4 : NUMBER AND CAPACITY OF STEEL MILLS

	No. and size of EAF	Melting Capacity (t/yr)	Rolling Capacity (t/yr)	Casting
Siam Iron & Steel Co Ltd	2 x 30 t	240,000	±200,000	2-3strands CC.
G.S. Steel Co	3 x 20 t	158,000	±150,000	ingot casting
The Bangkok Iron and Steel Co Ltd	2 x 20 t 1 x 15 t	130,000		1-3strands CC.
Bangkok Steel Industry Co	2 x 20 t	111,000		1-2strands CC.
Thai-India	1 x 10 t 1 x 6 t	45,000	1/	
Thai-Pattana Casting Steel Co	2 x 5 t 1 x 20 t	±60,000	2/	
Thai Special Steel Co	?	2,000		
Thriumph Steel	1 x 20 t	50,000	3/	
Bangna Machine Works	1 x 20 t	50,000	4/	

1/ at the time of study, the steel shop was closed. They were installing a computor controlled section mill for channels up to 150 x 75 x 9 mm and angels up to 100 x 10 mm with a capacity of 120 t/d. The old mill will be rebuild and used for the production of wire rods.

2/ A 20t second hand EAF has been bought recently.

3/ Also reported to have bought a second hand EAF. As a former re-roller they have been concentrated on angles. They will now start the production of angles and small sections from own billets (information BOI).

4/ A third company reported to have bought a second hand EAF.

Source : Ministry of Industry.

Low capacity utilization rate is the main reason for the weak position of the steel producers. To increase the utilization rate by exporting the excess production is not possible since the production cost of Thai steel is not internationally competitive. In the comparison made in the Dastur report [1] on the cost price of the raw materials in the ASEAN countries, it came out that Thailand is one of the most expensive countries as regards local scrap (64 per cent more than in the cheapest country), labour costs, energy costs (except for fuel oil) and electrodes, and by far the most expensive as regards ferroalloys. As the special rate of 20% on ferroalloys has not been extended after October 5th, 1983, this disadvantage may have disappeared.

Based on those cost price items, Dastur has calculated a minimum economic size of a billet plant of more than 150,000 tons. Among the large steel mills, only Sisco and G.S. steel exceed this mark, while Bangkok Iron and Steel and Bangkok Steel Industry remain just below the mark. However, Sisco has a significant disadvantage in its location, which raises its transport costs of scraps and its final products, by more than 100 baht a ton. G.S. Steel has the disadvantage of using the ingot casting method instead of the continuous casting. Therefore it can be said that each of the four companies mentioned has nearly equal chances to become internationally competitive. The viability of the other companies as viewed from their scales and techniques of production is considered quite unlikely.

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[1] M.N. Dastur Co.,Ltd., Study on Minimum Economic Size Plants for Steel Processes in ASEAN countries, Calcutta, 1980.

The Re-rollers

It has been impossible to arrange one or more visits to those industries. Therefore the analysis has to be based entirely on second hand information.

The re-rolling industry consists of a small number of well-equiped companies with a sizable capacity and a very large number of small companies. (From some available studies the following list could be taken of companies with their respective capacities, Table 1.5). Some of those companies may no longer exists, but it seems appropriate to list them here, to give an impression of the type and dimension of those companies.

Based on the imported quantity of scrap their annual production is estimated at over 300,000 tons, mainly of round bars, a year. In 1983 production might even have surpassed 400,000 tons. The primary material for the re-roller is mainly imported cobble plates, used rails, ship plate from ship breaking yards. The plates are cut into small billets, that are reheated and further rolled into bars. Most of the re-rollers are limited in the thickness of their input to about 40 - 60 mm. Only very few of them can use billets up to 100 mm square.

In spite of the fact that there is a large over capacity for billets in the existing steelworks, there seems to be a tendency to embark upon own production of steel instead of buying billet from other companies. Three of the aforementioned companies have bought second hand EAF. Direct sales of billets is very limited at Sisco. Only Thai-India reported direct sales of

Table 1.5 : NUMBER AND CAPACITY OF RE-ROLLERS

	No.of lines	Capacity t/yr	Dimension
Siam Steel Industry	3	60,000 t	5.5 - 50 mm
Sahaviriya Steel Works Co Ltd	4	48,000 t	6 - 25 mm
		58,000 t	6 - 15 mm
Sahabhand Lek Thai		48,000 t	6 - 12 mm
Union Metal Co Ltd	3	30,000 t	6 - 33 mm
Meyer (Thailand) Co Ltd	1	12,000 t	6 - 15 mm
Bangna Machine Works Co	1	18,000 t	6 - 12 mm
Chonviriya Steel Co Ltd	1	18,000 t	6 - 9 mm

Source : Ministry of Industry.

about 8,000 tons. Although some of the re-rollers also produce small section, most of the re-rollers produce only round bars ranges in sizes from 6 - 15 mm. There is a strong price competition with the integrated steelworks.

It is reported that the smaller re-rollers cannot maintain adequate tolerances. The existing standards and also the proposed standard give them too much opportunity to sell undersized products. The quality of the raw material raises serious problems. A shipplate of a given size and thickness usually have known properties. A lot of scrap however is used of which the properties are not known. Nonhomogenity of the input material causes defects in the final product that are very difficult to trace. Pervasive uses of substandard steels by the construction industry is the main obstacle to improve the quality standard.

Tinplate Industry

There is one tinplate producer in Thailand, currently using two ETL (electrolytic tinning lines). The first one with a capacity of 60,000 tons was started in 1973, as a replacement for a hot dip line which started as early as 1960. In 1982 a second line with a capacity of 90,000 tons has started production. The second line is also adapted to produce TFS (Tin free steel). Recently the chairman of the company confirmed in a press release the commitment to go ahead with a third line. Tinplate production in 1983 was 80,000 tons, a utilization of

capacity of 53 per cent. This year it is expected to grow to 100,000 tons or 69 per cent. In spite of an import duty of 15 per cent or 1.5 baht/kg., there is still a significant amount of import of 60,000 tons in 1983, of which 35,000 tons from Japan, presumably of special quality according to the price in the import statistics. The remainder is made up mainly of second choice material. The industry is trying to persuade the government to restrict those imports to improve the quality and the image of canned food.

The dependence on 100 per cent imported material makes it very difficult for the Thai tinplate industry to enter the international market. Compared with the Japanese tinplate industry there is a principal disadvantage in additional transport and handling costs.

The Galvanizing Industry

There are three traditional galvanizers in Thailand. The three are all started up as a Japanese-Thai joint venture. They produce hot-dip corrugated or plain galvanized sheets in a thickness up to 0.2 mm. The input materials are imported, by ship to Bangkok and then in lighters to the plants therefore incur additional handling and transport costs. The process is not continuous : the coils are cut first in sheets. Because of the hot-dip galvanizing, corrugating possibilites are limited : to sharp a bend will damage the zinc coating.

The production is very seasonal, 80 per cent of the production goes to farmers out of Bangkok as building material. During the period of the harvest, they cannot do construction work. The demand is sharply fluctuating from year to year depending on the income level of farmers. Production of 145,000 tons in 1981 or 71 per cent of capacity is rather high for a seasonal product. To protect the market there is the same import duty on imports as for tinplate, 15 per cent or 1.5 baht/kg. On the imported coils the import duty is only 0.2 baht/kg. and for the commonly used thickness of 0.2 mm. even 0.1 baht/kg. Because of this very small thickness they use, which can be produced only by very few producers, they have to pay a rather high price for the imported coils. Main competitors are the suppliers of the raw material. Because of this, and because of their extra handling and transport costs, no export is possible.

The new line of Bangkok Steel Industry Co. will be a continuous electrolytic galvanizing line with a resonably high speed. It will produce galvanized sheets in a much greater range of thickness, with much better surface quality. The greater variation in thickness gives the company also a greater choice of potential suppliers. The highly efficient and modern installation will give the company even the potential to be competitive in the international market.

For the existing hot-dip galvanizers, and to a lesser extent this applies too to the tinplate industry, the economic meaning for Thailand is doubtful. The imported input

Table 1.6 : PRODUCERS OF GALVANIZED SHEETS

	No.of lines	Capacity t/yr
Sangkasi Thai	7 lines,cap.	84,000 t/yr + 2 color lines
Thailand Iron Works	5 lines,cap.	60,000 t/yr
Far East Iron Works	5 lines,cap.	60,000 t/yr
and 1 new one still under construction.		
Bangkok Steel Industry Co Ltd		
	1 line,,cap.	60,000 t/yr (EGL)

Source : Ministry of Industry.

material makes up 80-90 per cent of the total cost. As far as there is an additional import charge on the competing imports the contribution to the Thai economy even might be negative, as has been pointed out in a paper prepared by IFCT & IDE., "Comparative advantage of iron and steel industry in Thailand".

Tube and Pipe Making

There are in Thailand more than 10 producers of tubes and pipes with a total estimated capacity of over 300,000 tons. Production mainly consists of water pipe and furniture pipe in the range of 4" and 8" diameter. Sathask Driam produces spiral welded pipes in a diameter up to 60". For those big pipes, the company is seriously handicaped by a maximum coil weight of 9 tons, a limit given by the rail transport as well as by the own handling facilities. Some of the producers have the possibility to produce mechanical pipe, structural pipe and conduit pipe.

Production peaked in 1980 at 214,000 tons, approximately 75 per cent of capacity, since then the market has been depressed. In spite of an import duty of 30 per cent or 1.0 baht/kg, the production of ordinary water pipe has not been very profitable. In the more special products, big spiral welded pipes, mechanical pipe, structural pipe and conduit pipe, the market has shown less competition. However, domestic demand is quite limited. The high production of 1980 was partly contributed by large amount of export, 80,000tons The international market for tubes has been deteriorated, mainly as a consequence of the collapse of the American oil country goods market. However, the

Table 1.7 : MAIN PRODUCERS OF TUBES AND PIPES

	Installation	Capacity t/yr
Thai Steel Pipe Industry Co Ltd	3 ERW - lines	60,000 t
Thai-Asia Pipe Co Ltd	2 ERW - lines	48,000 t
Sathask Driam (Thailand) Co Ltd	2 spiral lines	15,000 t
Thaveesin, Engineering or Ship building		20,000 t
High Pressure Steel Pipe Industry Co Ltd	1 ERW - line	36,000 t
Thai Union Steel Co Ltd	3 ERW - lines	42,000 t
Saha Thai Steel Pipe Co Ltd	2 ERW - lines	36,000 t

Source : Ministry of Industry.

export of Thailand has fallen more than the world trade in total, indicating an erosion of the export competitiveness. In the course of 1983 there has been a turn for the better, notably in the fourth quarter. A sharp acceleration took place in the second quarter of 1984. However, there may be a relation with the voluntary export restriction of the Japanese mother company to the USA in the same period. Up till now it is not clear if the export of Thai pipes to the USA will escape the protectionistic mood of the American government. The strong ties of the Thai exporter with Japanese companies will certainly weaken the Thai case.

Export of tubes, x 1,000 mt.

1982	Q1	Q2	Q3	Q4		1984	Q1	Q2 /1
	10	10	13	17			9	18

The development up till now certainly shows that the Thai tube making industry has export possibilities. Together with a further upgrading of their products, this will give this industry the possibility to make better use of the capacity and as such a better porfitability. Weak points in the overall competitiveness remain the insufficient harbour facilities and the dependence on imported raw materials.

Foundry and Casting

The number of firms engaged in foundry and casting was estimated at about 250. Most of them are located in and

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/1 Only two months.

around Bangkok. Only about 20 per cent of these firms are registered as company limited. The rest are generally small firms which are divided roughly equally between limited partnership and single proprietorship. The survey by the Industrial Service Institute (ISI) indicated that most of the firms are engaged in the production of cast iron. Grey cast iron is the most common type of products of these firms. The proportions of firms which produce alloy grey cast iron, modular cast iron, and malleable cast iron are relatively insignificant. About 30 per cent of the surveyed sample produce nonferrous products and more than half of which also produce cast iron. Out of which, 90 per cent produce aluminum alloys and 50 per cent produce copper alloys. The annual production of cast parts by all firms in the industry was estimated at 70,000 tons. The eight largest firms account for about one-third of this total.

Aluminum Sections

Thailand imported 2,607 million baht worth of aluminium and aluminium products in 1983. Export in the same year of these products stood at 476 million baht. The largest exported item in this category was aluminium section which accounted for about 45%. There are 7 producers of aluminium section in Thailand with the total annual capacity of 27,900 tons. Between 1976 and 1981, actual production increased steadily from 6,200 tons to 9,900 tons while capacity were expanded from 12,7000 tons to 24,400 tons resulting in the capacity utilization rates of 40-

60%. During this period, domestic consumption also increased rapidly from about 3,600 tons in 1976 to about 7,000 tons in 1981. Exports in recent years accounted for about 25-30% of the total production while imports were relatively insignificant.

The process employed by the Thai producers is the direct extrusion process. Major raw material is unwrought aluminium ingot. The industry is dominated by Alcan Thai, the largest producer which controls slightly over one third of the country's total capacity and captures about one half of the domestic market.

Compressed Gas Cylinder

As of 1983, there were 4 producers of LPG cylinder as listed in table 1.8. Their combined capacity was estimated at 1.5 million units per year. The cylinder size varies from 4.5 kg. to 50 kg. About 75% of the total production is the 15 kg. size which is commonly used for cooking by households. Between 1976 and 1980, production increased steadily and rapidly from about 200,000 units to 630,000 units. Production in 1981 and 1982 fell much below the 1980 level due to sharp decline of exports. The capacity utilization rates in the last few years have been well below 50%. In recent years, Thai households have been switching their cooking fuel from traditional sources to LPG at a rapidly increasing rate. The use of LPG in place of charcoal and firewood is expected to become more widespread in the near future in view

Table 1.8 : REGISTERED CAPITAL. NUMBER OF EMPLOYEES AND CAPACITY OF COMPRESSED GAS CYLINDER (1983)

	Registered Capital (million baht)	No.of Employees	Capacity
Gas Cylinder Industry Co.,Ltd	11.25	471	1,152,000
Sahamit Gas Cylinder Co.,Ltd	15.00	35	64,800
Chuansiri Co.Ltd	25.00	197	222,000
Saeng Uthai Engineering Co.Ltd	1.00	75	60,000
Total	52,25	778	1,498,800

Source : Ministry of Industry

of the availability of supply of natural gas from domestic sources and the scarcity of wood.

The industry employs about 800 workers, more than half of which are in the largest firm which controls about 75% of the total capacity. Major raw materials are steel sheet, brass and steel rods. About 80% of raw materials are imported. Export of LPG cylinders is highly fluctuated but generally exceeds import. In 1980, export of the cylinders surpassed half a million units, representing about 85% of production. It fell sharply in the three subsequent years to about 140,000 units in 1983.

Steel Cabinet

There are 6 major producers of steel cabinet plus some small and unidentifiable producers. The total number of steel cabinet producers is estimated to be fluctuating around 20. Total production capacity of the 6 major producers is estimated at about 210,000 units per year. A survey in February 1984 indicated that the actual production at that time was about 90% of capacity. At such the level of production, annual turn over may be estimated at about 300-400 million baht. Comparing to the employment level of nearly 1,000 and the registered capital of 12 million baht, this industry can be said to be highly labor intensive.

Production Cost

Our attempt to obtain the production cost data through interview was unsuccessful as the interviewed firms were unwilling to reveal such informations. Therefore the cost data were sought from various publications from the series of the specific Industrial Economic Reports of the Ministry of Industry. The cost structures of some metal products which are available from these reports are presented in table 1.9 with some modification to make them comparable. As These reports employed different accounting framworks and the methods are not precisely known, the comparisons of the cost structures among these products are only tentative.

With the exception of cast steel pipes, the greatest component of the cost of these products is raw materials which ranges from 64.4 per cent in rolling mills to more than 90 per cent in galvanized sheet, tin plate and small welded pipes. In steel bar making, the cost of raw materials for the rolling mills is much lower than for the re-rolling mills because the former use cheaper steel scrap which has to be melted before undergoing the rolling process. Energy is generally a significant cost component in the products that involve the process of heating the workpiece at high temperature such as in rolling mills, aluminum extrusion and cast steel pipes. Labour cost is relatively insignificant in the production of tinplate, galvanized sheet, small welded pipes and aluminum extrusion.

Table 1.9: COST STRUCTURES OF SOME METAL PRODUCTS

(Percentage)

Product	Raw materials	Energy	Wage & Salary	Others
Steel bars				
- rolling mills	64.6	16.4	9.2	9.8
- rerolling mills	79.2	6.5	4.4	9.9
Galvanized sheet	91.4	2.2	2.2	4.2
Tin plate	91.1	2.5	1.3	5.1
Welded pipes				
- small	90.5	4.5	1.7	3.3
- large	72.9	5.0	17.0	5.1
Cast steel pipes	21.4	35.7	21.4	21.5
Aluminum extrusion	75.9	11.1	2.5	10.5
LPG tank	69.6	1.1	18.5	10.8

Source : Ministry of Industry

Raw Materials

Comparison between the existing steel industries in Thailand and the flow diagram of figure 2 reveals that some important links are missing in the domestic production structure. These missing links put the country on a serious dilemma between letting the industries continue to rely heavily on import of steels and taking the risk of establishing the crucial links namely an integrated steel mills or a sponge iron plant. At present, Thailand has to import about 2.5 million tons of steel products annually. About half of this total is in the form of coil, plate and sheet used as raw materials in tinplate, galvanized sheet, steel pipe and other sheet metal working industries. About one quarter of the total import of steels is in the form of scrap mainly used by rolling and re-rolling mills.

In the production of steel bars, the rolling mills are less dependent on imported raw materials as the use of electric arc furnace allows them to use domestic steel scrap. The ratio between domestic scrap and imported scrap used by the rolling mills is approximately 9:1. The re-rolling mills are totally dependent on imported steel scrap. All flat steel users are also entirely dependent on imported coils, sheets and plates. These industries are thus very susceptible to the fluctuation of steel prices in the world market. For example, when the world price of tin plate drops sharply as in the year 1982 and 1983, the price differential between steel coils and tin plate became very narrow and the industry lost much of its domestic market

share to imported tin plate.

Our survey of 24 firms in the metal product industries found that 12 of these firms are totally dependent on imported raw materials. Only 2 firms use 100% domestic raw materials. Among the remaining 10 firms, 7 firms use imported raw materials in greater amount than domestic raw materials. In nearly all cases, the reason for using imported raw materials was given as due to unavailability of domestic supply. A few firms also indicate other reasons as reported at the lower part of table 1.10.

Among other raw materials, scrap deserves special attention in the course of steel industry development. In 1983 the local steel producer used 95 per cent local scrap, whereas for the re-roller, this amount has been estimated at less than 10 per cent. Scrap arising within the steel industry is estimated at 100,000 tons. This is the scrap with known properties. The total amount of local scrap is estimated at about 400,000 tons, a level already reached in 1980. Therefore 300,000 tons are industrial scrap and capital or old scrap, with the larger share comes from the former category.

With a growing steel consumption, the amount of industrial scrap may rise accordingly. However, with improvements in the technology the relative by increasing share of the scrap will decline. As the amount of old or capital scrap still will be limited, local scrap to supply the existing steel industry will be in short supply, when the steel industry wants

Table 1.10: DISTRIBUTION OF FIRMS BY PROPORTION OF IMPORTED RAW MATERIALS V.S. DOMESTIC RAW MATERIALS

% of imported raw materials	Number of firms	Products
0	2	Cast steel pipe, Brass casting
1 - 20	2	steel bar, steel casting
21 - 50	1	Steel wire
51 - 80	4	Metal furniture, Lock set, Aluminum products
81 - 99	3	Welding electrode, Bolt & Nut, Gas container
100	12	Welding electrode, Fire extinguisher, Switch board, Sheet metal cutting, Lock set, Drawing dies, Metal fixtures, Steel bar, Welded pipe.

Reason for using imported raw materials

	given by
Unavailability of domestic supply	20 firms
Better quality	4 "
Cheaper	3 "
Convenience	2 "
Binding agreement with joint venture partner	0 "

Source : Survey

to keep their share of the market or even wants to grow faster, by forcing some of the re-rollers out of the market.

It has been found that the price of scrap in Thailand is structurally on the high side, more than 2,000 baht/ton for a rather poor quality compared to US $ 78.5 as the quoted price in the USA for the first quality (those prices have to be compared at an exchange rate of 23 baht/$). The high price can be regarded as a consequence of the high price of imported scrap, based on the USA price including transport and handling cost. Another reason is attributable to the structure of the collection system. Here a lot can be improved, and will be improved when the whole infra-structure of Thailand becomes more adapted to the industry and when the industrial plants grew larger and have to take care of organizing their own waste problem.

It may be concluded that the availability of local scrap in Thailand will allow some further growth of the existing steel industry, giving them a chance to achieve better operating rates. On the other hand, the availability will not be enough to allow the existing steel industry to take care of the total supply of non flat products. To rely on imported scrap for this purpose will be at rather high costs and with always the risk of limitation in scrap exports by the USA and the EEC.

An alternative source of good quality scrap is a ship-breaking yard. Thailand has some advantages here as regards the availability of labour. However, as the country exports

relatively large amount of bulky products such as rice and tapioca, part of the ships to be demolished have to be brought in with only balast load, and therefore causing additional costs. Also up to now the market in Thailand for other products, recovered from the demolished ships is fairly small.

Capacity Utilization

Reviews of subsectoral studies indicate that many subsectors of the metal product industries are operating at low rates of capacity utilization. Our survey of 15 firms in these industries also confirms this fact as can be seen in table 1.11. These firms were also asked to give their estimates of the effect of capacity underutilization on their unit cost of production. Among the 15 firms that provide such estimates, only 2 firms had the opinion that it did not affect the unit production cost. The other 13 firms believed that the unit cost could be lowered if they operated at full capacity. The reduction cost was estimated at 5 per cent by 3 firms, at 10 per cent by 5 firms and at 20 per cent to 40 per cent by the remaining 5 firms.

Apart from the re-rollers that in general use rather poor machinery except for few of the bigger ones, the under-utilization is not caused by technical factors. The main cause lies in the limitations of the demand, whereas for the galvanizing industry the high seasonal effect has to be taken into account. The export market cannot be exploited due to the following reasons:

Table 1.11: CAPACITY UTILIZATION AND ITS EFFECT ON UNIT PRODUCTION COST

Products	No. of employee	No. of Working hours	Capacity Utilization	estimated % cost reduce if operate at the capacity
Steel bar	80	16	38-50	30-40
Sprocket, Bearings Roller	30	12	50-67	5
Aluminium Tube	270	24	more than 50	more than 25
Latch, Hinge, Handle, Section	17	11	55-73	10
Dies, Tip	41	8	50-75	not reduce
Lock Set, Mensunny Tape	135	8	50-75	not reduce
Lock Set	60	8	50-75	10
Steel Chairs and Desks Steel Shelves	60	6	67-100	15
Switch Board Steel Cabinets	25	8	25-50	20
Sheet Metal Cutting	6	6	67-100	30
Tanks, Tool Box	10	8	50-75	5
Tanks	51	12	50-67	10
Wire Rod (welding rod)	134	20	30-40	10
Serew Bolt and Nut	14	8	75-100	10
Wire Rod	19	8	75-100	40

Source : Survey

For the steel mills : high costs of raw material, scrap, ferro alloy, disadvantage as regards transport costs.

Re-rollers : high price of scrap.
low quality of the products.

Tinplate/galvanizing: high dependence on imported raw material value added created in Thailand sometimes even less than the extra handling and transport cost.

Tube and pipe making : high dependence on imported raw material, but slightly less than the former industries. Depending on the state of the world market, export has proven to be possible, but only within the framework of the Japanese mother company.

As for the whole iron and steel can be classified as a process-based industry or for some parts an equipment-based industry (see : UNIDO : Appropriate industrial technology for basic industries, p.61), the technology needed is acquired from the supplier of the equipment and further developed with some engineering consultancy. When needed the interviewed companies

all reported that for modification of the existing equipment they could rely on assistance from the company that has developed the process modification (e.g. the oxygen blown EAF at Sisco, developed by Thshin from Japan). This is a common phenomenon, seen in the steel industry over the whole world.

In spite of this application of universal process technology, the steel industry in Thailand faces a quality problem : The steel users, mainly the small building industry, is not asking for quality, but for low prices. This means that by not keeping to the standards, the re-rollers have forced the steel mills out of the market. Improvement of the standards and a strict implementation will force a large number of the re-rollers to use better input material, e.g. billets bought from the steel mills, and to invest heavily in better equipment. This will force some of them out of the market, others will solve their problem by making joint ventures. The result of such a policy will be an overall reduction of capacity and therefore some improvement of the capacity-utilization rate. A further improvement of the utilization rate will be achieved by the growth of the market.

Consumption and Growth Pattern

The domestic consumptions of steel in seven major product groups over the 1975-1982 period are shown in table 1.12. Between 1975 and 1979, the total consumption of these seven groups increased rapidly form 1.03 million tons to 2.01 million tons. After the oil shock in 1979 which was followed by worldwide recession, the amount of steel consumption appears to be

Table 1.12 : STEEL CONSUMPTION BY PRODUCT GROUPS

(thousands of metric tons)

Year	Bars/ Sections	Rails/ Wire rods /wire products	Sheets	Tin plate	Galva- nized	Tubes & Pipes	Other Flat Products	Total
1975	483	101	64	46	112	129	94	1,029
1976	588	129	251	71	130	173	90	1,432
1977	708	176	232	86	160	165	115	1,640
1978	794	160	336	88	139	140	44	1,701
1979	808	186	414	131	222	154	96	2,011
1980	703	147	363	97	146	155	66	1,677
1981	703	143	514	141	171	148	50	1,870
1982	577	137	529	114	170	125	53	1,705

Source : Ministry of Industry

stagnated. Under this overall growth pattern, the composition of the steel consumption has been changed gradually in favor of flat products as their share has increased from 43.2 per cent in 1975 to 58.1 per cent in 1982. The fastest growth is steel sheets which are used for a variety of products such as automobiles, furniture, and air conditioners. Consumption of steel sheets in 1982 was about eightfold of that in 1975. Tinplate and galvanized sheet also increased rapidly during this period while tubes and pipes and other flat products appeared to be stagnated.

Table 1.13 shows the patterns of production, trade and apparent consumption in value terms of the metal product industries during the 1978-1982 period. The apparent consumption appears to grow slowly even in terms of current value of baht. When these values were deflated by the GDP deflators, the consumption growth over this period was found to be negative at -8.0 per cent. This is probably due largely to the falls in relative prices of most of these products as suggested by comparison between the changes in the price of some major products and the change in the general price levels as shown in table 1.14.

As a result of the weak domestic demand expansion over this period, the growth of production of the industries was relatively slow and even negative when measured in real terms. Production of metals and metal products at current prices increased by only 25.4 per cent over the 1978-1982 period, contrasting to the increase in the gross domestic product of

Table 1.13: VALUES OF PRODUCTION, TRADE, AND APPARENT CONSUMPTION OF METAL PRODUCTS.

(million of baht)

	Production	Import	Export	Apparent Consumption
I Iron & Steel and Secondary steel products (I-O:105-106)				
1978	8,495	9,520	249	17,766
1979	11,486	13,093	459	24,120
1980	11,860	12,633	1,057	23,436
1981	10,880	16,405	700	26,585
1982	10,207	13,624	750	23,081
II Nonferrous metals (I-O:107)				
1978	11,831	2,325	7,418	6,738
1979	15,556	3,493	9,352	9,697
1980	19,204	4,170	11,467	11,907
1981	17,181	4,512	9,196	12,497
1982	14,189	4,107	7,945	10,351
III Fabricated metal products (I-O:108-111)				
1978	6,328	2,474	597	8,205
1979	6,831	3,228	857	9,202
1980	8,276	5,310	1,360	10,226
1981	8,698	4,202	1,396	11,504
1982	9,019	3,292	1,451	10,860
IV All metal products (I-O:105-111)				
1978	26,654	14,319	8,264	32,709
1979	33,873	19,814	10,668	43,019
1980	39,340	20,113	13,884	45,569
1981	36,759	25,119	11,292	50,586
1982	33,415	21,023	10,146	44,292

Source : NESDB

82.7 per cent over the same period. Measured at constant prices, the production of metals and metal products over this period decreased by 14.8 per cent while the GDP increased by 24.2 per cent. The fall in real value of production was greater than that in consumption due to the increase in the share of import in domestic consumption coupled with the stagnation of the world demand for tin, the greatest exported item of the metal industries.

Table 1.15 shows the percentage growth of each subsector of the metal industries as measured at current prices and decomposes the growth of each subsector by the three sources, namely domestic expansion, import substitution, and export expansion. The subsectors that grew faster than GDP were the two smallest ones, i.e. metal furniture and fixtures and structural metal products. The percentage growth of the three larger groups, namely iron and steel and secondary steel products, nonferrous metals , and cutlery and hand tools were unsatisfactorily low and would have large negative values if measured in real terms. These subsectors also lost much of their market share to imports as evident from large negative contribution to growth in the import substitution components.

Except for nonferrous metals export expansion of all other subsectors outpaced their respective domestic demand expansion and contributed significantly to production growth. However, the negative contribution of the nonferrous metal subsector alone was significant enough to negate the overall export expansion effect. The overwhelming effect of the

Table 1.14 : PRICES OF MAJOR METAL PRODUCTS

	Prices in		%
	1978	1982	change
Steel bars (baht/kg)	6.60	8.04	21.8
Galvanized sheet (baht/ft)	4.15	6.72	61.9
Tin plate (baht/kg)	12.49	17.69	41.6
Welded pipe (baht/kg)	8.60*	7.58	-11.9
Tin metal (baht/kg) **	249.77	312.31	25.0
GDP deflator	180.0	261.1	45.1

* average price of welded pipe in 1980

** average export prices of tin metal

Sources : NESDB
BOT
MOI

Table 1.15. GROWTH AND SOURCES OF GROWTH (1978-1982)

(Percentage)

Sector	Growth	Domestic expansion	Import substitution	Export expansion
105 & 106	20.2	148.5	-73.4	24.9
107	19.9	269.0	-22.7	-146.4
108	10.5	91.6	-19.3	27.7
109	89.6	70.6	-0.3	29.7
110	89.6	92.7	3.6	3.8
111	58.1	68.7	0.3	30.9
Total	25.4	139.6	-24.1	-15.5
Excluding tin	32.2	110.2	-25.8	15.6

nonferrous metals can be pinpointed to a single commodity, tin, whose export dominates the whole exports of this product group. The exclusion of tin from these industries drastically changes the export expansion effect of the group from -15.5 per cent to +15.6 per cent.

In summary, the growth performance of the metal and metal product industries during the 1978-82 period was quite unsatisfactory. The industries were confronted with sluggish domestic demand expansion and stiff competition from imports. The lost of market shares to import resulted in the reduction of production growth by about 25 per cent. The stagnation of tin export was the main reason for slow expansion in exports of this product group relative to domestic demand expansion and thus contributed negatively to the growth of production. Export performance of the rest of the industries was quite respectable as they grew relatively fast and significantly contributed to the growth of the industries.

Determinants of Demand

At the outset the metal and metal product industries were shown to have very high forward linkages which implies that these products are used extensively in industrial production relative to final demand consumption. According to the 1975 I-O Table of Thailand, the industrial consumption of iron and steel and secondary steel products in that year was about 10,660 million baht as compared to the final demand consumption of only 341 million baht. For the fabricated metal products, the values of industrial consumption and final demand consumption were 4,615 million baht and 3,641 million baht respectively. The nonferrous metal sector has a special characteristic that its demand is greatly influenced by the export demand for tin. For the domestic demand component, the industrial consumption accounted for about 2,895 million baht compared to the final demand consumption of only 376 million baht.

As the final demand component of the basic metal products is relatively insignificant as compared to the industrial demand, the demands for these products should be analyzed in relation to the user industries. The major user industries of the basic metal products may be identified as construction, fabricated metal products, electrical and nonelectrical machinery, and motor vehicles and other transport equipment. The construction sector is the direct user of steel bars, galvanized sheet and welded pipes and has an indirect influence on the demand for other metal products through its needs of construction machinery and equipment. The relationships

between fabricated metal products, machinery, transport equipment, and basic metal products can be seen from the diagram in figure 1.

On the demands for individual products, the regression analysis has been applied to a few major products in two studies. The study by the IFCT in 1982 analyzed the demand function of steel bars and wire rods, galvanized sheet, and tin plate. /1 The demand for steel bars and wire rods was found to be significantly influenced by the value added in construction. The demand for galvanized sheet was found to be explained by the value added in agriculture since it is used mostly in the upcountry area. The demand for tin plate was found to be influenced by the production level of canned pineapple and condensed milk since tin plate is used mostly in the production of can which in turn is used mostly by these two industries. The Market Survey paper by Vlemmings analysed the demand function of tin plate, galvanized sheet, sheet and plate, and nonflat products for forecasting purpose. /2 A suitable explanatory variable for forecasting the consumption of tinplate was found to be the level of agricultural production. That for galvanized sheet was found to be the purchasing power of the agricultural sector. The level of industrial production was used as the

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/1 IFCT, Comparative Advantage in the Iron and Steel and the Petrochemical Industries in Thailand, Bangkok 1982.

/2 Vlemmings.

explanatory variable of the demand for sheet and plate, and the demand for nonflat products was related to the construction sector. The results of the two studies can be said to be essentially the same. They are different only slightly in the definitions of the variables and the choice of functional forms.

Growth Prospects

Consumption of steel in developing countries like Thailand is generally expected to grow rapidly. From 1975 to 1982, consumption of steel increased by 66 per cent by weight as compared to the increase in real GDP over the same period of 59 per cent. However, the growth of steel consumption is highly sensitive to business fluctuation. As table 1.12 shows, the growth of steel consumption was remarkably high during the period of rapid economic growth between 1975 and 1979. After 1979, the growth of GDP started to slow down and the consumption of steel dropped sharply. The sensitiveness of steel consumption to economic fluctuation is related to its major user industries, i.e. construction, fabricated metal products, machinery and transport equipment. All of these industries are subject to high degrees of fluctuation as their products are investment goods and consumer durables.

The patterns of growth over the past few years show more rapid and robust growth in the metal furniture and fixture, the structural metal products and the other fabricated metal product sectors than the basic metals and the cutlery and hand tools sectors. The fabricated metal product industries may be

expected to maintain relatively high growth rates in the future. These industries are less subject to scale economy and have relatively high labour intensities. /1 From 1978 to 1982, export of fabricated metal products increased by 143 per cent and the share of export in total production increased significantly from 9.4 per cent to 16.1 per cent.

The opinions of the producers on the growth prospects of their products were solicited in order to check whether their views are different from ours. On basic metal products, their outlooks are divided equally between slow expansion and stagnation. Those who foresee no expansion at all are the producers of steel bars and iron and steel castings. Slow expansion is foreseen by the producers of steel wires, welded pipes, and nonferrous metal products.

On fabricated metal products, the outlooks are relatively brighter. From the 13 respondents, 5 of them expect rapid expansion in the future, 5 expect the expansion to be slow, 1 expects no growth and 2 anticipate declining demand. More details are presented in table 1.16.

/1 Direk Patmarisiwat. Employment and Industrial Growth, Report prepared for NESDB, Thai University Research Association, Bangkok, 1980

Table 1.16 : EXPECTATIONS ON FUTURE PROSPECTS OF METAL PRODUCT PRODUCERS.

Products	Outlook	Reason
Basic Metal Products		
steel bar (1)	no growth	Stagnation in construction
" (2)	"	"
" (3)	"	"
iron/steel casting(1)	"	"
" (2)	"	"
aluminum extrusion(1)	slow expansion	competition from new products
" (2)	"	"
brass casting	"	"
steel wire	"	"
welded pipe	"	"
Fabricated Metal Products		
welding electrode (1)	rapid expansion	"
switch board (1)	"	growth in electricity consumption
" (2)	"	"
lock set (1)	"	consumers becoming more convinced of his product quality
drawing dies		"
welding electrode (2)	slow expansion	loosing market share to special welding electrode
bolts and nuts	"	economic slowdown
cast steel pipe	"	"
LPG tank	"	economic slowdown
sheet metal cutting	"	competition from plastic products
fire extinguisher	no growth	"
metal furniture	decreasing demand	competition from knock down furniture
metal fixtures	"	"

II. TECHNOLOGICAL CAPABILITIES

Introduction

Apart from the trade structure and financial constraints, technology is one of the most important factors that limit the growth of the industry. As discussed in earlier sections, the majority of the industries in this subsector are process-oriented and are of small to medium size. At present, barriers or obstacles to modernization and development of the industries in this subsector result in high cost, degraded product quality and general inability to utilize the flexibility advantage of the process oriented and of the small to medium size industry, i.e., not able to react quickly to the change in market situation. For the industry to be competitive, they must utilize the existing resources of machines and labour efficiently and must have continuous programme to improve their technical capabilities.

In the past years, there have been a number of assessment of the technical capabilities of Thailand is engineering industries. The major works include the JICA/Technonet Asia survey of small and medium metal firms in 1978, Mr. Moore's World Bank Mission in 1979, RDR/ISI feasibility study of a project to develop engineering industries in Thailand in 1981, and IMC report on technical assistance for engineering industries in 1984. These reports, however, emphasized the engineering industries as a whole. No report focused on the metal and metal product industries.

In our study, the method of collecting data is a personal interview using a questionnaire and direct observation. The purpose of the survey was to establish some general impression of the technological capabilities and operational characteristics of the metal and metal product industries. The survey was conducted on 35 firms in August-September 1984, but the sample was not drawn in any rigidly systematic way. There was no list of firms available which could serve as a sampling frame. The consultants and the staff of the Industrial Management Co.,Ltd., and the Industrial Service Institute used their local knowledge and some research in directories and similar publications to draw up a list of the metal and metal product firms. The results presented below represent a distillation of the most relevant and interesting parts of the survey. Supplementary information from the previous studies was also analyzed and taken into account to give a clearer snapshot of the industrial capability.

The products of the subsector can be categorized as:

(a) flat products; the products that are produced from raw materials in flat-form and involving few operation such as pressed part, pipes.

(b) fabricated products; the products that involve some fabrication works such as storage tanks, boilers, metal furniture , lock sets.

(c) casted parts and forged parts; the products that are made by casting or forging.

(d) sections; the products that are made from ingots which are rolled or extruded to form various types of sections such as round bars, angles etc.

General Diagnosis

Similar to the whole engineering industry sector, the firms in the metal and metal product industry subsector can be roughly divided into two groups. The first group consists of small local firms which do not possess significant technological capability. They seemed to lack basic knowledge of production technologies, of metallurgy, of the use of fine measuring instruments, of management techniques, and of the ability to get access to industrial information. Plant and equipment are generally out of date, in poor condition, and operate inefficiently. Typical examples are small foundry shops, small forging shops, and small fabrication shops scattered around the country. Some firms emerged because of commercial prospects such as the re-rolling mills. Firms in this group usually concentrate on the manufacturing of basic metal products including furniture , agricultural hand tools, simple structural metal products, and simple fabricated metal products. These products usually can conform with very low quality requirements, the delivery is always irregular and can be sold mostly in the lower end of the market.

Those firms in the second group are relatively larger establishments. Their operations are on the type of products that

usually require large investment and involve higher level of technology. Typical examples are the rolling mills with melting furnace, large scale foundries and forging plants, and large fabrication establishments. The firms in this group are either fair or well equipped both with machinery and personnel. Most of these firms obtained their production technology from abroad either in the form of joint venture, licensing agreement or technical assistance and consultancy through the purchase of equipment and raw materials. Some fabricating firms gain their technological knowhow through the subcontracting works from foreign firms. Although the firms in this group do not have the capability to produce wide range of products to effectively support the engineering industry, in most cases, they are able to produce their products to conform with requested standards, tolerance and other requirements including delivery regularity.

In general, the overall picture of the industry in the metal and metal product subsector is similar to the whole engineering industry sector. They share some basic problems such as poor plant layout, poor plant conditions, lack of managerial skills, lack of technical knowhow and technical manpower etc. However, a large number of products of the subsector involve limited number of processes. Main processes are casting, forging, metal forming (rolling, extrusion and press work), heat treatment, surface finishing and welding and fabrication, as shown in Table 2.1. In most cases, the processing facilities are versatile and can turn out a variety of products. Once the firm possesses adequate technical knowhow in the major process

Table 2.1 : MAIN PROCESSES EMPLOYED

Main Process	No. of Respondent	%
1. Casting	6	17.1
2. Forging	1	2.8
3. Sheetwork and welding	7	20.0
4. Plating	1	2.8
5. Assembling	1	2.8
6. Machining	3	8.5
7. Presswork	8	22.8
8. Heat treatment	-	-
9. Rolling	13	37.1
10. Drawing and extrusion	-	-
11. Unspecified	3	8.5
Total	43	100.0

Note : More than one choice can be applicable to any one plant

Source: Survey.

involved, the firm can become a product specialist by acquiring or developing the specific knowhow that might be needed to produce a specified product.

There are some factors that worth special discussion. These factors are those related to plant equipment and maintenance, workforce and productivities and technical capabilities which include such factors as technical manpower, R&D activities, etc. The first two factors are discussed in the following paragraphs while the technical capabilities are discussed separately in later section.

Equipment and Maintenance

Sophisticated equipment and major machinery are all imported, either new or used. Some plants import the whole processing equipment however, most plants import only major equipment and have the accessories built locally. Local industries are capable of supplying simple machinery such as presses and many process accessories such as heating furnaces, cooling towers, mixing tanks etc. (with imported major parts). Some equipment are locally built by copying from the original imported model. However, the locally built equipment containing moving parts or subjecting to severe operating conditions are likely to have durability problem and accuracy problem.

Equipment in many plants are rather old. As shown in Table 2.2 of the 35 firms covered in the survey, only 7 firms use relatively new equipment. Comparing to newer equipment

Table 2.2 : AVERAGE AGE OF MAIN MACHINERY AND EQUIPMENT IN USE
(No.of Respondent)

Average Age	I-O Code						Total
	106	107	108	109	110	111	
1. Over 10 years	7	2	1	1	1	-	12
2. 6-10 years	4	2	2	2	2	4	16
3. 2-5 years	2	2	1	1	-	1	7

Source : Survey

designed and built with more advanced technology the older equipment consume more energy and have lower productivity rate. This results in higher production cost especially for the energy intensive equipment such as the melting furnace. One firm indicated that its melting furnaces consume 37 per cent more energy and 45 per cent more electrode comparing to average industry in Japan producing at the same capacity.

The majority of the firms in the subsector do not have maintenance programme for their equipment. As illustrated in Table 2.3, few larger companies have scheduled maintenance. No company has higher level maintenance scheme such as productive maintenance. There is a shortage of maintenance personnel both in the managerial and the operating level. One plant recorded the equipment downtime ratio as high as 50 per cent. In some plants where the processing equipment were purchased from abroad , the maintenance personnel were sent for training with the supplier at the time of purchase. These personnel, however, are unable to properly maintain the equipment.

As more sophisticated machinery are introduced, the shortage of maintenance personnel will become more serious. Currently there is serious shortage of maintenance personnel who have experience in servicing instruments and electro/mechanical system.

Some of the repair or replacement parts are locally produced. The quality of the parts is normally inconsistency and is generally lower than the original parts, this results in

Table 2.3 : MAINTENANCE PRACTICE

(No. of Respondent)

Method Used	I-O Code						Total
	106	107	108	109	110	111	
1. When breakdown occurs	4	4	1	2	2	3	16
2. As convenient	1	-	1	2	-	2	6
3. Arbitrarily set routine schedule	9	2	3	-	-	2	16
4. As suggested in instruction manual	-	-	1	-	-	-	1

Source : Survey

higher downtime. Maintenance of production tools is also poor. Classic example is the maintenance of cutting tools. The reshapening of tools are mostly done by hand. This results in the cutting surface being ground at incorrect angles, therefore, excessive wear of tools and poor quality products.

Workforce and Productivity

The majority of the workforce in the metal and metal product industries have only primary school education. A very high proportion of new labour recruited into the industry come without benefit of any training in industrial skill. The foremen or job supervisors are either experienced workers or trained craftmen or technicians. With the exception of Siam Iron and Steel Co.,Ltd., no firms in the subsector had something which may be called a training scheme. The usual method for training workforce, as shown in Table 2.4, is on the job under the supervision of established workers or foremen. Some firms send their supervisory personnel to seminars or short courses training mainly those offered by the Thai-Japan Technology Promotion Association.

In most firms, there seems to be a lack of standard job methods and job instructions. The majority of the firms surveyed provide only simple, sketchy drawings or by words as shown in Table 2.5. There are only a few application of accessories such as jigs and fixtures to simplified work and for better utilization of unskilled labour. Smaller firms are also subjected to high labour turnover rates while the larger firms

Table 2.4 : TRAINING FOR NEW LABOURS RECRUITED

(No. of Respondent)

Method Used	I-O Code						Total
	106	107	108	109	110	111	
1. By more experienced workers	4	3	2	4	1	3	17
2. By foreman	9	2	3	-	1	2	17
3. By engineer	2	-	1	-	-	-	3
4. By training scheme	1	-	-	-	-	-	1

Note : More than one choice can be applicable to any one plant

Source: Survey

Table 2.5 : METHOD OF JOB INSTRUCTION

(No. of Respondent)

Method Used	I-O Code						Total
	106	107	108	109	110	111	
1. Providing sample, sketchy drawing or by words	7	3	3	4	3	4	24
2. Drawing and technical spec. from customers	1	1	1	-	1	-	4
3. Drawing and technical spec. prepared by the plant.	2	-	1	-	-	1	4
4. Others	2	1	-	-	-	-	3

Source : Survey

tend to have more stable workforce.

Poor job assignment practice in which the workers are not assigned to a specific job but rather be rotated to several activities does not allow the worker to accumulate work experience, this practice can be found in some factories. All these factors combined result in low productivity of the workforce. Most workers lack full understanding of their job. The productivity improvement under present situation is difficult.

Operating Practice - Major Processes

Foundry and Casting

Most of the foundry work are small scale operations. The widely use processes are sand casting and die casting. Foundry shops using sand casting technique have been in existence for a long time, producing both cast iron and non-ferrous casting. Steel casting technology and die casting technology, on the other hand, have been introduced into local scene only during the last 15 years. At present, there is significant difference in the technology among the non-ferrous and cast iron industry which use sand casting processes, the steel casting industry and the die casting industry. The companies which produce steel casting are larger establishments with fairly modern facilities and, in most cases, with good access to foreign technology. The die casting technologies have been well unastered by local companies. In contrast, most of the non-ferrous and cast iron industries still employ the same techniques which have been practised for many decades. Technological improvement in this

sector is low because, in most cases, owners and workers alike lack educational background. Since most of them acquire the skill through apprenticeship, the same methodology is employed over and over again without significant improvement.

Sand Casting Technology

Sand Moulding: Green sand is the most popular for sand moulding. Some foundry shops use bentonite and resin sand. This is due to the fact that green sand has been used for a long time and the investment is low. In terms of mechanization of mould making, approximately 70 per cent of the factories surveyed make their moulds and core by hand. Only two out of eleven factories surveyed employ automatic or semi automatic moulding and core making machines. The survey reveals that only 9 per cent of the firms have their own sand testing facilities and regularly do their own sand testing. More than 70 per cent do not perform quality control of sand for moulding.

Pattern Making: Patterns used in most foundry shops are made of wood, except for large batches when metal one are justified. Some foundry shops have their own pattern making section where wood patterns are made. The survey results show that over 60 per cent of the pattern used are made from outside.

Material Handling: Larger foundries employ forklift and overhead crane in their casting shops. However, in smaller foundries, hand-carried is the only method used. By using the hand carried laddle, the weight of the casting is limited and in

some cases, the quality problems due to temperature drop of molten metal can be created. The handling of sand is generally poor in both larger and smaller foundries. The popular equipment used are spades and wheel barrows rather than hoppers and conveyors.

Cleaning: In most foundry shops, casting is removed manually. Less than 20 per cent have shake out machines. Cleaning and finishing are mostly done by hand and hand grinders.

Die Casting Technology: Die casting technology is a relatively new technology in Thailand. Most of the factory and equipment used is relatively new. Many die casting shops are actually a section of the firm producing various kinds of products. Nearly all the factories produce aluminum alloys casting. Some produce zinc alloys and few factories produce copper alloys.

One of the most important aspects of die casting is die design and die making. According to the survey by ISI in 1978, 70 per cent of the factories have their own die making section, 25 per cent have copy milling machine as well as EDM. The rest possess only general machine tools. Still, many have their dies made from outside dies making shops in the country. Some import dies from foreign countries.

Raw Materials: Pig iron and coke are the two basic raw materials for steel and iron casting. Aluminum alloys, brass and bronze are common basic raw materials for non-ferrous casting. More than half of these raw materials used are scraps.

All of the coke used are imported.

Melting Equipment: Cupola is the most popular furnace used in foundry shops. A few employ electric arc furnace or induction furnace. For non-ferrous casting, crucible is the most popular equipment. Few non-ferrous casting shops also employ induction furnace.

Workforce: Workers in nearly all the small foundry shops acquired the skill through apprenticeship. Due to predominance of manual operations, the demand for skill labour is high, but there is no institution , private or public, which offers skill training in foundry technology. Most operators of these small foundry shops possess little or no knowledge in the melting and pouring technique, no knowledge in the composition of casting and pay no attention to product testing or quality control.

Engineers and technicians can be found only in medium and large scale operations but many larger scale foundries still lack experienced metallurgical engineers.

Both groups of foundry shops still face the problem of shortage of qualified pattern makers who can work from drawing.

Product and Quality Control.

Most small sand casting foundry shops turn out product such as agriculturai hand tools, repair parts for

agricultural machinery, architectural metal works, plumber brass goods and pipe fitting. Many of these products are low priced and are substandard. Larger foundries can produce most standard alloy steel castings. Their major business is in the production of heavy parts for tractor, truck, and processing machinery. However, difficulties still exist in achieving the desire composition and microstructure in producing close-tolerance products.

Major products from die casting shops are auto parts, parts for electrical and telecommunication machinery and parts for architectural, carpentry, and household items. Few involve in production of hand tools.

Most of the foundry shops especially the smaller ones, pay little attention to the standard and quality of castings except for high quality products which require standard quality. For reference, they sometime use American, Japanese or standards of other countries, survey indicates that about 70 per cent of the firms perform mechanical testing while about 55 per cent perform composition analysis on some of their products. Out of these figures, 45 per cent of the firms have their own mechanical testing equipment and 36 per cent have composition analysis equipment.

Research and Development

None of the foundry surveyed has research and development personnel although there are some product development works carried on the on-and-off basis by regular plant engineers

with periodic consultation with university staff .

Problem of the Industry

The basic problem can be summarized in three categories:

(a) Most foundry shops lack technical knowhow and have soft metallurgical engineering base. This prevent them from improving their operations. Most people in the industry learn their skills through apprenticeship and the same method is repeated over and over again. There are insufficient education and training or workers and a shortage of metallurgical & production engineers to perform casting design and casting procedure effectively.

(b) The quality and standard of casting are among the most important elements for development of the casting industry. Because of fierce price competition and the cost-conscious nature of the average market, the quality level is on the decline.

(c) Domestic market is small and is not profitable. Only some types of products can be mass-produced economically.

Survey reports from Japan and England indicate that the foundry industry has been highly dependent upon the

automobile industry. Thus, if greater percentage of casted parts were to be used by local automotive industries, a comparatively large market for quality casting could be open up.

Forging

There are only two or three forges which are fairly well equipped and able to produce some forged parts to meet the need of modern industries. These larger forging shops are equipped with heat treating facilities and material testing facilities and are producing replacement parts to various automobiles, truck and contractor plant. Recent survey indicate that some companies can forge items having forged weight of up to 6 Kg. These type of forged components appear to have fair quality and workmanship. In general, local forged parts only have room for replacement, not originals equipment market where quality control is more stricted. The machinery manufacturer still import "as forged" parts for originals equipment market. Other forged shops are those producing bolts and nuts, hand tools and small jobbing shops produce simple products.

Similar to the die casting industry, an important aspects of forging is die design and die making. Larger forging shop have their own die making facilities. Some have the die made from independent local die maker.

Apart from the forging knowhow itself major problems of the forging industry can be identified as, first, the die design and die making capability of local industry.

Improperly designed dies increase working steps and more waste. Poorly made dies also result in high waste and shorter die life which, in turn increase the cost of the products. Second problem is marketing. Since major use of the forged parts is in automobile industry as shown in Table 2.6, a comparatively large market for the forging industry could be opened up if a greater percentage of forgings were to be used by local car and truck manufacturers. At present, the demand for forged parts is low. Two out of three forging shops surveyed reported, on the average, less than one working hour of their forging machine per day.

Presswork

Presswork is the mass production of parts from sheet metal. The process involves the pressing or stamping of blanks from the sheet and may be followed by blanking, piercing and forming operations. Typical products of the metal and metal products subsector which involve high degree of presswork are metal furniture and some structural metal products such as tanks and pressure containers. Other major products are electric machinery and automobile parts.

No plant visited was solely engaged in presswork, many were using presses as part of the manufacturing process for some of the components produced such as metal furniture, tanks and containers. Most of the small to medium size presses are locally built. These locally built presses normally have poor alignment and can be used to produce parts to a satisfactory quality level only for products which do not require close

Table 2.6: USE OF FORGED PARTS

Industry	%
1. Automobile	65.7
2. Agricultural Machineries	4.9
3. Other Vehicles	3.5
4. Bicycle	0.2
5. Machinery	8.9
6. Rolling stock	5.3
7. Mining	2.3
8. Ship building	0.7
9. Aero - industry	0.1
10. Others	9.4
	100 %

Source: Forging Handbook, Germany 1973

tolerance. The problem in presswork operating practice lies partially on the improper selection and use of the machine and partially on the lack of the capability in tools and dies design and production. The use of tools and dies is also unappropriate. It was noticed during the survey that very little use was made of die sets which are required for the accurate location of die and punch. These poor practices have resulted in high scrap rate and more secondary operations to bring the quality of products upto acceptable standard.

Almost 40 per cent of the press-shops surveyed engage solely in the production of steel products. Around 85 per cent of the presses used have capacity between 10 to 300 tons. Almost 80 per cent of the dies used are simple die. Only 30 per cent of the firms use progressive die or transfer die in their stamping works.

In terms of productivity around 80 per cent of the pressshops have manual operated press. Twenty percent of the firms employ more than one operator to operate the press. Only twenty per cent have semi automatic or automatic press machine. Also, almost 30 per cent of the press shops still use manual method of feeding the workpiece to the press.

Over 60 per cent of the pressshops have in-plant facility for tool and die making. The facility ranges from standard machine tools in most press shops to sophisticated machine such as EDM in a few press shops. However, in general, the press-shop lacks qualified experienced tool designer,

tool maker and tool fitter

It should be noted that according to the survey, the press-shops of the factories that produce locksets which are categorized under I/O code 108 Cutlery and Hand Tools appear to have higher level of technology compare to the rest of the subsector. .They are the shop that reported to use complex dies, having automatic or semi automatic machines and having in-plant facilities to produce all dies used. It is also noted that, many of the press-shops are subcontractee and supplier of press-formed parts to such industry as the automobile industry. They are mostly medium to large size firms, using good quality equipment, and have relatively good technical manpower.

Fabrication

Fabrication covers the joining of metal parts and includes such processes as welding, brazing and other metal joining processes as well as preparation of the part prior to these processes. Fabrication works in this subsector cover wide range of products from small and relatively light workpieces such as metal furniture to process equipment and to large structural products. The metal commonly used is steel which offers more strength per unit weight than other standard materials.

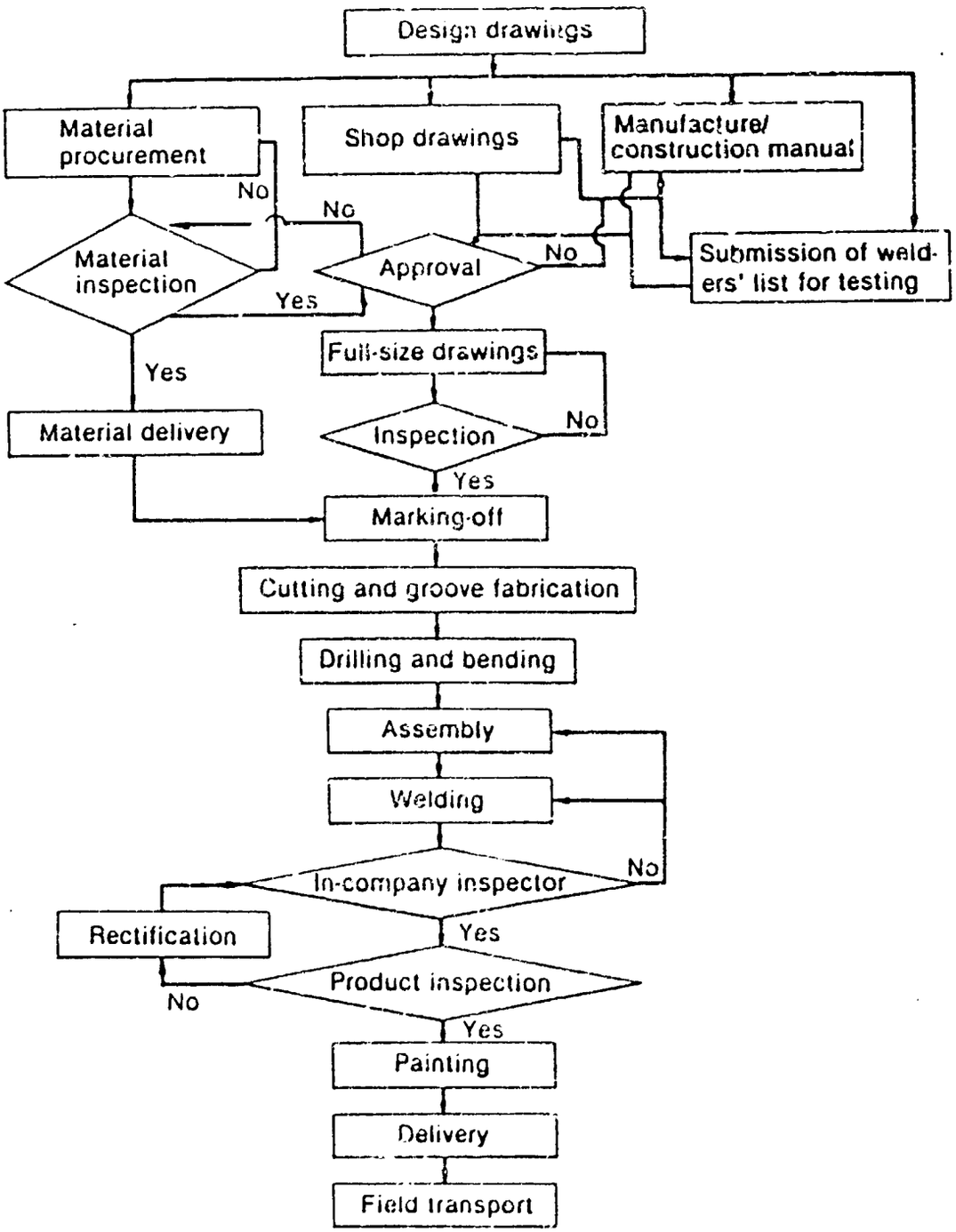
Steel fabrication consists of two main stages. It begins with cutting and forming of steel materials to the specific sizes and shapes along with any drilling that can be done before assembly. Next these steel members and parts are

assembled together. Today, electric welding is ordinary employed. Rivets or high-strength bolts are also used. For structural works, the prefabricated parts are coated and shipped to construction sites for final erection. The complete shop fabricatic process for steel structure is illustrated in figure 3.

For light fabricating products such as metal furniture , the processes employed are relatively simple. If proper equipment and tools such as jigs and fixtures were used, the industry would not require large number of skilled labors. Major problem in production process is die design, manufacturing and use. This results in poor dimensional accuracy and poor appearance of the products. For metal furniture in particular, poor dimensional accuracy can be major obstacle to the production of knock-down furniture. The metal furniture industry as a whole lacks product design capability. Most of the designs are copied from imported or from foreign catalogue. The steel plates used are also 100 per cent imported from countries which are major produces of the metal furniture .

Processing Equipment: Large fabrication firms are fairly well equipped with various types of welding and work piece preparation equipment. According to the survey, which focussed on the larger fabrication shops of the subsector, approximately 70 per cent of the firms employ semi automatic or automatic welding machine together with standard manual welding machine. However, half of these firms still use manual flame cutting method for weldment preparation. Jigs and fixtures are widely used in these

Figure 3 : SHOP FABRICATION PROCESS FOR STEEL STRUCTURE



larger establishments, 50 per cent of these firms reported regular use of jigs and fixtures in their fabricating operations and 20 per cent of the firms reported occasional usage.

For small fabrication shops, only simple electric and gas welding equipment are used. The control of the fabrication and welding processes is generally poor. The equipment used in preparing the workpiece for fabrication are fairly basic such as simple guillotines and flame cutter. Jig and fixture use is almost non-existent.

Product Quality and Quality Control: Larger fabrication firms have the ability to produce upto standards in some products. For such products as large storage tanks, pressure cylinders, and boilers, the fabrication works have been done according to standards. However, less attention appears to be paid to fabricating other products. For the products which are not under strict safety control, results from the survey indicate that almost half of the firms have no tolerance control of products dimension and only 20 per cent employ non-destructive testing techniques to inspect the weld.

Large fabrication shops fabricating standard products are equipped with testing facilities which range from mechanical testing to some non-destructive testing equipment such as ultrasonic apparatus or x-ray devices. Some firms employ outside agency such as TISTR to inspect and certify their products. The testing and certifying service is also available from private companies but has not been widely used by local

fabrication firms.

The fabricated products from small fabrication shops are normally of low quality and have poor appearance. There is no use of drawings, dimensional control or any inspection of welds except by eye inspection.

Workforce: In general, most of the fabrication shop are having difficulty of recruiting and retaining certified welders. Several certified welders have gone to a much better paid job in the Middle-east. The training and certifying program carried by the NISD is not sufficient to supply the whole metal industry. In addition, there is no reliable system of issuing the certificate of skills of the skilled workers in the industry, thus, when large fabrication work exists, the fabrication firms always have difficulties in finding the appropriate skilled workers.

Only a few firms feel the necessity for welding design. In most cases the work tends to be carried out rather haphazardly based only on past experience. Thus, many products show poor reliability against the basic principles of welding design. However, for the firms that carry large fabrication works and produce the products which must meet the standard, there are problems of shortage of experienced fabrication/production design engineers. The technical manager of one large fabrication firm visited indicated that most local fabrication designs and drawings do not contain enough information for actual fabrication work or production work. As the results, it is very

difficult to fabricate good quality works or to achieve the desired tolerance.

Raw materials: Practically all the raw materials input to the fabrication industry are imported. Steel plates and large steel sections are imported except for tubing section which are rolled locally but from imported steel plates The locally made welding rods also use imported raw materials. Bolts and nuts are locally made but the high strength bolts and nuts are also manufactured from imported raw materials.

Rolling Mills.

There are two types of steel rolling mills, the ones with melting equipment and the ones without melting equipment. The latter type is commonly known as the re-rollers.

For the steel mills with melting equipment, Daster report /1 indicated that, among ASEAN countries, Thailand is one of the most expensive countries as regards local scrap, labour cost, energy costs and electrodes, and by far the most expensive as regards ferro-alloys. Also, according to the surveys, the equipment conditions and operating practices of the rolling mills resulted in higher energy consumption rate and more electrode consumption per ton of steel production when comparing to the mills of the same size in developed countries. All this combined resulted in the uncompetitiveness of local steel industry.

/1 M.N. Daster Co.,Ltd., Study on Minimum Economic Size Plants for Steel Processes in ASEAN countries, Calcutta, 1980.

Major products of these steel mills are round structural steel bars. Although their products are conforming to standards, the lack of formal R&D activities and the lack of metallurgical engineers who specialize in steel making prevent the mills from improving the product quality or diversifying to better quality products which have more value added.

Most of the re-rollers have no possibility to maintain adequate tolerances neither dimensionally nor chemically nor metallurgically. The raw materials inputs are of low quality or even unknown properties. These re-rollers produce low and uneven quality products for the cost-conscious users.

Machining

The machining capability of the subsector is generally low. Only few products of the subsector require precision machining. The process has been considered a secondary or supporting process in most companies. In the industry which requires extensive use of dies and forming tools such as aluminum extrusion plants and rolling mills, quality and special purpose machine tools are being used in the production of tools and dies. The tool and die production, however, is normally limited to in-factory used. Some larger foundries especially those producing machinery parts operate their own machine shops.The shops consist mostly of general purpose machine tools and do not produce high precision products.

Technical Capability

The technical capability is defined as the capability of the enterprises to absorb the transfer of technology, to undertake engineering research and development, product and process evaluation and design functions. The capability depends mostly upon the availability of technical manpower, the level of research, development and design activities and the ability to get access to technical information. The discussion will focus on the larger size establishments since small establishments in the subsector do not possess significant technical capability.

Technical manpower

All larger size firms employ engineers and technicians. The technicians are mostly employed in the operation level, as foremen or supervisors. However, few engineers are employed solely in a technical role such as design and development. Most of them combine the role with the business management of the firms. Most graduate engineers are assigned to work in the process for a few years as an on-the-job training program and then be assigned to assume some management function outside the plant. Therefore, most engineers of the subsector have only a few years of experience in production process. Most of these engineers also do not have good managerial or industrial engineering background.

There is a shortage of matallurgical engineers and production engineers in the subsector. The technician graduates

also have soft background in materials technologies, production technologies and instrumentation. Thus, the technical workforce of the industry, although able to operate the process successfully, have difficulty in the development activities.

A recent survey indicates some shortage of technical manpower in industry especially in the field of metallurgical engineering and production engineering. However, since there is not any significant technology improvement activities being pursued in the industry, this shortage is often not seen as a serious drawback by most of the entrepreneurs. However, for further deepening and maturing of the industrial structure, technical manpower is essential and its shortage can create a serious bottleneck for development. Some enterprises begin to realize the shortage of engineers, technical and skilled personnel as one of the major obstacles to their operations. Therefore, any future development program must necessarily incorporate plans for upgrading the skilled levels of the production workers and the professional engineering personnel.

Research and development (R&D)

Research and development activities in this subsector are almost non existent. None of the firms has their personnel assigned to work solely in research and development activities or set aside a budget for research and development work. There are some informal development works toward the production of new steel alloys. Some works have been carried with

co-operation from university staff, however, the progress is slow. At present, there is no R&D institution in direct supportive of the industries in this subsector.

Design

The design capability is limited to only basic design. Most of the product designs are copied from imported goods or through licensing, joint venture, or subcontracting from foreign originals. The major obstacle is the lack of product designers and experienced production design engineers.

Access to technical information

Typical larger firms in this subsector have some access to technical information through joint venture or licensing agreements or through the supplier of equipment and materials. There is no local agency to supply technical information or to give technical consultancy services.

Testing facilities and quality control

Most of the larger firms have basic testing equipment necessary for their product testing. Some equipment are expensive and are available only at plant with larger scale of operations. The spectrometer which is used for chemical composition analysis is one good example. Some firms which have production activities involve the remelting of metal scrap do not have the spectrometer. Therefore, the composition of each melting is unknown which resulting in poor product quality. Large industries which are fully equipped with testing facilities are

unwilling to offer service to other firms in the same subsector.

There is no calibration service available. Some testing equipment have been in use for some time without any calibration. Laboratory personnel in some plants have not been trained to perform the test accurately. As shown in Table 2.7, a simple check of quality of the products exists in the majority of the plants surveyed. Some of the purchased materials and manufactured goods are often chosen for inspection. However, statistical quality control in the strict sense is rare. Furthermore, results in Table 2.8 indicate that only a few firms are aware of the significance of the Thai industrial standard and/or international standard.

Industrial management capability

The management of production activities in most of the larger firms in the subsector is ineffective. The majority of the firms in this subsector are family owned-and-operated. All management functions including the production management are performed by the owner-manager of the firm which usually possesses little or no knowledge of production and industrial management. Only a few firms have industrial engineers responsible for the task.

The lack of industrial management skill in most of the firms in the subsector, including all smaller size firms, creates serious adverse effects. Poor production planning and control resulting in high production cost, low and inconsistent

Table 2.7 : QUALITY CONTROL SYSTEM
(No. of Respondent)

Practice	I-O Code						Total
	106	107	108	109	110	111	
1. Once the problem occurs	1	-	-	1	-	-	2
2. Check the first workpiece	2	-	1	-	1	-	4
3. Simple check list	3	3	3	3	-	1	13
4. By control chart	6	1	2	-	1	3	13
5. Check every station	3	-	-	-	-	3	6
6. No control	-	1	-	-	1	-	2

Note : More than one choice car be applicable to any one plart

Source : Survey

Table 2.8 : CONFORMITY WITH INDUSTRIAL STANDARDS
(No. of Respondent)

Type of Standards	I-O Code						Total
	106	107	108	109	110	111	
1. Customers' standard	2	3	-	1	2	-	8
2. Own standard	-	1	3	4	-	-	8
3. Thai standard	11	-	-	-	-	2	13
4. International standard	3	1	2	-	-	4	10
5. Others	2	-	-	-	-	-	2

Note : More than one choice car be applicable to any one plant

Source : Survey

product quality and irregular delivery.

To draft a picture of the industries' technical capability which can be useful for the restructuring and development scheme, the firms in this subsector are classified into four levels according to their technical capability. The major processes involved are classified as summarized in Appendix I. In each process category, level 1 is the lowest capacity level and level 4 is the highest capacity level. In general, firms classified to level 1 are those who do not possess any significant technical capability. Firms in level 2 are those who possess some technical capability and can produce products which are slightly substandard or with inconsistent quality. Level 3 firms are those who can produce standard products with good quality control schemes to assure consistency in quality and have good technical capability including the basic design capacity. Level 4 firms have similar characteristics as those in level 3 but have stronger technical staff with knowhow and experience to produce specified products and also have research and development capacity for product development.

Referring to the classification of firms in page 59, all small firms which are classified to the first group stand as level 1. Majority of the firms in the second group are in level 2. Few firms in each product group classified under I/O code 105 to 111 have capability upto level 3. These firms are either the joint venture firms or larger local establishments which have good access to foreign technology. With the exception of the Siam Iron and Steel Co.,Ltd., none of the firms surveyed

can be classified to level 4 category.

It should be noted that, at present, Thailand not have any firm in regular production of primary iron and steel products listed in I/O code 105. The absence of local industry to produce primary steel products has results in high degree of import dependence of input materials to the secondary steel industries.

Technical Prospect

At present, none of the technology used in the subsector reaches the mature stage. However, industries in the subsector have some strong points which show potential for future development. Larger size industries have good technical manpower and could assume leading role in technology development. Smaller industries can have the flexibility advantage, if properly managed. However, there are several shortfalls which are obstacle to technology development. The strong points and shortfalls can be summarized as follows.

Strong points	Shortfalls
- low labour cost	- low labour productivity - low education, low skill labour
- average workforce has fairly good craftmanship	- average work force lacks mechanical sense
- fairly good technicians good engineers (larger industries)	- technical staff are assigned managerial functions after few years of technical experience
- process oriented, flexible to produce wide range of products.	- inadequate processing knowhow to diversify product line

- mostly small to medium size, more flexible with variations of product at low quantity	- most small to medium size industries lack technical and managerial skills to utilize their resources efficiently resulting in high cost and low quality products.

If these shortfalls can be eliminated, the industries in this subsector can be well developed.

III THE INTERNATIONAL STEEL MARKET /1

Steel is the most important metal contributing to industrial development. Many studies prepared by various international organizations and the recent one by Dr.F.A.M. Vlemmings in his capacity as UNIDO advisor have thrown some light on the world steel industry. Two major themes emerge from those analyses : (i) the growing internationalization of industry and (ii) the worldwide consequence for steel industry of industrial policy decision-making taken at the national level.

Steel Consumption

The international steel market has been in a state of more or less chronic crisis since the first oil crisis in 1973 changed the pattern of economic growth drastically in a great number of countries. Until 1974 world steel demand had been growing at about 5.6 per cent a year. After that year, it took 5 years before world steel production reached a new peak in 1979, followed by a new crisis that forced production back in 1982 to the 1972 level.

The production level in 1984 is expected to be the same as that of 1978, provided that no major shock occurs, production in 1985 should be at the same level as 1979.

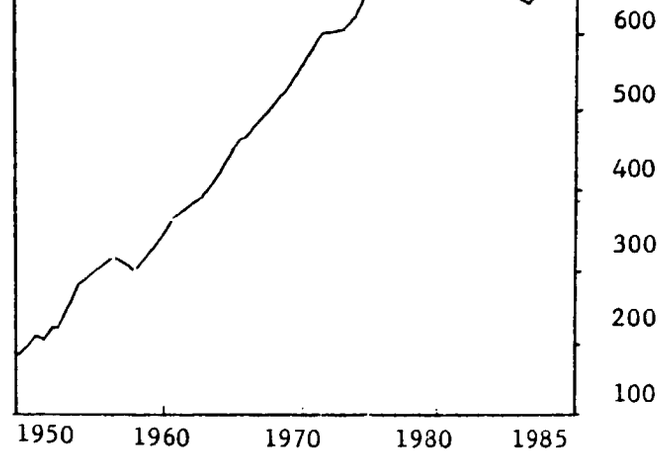
/1 This Chapter is excerpt from the work of Dr. F.A.M. Vlemmings, Report on the Iron and Steel Industry, prepared for the Thai Government, UNIDO, Vienna, December 1984.

Whereas consumption in the industrialized countries in 1983 was down 17.5 per cent from 1977, the developing countries showed for that period a gain of 17.0 per cent. The worldwide squeeze of demand for steel has resulted in increasing protectionistic mood in the steel producing countries of Europe, and the USA.

In a study carried out by the OECD secretariat on behalf of the OECD steel committee, attempt was made to identify a number of factors that has caused the short fall of steel consumption in the OECD countries. As main causes there came out:

- a shift from investments to consumption. After the energy crisis of 1973 the economies kept growing, but the burden of the increased energy prices was placed chiefly on industry. With profits squeezed they reduced investments, e.g. in Germany the investment share of GDP has fallen from 24 per cent to less than 16 per cent. As about 70 per cent of steel consumption goes into investment goods, this has had a tremendous impact on steel consumption. Even the relatively good performance of the automotive industry and a strong increase of exports of investment goods towards developing countries could not outweigh this loss.
- within certain industries a shift from steel intensive goods towards less steel intensive

Figure 4 : WORLD STEEL PRODUCTION



goods, e.g. in the electrotechnical industry towards electronics.

- the collapse of the ship building industry as a consequence of the stagnation first in the oil transports. Although this factor counted very heavily in a number of countries, the over-all impact was rather limited. On the world level even in the best years ship-building did not count for more than 4 to 5 per cent of total steel consumption.
- a changed attitude as regards stocks. As up to 1974 steel has been regarded as a commodity that was in scarce supply, the users were accustomed to keep large quantities of steel. With the increased interest rates, the ample supply and the highly sophisticated inventory management systems (e.g. the Kaban system in the Japanese automotive industry) the inventories have been decreased to a minimum. It was estimated that inventories have been decreased from more than 4 months, to less than 2 months, causing a decline in steel demand by nearly 20 per cent over the 10 year period (1974 - 1984) or 2 per cent a year.
- higher efficiency in steel making. As steel consumption and production normally are measured in crude steel, those figures underestimate the real development of the

consumption in finished steel products. If the same amount of finished products as in 1983 were made by ingot casting, as was usually before 1970, the steel industry should have produced 40 million tons of steel, or about 7 per cent more than they actually did.

- a lowering of specific steel consumption in a number of industries. This point will be discussed below in somewhat more detail.

Although the reasons above were drawn from the experience of the OECD countries, they might as well applicable to the situation in LDCs, though somewhat different in timing and magnitude of the impact. For in the developing countries, particularly in the newly industrializing countries, just in this period a tremendous investment activity has been started. This explains most of the fact that in those countries steel consumption grew further after 1973, unchecked until economic recession of 1981/1982 caused the troubles here too.

Yet a lot of room for further growth in steel consumption is conceivable. Even during these recession years steel consumption in the EEC, the USA and Japan stayed well above 400 kg/capita a year, in a country like Thailand it has just reached 40 kg/capita. The USA, a country now well underway in the post-industrialization phase has an accumulated stock of steel embodied in their infrastructure and in their industrial investments of over 10,000 kg per capita, a level also to be

found in the industrialized countries like Sweden, Germany and Tjecho-Slovakia. The embodied steel stock for Thailand has been estimated at about 600 kg per capita.

Specific Steel Consumption

Some special attention should be given to the development of specific consumption of steel by unit of production in the various branches. From the OECD's report, it came out as a contributing factor to the recession of steel demand. This factor has probably been overemphasized in a number of published studies. Most of the confusion comes from an unclear definition of the problem. E.g. in the UNIDO report "Industry on a changing world" some figures for Germany are quoted (p. 272), showing that use of steel in various sectors has declined considerably, e.g. 23 per cent in shipbuilding. However, another study reveals, that because of the growing complexity of the industrial structure, shipbuilding industry has increased its purchases of mainly steel containing components from imports or from specialized firms in other industries from 20 per cent to over 40 per cent. Therefore, the actual decline of the amount of steel used in a ship will be far less, although in the total costs of a ship the amount of electronic equipment has been growing. Even more striking figures can be found for the automotive industry, whereby a consequence of the growing internationalization has been more and more imported parts are replacing direct steel deliveries. Measured as a percentage share of the total weight, the steel in the European car has kept its position very well, whereas in the USA it has declined only 2 per

cent points. By absolute weight per car however, especially in the USA, steel consumption has been declining more, as cars have become much lighter. Most of the effects can be traced back to the replacement of heavy steel parts, by lighter ones, made of higher quality steels. In the EEC report, "Study on the evolution of specific consumption of steel" a very good theoretical treatment of the problem can be found.

Technology of Steel Use.

The increase of the energy cost since 1973 has put a high pressure on industries like the automotive industry to lower the weight of their product, in the first place to save fuel. The relatively high energy intensiveness of products like steel, aluminium, glass, cement, has caused price increases, that have triggered a strong tendency to decrease the material intensity. Although some shifts between the various materials can be observed, the most important phenomenon has been an overall decline of material intensity. For example, when a material index was constructed for the US, containing most of the raw materials, from iron and steel, non-ferrous metals up to plastics, all weighted by their tensile strength , it was found that this index has stayed behind the development of GDP. Within these indices steel has been losing nearly unchanged between the sixties and the seventies by about 0.5 per cent a year.

Steel has answered to the demand for lighter products the development of qualities which results in a much higher strength. Most of this upgrading of the products has been

achieved by improvements in rolling technique and heat-treatment. The hot-connection was introduced as a way to save energy, by which a continuously cast slab with max 600°C directly in the hot strip mill can be rolled. The process is now possible as already in the continuous casting machine and excellent surface quality can be reached, that can further be maintained in rolling. In the cold rolling, a big improvement in flatness has been reached by installing axial shiftable support rolls. This also leads to optimal width-tolerance. In the hot strip mill, a coilbox will give a better temperature history during the rolling process, and hence a more equal quality over the full length of the coil. The same can be reached, although to some lesser extent by covering the mill between the stands. Computer controlled rolling has made possible a considerable lowering of tolerance thickness. Continuous annealing further gives better surfaces and higher strength as a consequence of the better heat-treatment. Corrosion resistance traditionally has been achieved with hot-dip galvanizing. Electrolytic galvanizing however has some economic advantages : the thickness of the zinc can considerably be reduced although the corrosion resistance is even better; when needed the coating can be made one side, for better protection coating with zinc alloys, e.g. alu-zinc will be possible. For the user it is important that he is supplied with a product with a better surface.

All these developments have caused a shift in steel consumption to high quality steel with greater strength higher corrosion resistance, lower tolerances, etc. A good example is

the fact that in Paris it was found that some parts of the Eifel tower, that had to be replaced, could be replaced by constructions of only 20 per cent of the original weight, a sign of the enormous progress in materials technology. This process of material saving has been continuing at a speed of about 1.5 per cent a year, realized in number of waves.

Future Outlook

From the facts mentioned above it will be clear that the steel industry has adjusted and is adjusting itself to the future demand. From the causes of the stagnation, a number of them have a unique charactor, some of them will continue to work as they have done in the past over the whole history of the steel industry. As regards the most important one, the lack of investment activity in the industrialized countries, it could be expected that the efforts put at work by the various governments aimed at reversing this trend will have some results. Therefore, it is not illogical to expect that when the industrialized economies emerge from their economic recession, steel consumption in those countries again will start growing with the GDP, although at a slower speed.

It has already been shown that at a world level steel production has not dropped at all, but has been fluctuating around the level reached in the early seventies. The steel crisis therefore has not as much been a problem of falling demand, but a problem of over capacity, With a growth rate of steel consumption of over 5 per cent up till 1973 a lot of

expansion was going on to match the further expected continuation of this growth. As a consequence of the long gestation period, a lot of projects were under construction, to be completed into the years up to 1978. In some of the newly industrializing countries this process even went on to the early eighties. This caused over capacities as high as 150 million tons.

In its turn this over capacity caused a tremendous competition on the world market resulting in all kind of dumping practice and price cutting. Although the steel industry until now has been strictly nationally organized, there has always been a growing international trade in steel product, from 19 per cent of the total world production in 1970 to 25 per cent in 1982.

Investment activity in the iron and steel industry has fallen dramatically, from US $ 5 billion in 1979 to US $ 1.8 billion in 1983. In the steel producing countries all the investment activity is concentrated on modernizing the existing facilities. Only in some of the NICs some further growth of steel capacity may be expected.

On the other hand, in the USA there have been a number of closures, which reduce the capacity by 20 to 30 million tons. In the EC, the European Commission, that has the authority to deal with steel matters, has worked out a plan to reduce capacity by 40 million tons before the end of 1985. More than half of those closures have already been realised, in some countries even more total reduction is required. As even more capacities are becoming economically obsolete, real capacity

in the world is now coming down rapidly.

Together with some growth in demand, the steel industry in the second half of the eighties should have better prospects than it has had over the last 15 years. In Europe some of the companies are already doing well. So Hoogovens (Netherlands) has been able to announce a net profit of US $ 60 million in the first half of 1984, and even better prospects for the second half. Other companies like Arbed (Luxemburg) have announced possitive results for the first half of 1984 too, although to a lesser extent. This means that the actual prices in Europe (after the increase per 1/10/1984) may be considered to reflect more or less than actual level of steel cost in Europe. This level proves to be far less than the now prevailing level in the USA, but about comparable to or slightly higher than the Japanese home prices.

When the world steel market will gradually move in the direction of an equilibrium, it may be expected that the international price level will move towards this cost price level of Europe and Japan, the two regions that in spite of the growth in export of some other regions, still count for about 57 per cent of world steel exports.

IV DEVELOPMENT STRATEGY

The development strategy for the metal product industries will be based on the following objectives :

(a) Strengthening the linkages within the sector as well as with other sectors.

(b) Promoting exports of the products that Thailand has potential comparative advantage.

(c) Raising production efficiency of the industries in both technical and economic aspects.

To achieve these objectives, the following approaches are instrumental :

(a) Rationalization of protection system. Alternative tariff and business tax structure will be proposed to correct their bias against the production of basic and intermediate products and to create a trade regime which is not biased against exports.

(b) Promotion of Industrial Standard System. Industrial standard system includes material and product testing and certifying services, instrument and testing equipment calibration services and maintenance of industrial standards. To make these services available to industries is complementary to the subcontracting system. Product testing and certifying agencies should attain international recognition to support export products.

(c) Development of technical manpower especially in the field of metallurgy, metallurgical engineering, production engineering and industrial engineering.

(d) Development of labour skill including promotion of training scheme in industries.

(e) Promotion of industrial extension services.

(f) Promotion of research and development both in the government agencies and large industries. The research and development activities should be in harmony with the development of the industry in the subsector. Priority of research and development activities is set as follows :

i) technical consultation, technology assimilation and diffusion.

ii) adaptive development (adaptation of foreign technology to suit local conditions) and mission oriented R&D.

iii) basic research.

The R & D should emphasize the specialized manufacturing technology such as precision casting, metal forming processes etc.

(g) Supporting scheme for local enterpreneures, new or already in business, in setting up new product lines which utilize new technology or new innovation.

New Investment

The prospects for new investment in metal products may be judged from the following considerations :

(a) Since the second oil shock in 1979, the domestic as well as world wide steel consumptions have been much lower than expected. This has led to the current low level of capacity utilization as the production is not only constrained by stagnant domestic demand but also greater competition from foreign supply and difficulties in export.

(b) The global demand for steel in the future is expected to be shifting towards greater use of high quality steels as a result of high energy cost which forces steel users to economize it by weight reduction.

(c) Steel production facilities in Thailand are not adequately efficient. Production cost is far from being internationally competitive. Without reorganization and modernization of plants and equipment, high protective wall will have to be maintained indefinitely resulting in the high material cost for the steel using industries.

(d) In comparison with the steel making industries, the fabricated steel products have shown better performances with respect to self sufficiency and ability to export. Their growth path also appears to be more robust.

(e) The major constraints to the development of steel industries in Thailand may be identified as beckwardness of technology, lack of basic raw materials, and shortage of capital for large scale industries which are often associated with high capital intensity.

The comparative advantage of Thailand lies mainly on the abundant supply of cheap labor. Therefore the existing structure of the Thai metal product industries is concentrated in industries which require only low level of technology with low value added and those which can survive only behind the high protective walls. As the outlook of future steel demand appears to be unfavorable for low technology steels, the industry is in great need of strengthening its technological capability. New investment should be concentrated in product diversification and modernization of plants and equipment for existing products. Technological improvement should be emphasized in the promotional effort for sustainable growth of the industry.

To induce investment in the direction suggested above requires a consistent set of policy measures conducive to technological improvements. Tariff protection should be rationalized to contain undesirable expansion of inefficient

industries and should be more rewarding for the efficient ones. A package of fiscal incentives should be introduced to encourage more research and development as well as plant modernization and reequipment. Investment promotion should give priority to projects which contain the benefits of upgrading the country's technological capability. The BOI should require foreign joint ventures to submit plans for the transfer of technology to the Thai partners in granting its promotional privileges.

The following subsections review the investment opportunities of some selected subsectors with respect to the demand outlooks, potential markets, technical constraints and cost competitiveness of the domestic suppliers.

Forges and Foundry

The domestic demand for forged parts and cast parts may be divided into two main sources, namely those used as original equipment and those used as spare parts. The major users of these products as original equipment are the machinery, hand tools, and automotive industries. Domestic producers can satisfy most of the required original parts for agricultural machinery, pipe fittings, cutlery and hand tools, and diesel engines. For automotive parts, industrial mining machinery, tractors and other heavy vehicles, the original equipment are mostly imported.

Supply of forged and cast parts comes from about 700 local producers, most of which are located in Bangkok. Rapid expansion of the industry in the late 1970s followed by prolonged

period of slump in the early 1980s has resulted in the present high level of excess capacity. It is estimated that most firms are presently operating at the capacity utilization rate of 50 per cent or less.

There are only few firms that can produce forged and cast parts of reliable quality. The leading firm in this field is Siam Navaloha which supplies major components for agricultural diesel engines. With the except of these few modern plants, the rest are concentrated in producing low quality products. To speed up the development of this industry, the technical capability of the firms should be upgraded so that the range of these products could be extended towards high quality products. Some of these products such as agricultural machinery parts should be standardized so that the unit cost of quality products can be lowered. It is estimated that import of forged and cast original equipment for automobiles and other machinery is about 200 million baht per year. The prospect for new investment in this area should be further investigated. A specific product that should receive special attention is domestic production of standard gear box. A large potential market already exist for gear box, gear, and blank gear as there is a wide range of applications of these products. To capture this potential market, the products must be supplied at reasonable costs, assured quality and interchangeability. This can be made possible by standardization and active promotional effort to induce mass production.

Nonflat Steel Products

Since 1980, the demand for nonflat steels has been stagnant with annual consumption significantly below the peak level of 1979. Capacity utilization rates of the existing mills have been generally below 50 per cent. The production facilities are relatively inefficient as evident from high energy and electrode consumption per charge and high wastage of steel. Considering the prospect of growth of steel demand and the future competition among countries, upgrading the production technology and the necessary reequipment associated with the efficiency improvement are imperative. The conversion from ingot casting into continuous castings is among those desirable changes towards economizing energy and materials cost. It is estimated that continuous castings can reduce the unit cost of production by about 500 baht per ton of steel. The saving is mainly due to reduction in fuel consumption.

Modernization of plants and equipment may be accompanied by product diversification. A large market already exists for various steel sections and high stregth structural steels grade SS 40 to 50. These products can be produced with only minor additional equipment. They consume the same order of energy required by production of existing products such as steel bars, but their value added is significantly higher.

Expansion of steel making capacity without introduction of efficient production technology should be discouraged as it would only add up the excess capacity and will

perpetually require high protection for survival. The rerolling activity should be gradually phased out by toughening regulations.

Flat products and fabricated metal products.

Consumption of flat steel products has been increasing more rapidly and more stable than nonflat products. Some flat products and fabricated products such as welded pipes, compressed gas cylinders and metal furniture and fixtures have been exported in significant amounts. A large amount of cans are also exported indirectly with the exports of canned seafood and canned fruits.

Fabricated metal products generally involve unsophisticated technology, have high labor intensity and do not require large scale investment. Thailand is virtually self-sufficient in metal furniture and fixtures and structural metal products as imports of these products represent small fractions of domestic demands. This leaves cutlery and hand tools and other fabricated metal products as the major areas for import substitution to aim at. Table 4.1 identifies major imported items among fabricated metal products for further investigation into the possibilities of establishing local production.

Table 4.1: IMPORTS OF SELECTED METAL PRODUCTS

(1983)

BTN Code	Products	Import value (million baht)
731700	tubes pipes of cast iron	375.4
7318	tubes pipes of iron or steel	608.4
731821	- seamless	147.4
731822	- others	462.0
732009	tube pipe fittings	144.1
733221	bolts	162.5
8202	saws	70.9
8203	hand tools including cutting pliers	247.9
820301	pliers pincers	60.1
820303	spanners wrenches	78.7
820304	files rasps	71.0
8204	hand tools including mounted glaziers diamonds	178.9
820411	hammers	26.4
820412	screw drivers	28.0
8205	interchangeable tools	410.8
8211	razors & razors blade	50.9
830101	locks padlocks & parts	157.3
8315	wire, rods, tubes, plates electrodes and similar products	75.1
8401	boilers	2,250.7

Source: Customs Department

Table 4.2 shows the list of fabricated metal products that have been exported in significant amounts. These products demonstrate the ability of Thai manufacturers to compete in the international market. Export expansion also contributed significantly to the growth of metal furniture and fixtures, structural metal products and other fabricated metal products. The success in export does not only depend on selection of products but also on production efficiency of the producers and their marketing techniques. There are many cases in which producers are initially successful in export market penetration but quickly losing the markets later on due to unreliability in product quality or delivery. Rapid growth in exports is sustainable only if the producers continuously improve their technical capability and marketing strategies. In addition, they must watch closely and react quickly to the changing trend of the world market.

To identify specific products with promising export potential, knock down metal furniture may be an interesting area to be investigated. Thailand presently exports significant amount of metal furniture, but the products are bulky therefore their competitive advantage is eroded by high transport cost. The export market should be greatly expanded if the producers can improve their precision in producing the furniture in knock down forms. The products that have made significant progress in export as listed in table 4.2 should be further promoted by all export promotion measure , technical and financial assistances.

Table 4.2: EXPORTS OF SELECTED METAL PRODUCTS

(1983)

BTN code	Products	Export Values (million bant)
731700	tubes pipes of cast iron	107.8
731822	other tubes pipes	320.1
7320	tube pipe fittings	61.4
732001	- of cast or mallcable iron	59.7
7323	casks, drums, cans, boxes, etc.	29.2
732400	compressed gas cylinders	49.9
7338	articles for kitchen	42.4
820112	changols & hoes	26.3
8214	spoons forks, etc.	106.2
821403	- of copper bronze	105.0
830600	statuettes other indoor ornaments	47.3
940101	chairs	116.6
940303	other furniture & parts	399.5
940309	parts of other furniture	128.1

Source: Custom Department

Industrial Standard System /1

Present Status

Considerable legal and technical infrastructure already exist in Thailand to support the industrial standard system whose constitutive mechanisms pertain to the following activites :

a) Legal Metrology and Documentation Standards;

b) Maintaining Standard of Measurement; and

c) Materials and Products Testing Services (Industrial Metrology)

However, there seems to be inadequate interaction and coordination between various components and agencies concerned. Detailed discussion of the present status of Thailand's industrial standard system has been presented in the Industrial Restructuring Study Report Volume IV : Technology Development and Promotion for the Engineering Industries ; Chapter 6 Industrial Standard System.

Of the total picture, there are some notable points affecting the metal and metal product industry. These points will be discussed in the following sections.

Documentation Standard

Out of the 15 standard - groups, the basic metal is the group which is directly related to metal and metal product industries. Some standards in the industrial machinery group also

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/1 Industrial Management Co.,Ltd., "Technology Development and Promotion for the Engineering Industries," 1985.

affect the industries. Between 1970 and 1983, 62 Thai National Standards in the basic metal group have been issued. Some of them are being under revision. Also, TISI in close consultation with its technical working group has identified some metal products and some testing procedures (Table 4.3) whereby priority for industrial standards preparation should be given. Follow-up actions need to be taken.

Materials and Products Testing Services

Two outstanding features that have been detrimental to the development and expansion of metal and metal product industries are linked with the "technical competence/quality" aspect and the 'quantity' aspect of materials and products testing services. They can be attributed to the aforementioned infrastructural weakness, i.e., lack of coordination in legal metrology and the maintenance of national standards.

As raw materials analysis and products testing are integral to quality assurance scheme in all manufacturing industries, companies seek to undertake these tasks through their own means and those technical supports provided by laboratories in the public sector. In companies which are subsidiaries of those in developed countries or have access to their technologies, their testing facilities are adequate and their technical competence commendable. However, in most cases, awareness of the importance of making measurements traceable to the national standards is lacking. The situation is worsened by the fact that their measuring equipment have never been

Table 4.3: LIST OF METAL AND METAL PRODUCT, WHEREBY PRIORITY FOR STANDARDS PREPARATION IS PROPOSED

- Drainage Pipes
- Axes
- Piano Wire
- Welding Electrode
- Rivets (Steel)
- Steel for Welding
- Rerolled Carbon Steel
- Non ferrous metal testing
- Classification of surface finishing
- battery terminals
- Steel Lamp Post
- Fence wire
- Stainless Steel Pipe
- Aluminum tube
- Measuring tapes (up to 3 meters)
- Non - Destructive Testing
- Welding

Source: TISI

recalibrated since the time of purchase or, in many cases, are calibrated with 'national' standards not traceable to international standards.

The laboratories in the public sector suffer the same fate. As the testing of materials and products to obtain test certificates or to qualify for display of TISI industrial standard marks can only be done in the public sector/state enterprise laboratories, competency of these laboratories is seriously questioned. (Therefore, the results of materials and products testing have been inconsistent and cannot be accepted as accurately reflecting actual properties and performances.

At present there are thirty authorized laboratories only in the public sector and state enterprise agencies of which seven are attached to universities and six belong to various state enterprises.

In addition to the existing problem of quality controlling of TISI-authorized laboratories, testing time required by different laboratories varies considerably. The difference can be more than one order of magnitude and is attributed to several factors, viz :

(a) Only thirty TISI-authorized laboratories exist; not all laboratories have adequate facilities and manpower to undertake the complete range of tests required. Some of the principal testing agencies such as DSS and TISTR are over loaded.

(b) In some laboratories especially in universities testing is not considered as being of high priority and will be done after completion of other tasks.

Policy Guidelines

The policy guidelines for the Thai industrial standard system, to promote the metal and metal products industries, should base on the following tenets :

a) Improving the quality of metal and metal products

b) Increasing the technical capability of metal and metal product industries so as to assure their products being conformed to standards and compatible to the requirements of downstream industries.

Three measures have been proposed in the Technical Development and Promotion of the Engineering Industries Report :

a) Establishment of National Measurement Standard Board,

b) Establishment of a National Voluntary Laboratory Accreditation Scheme,

c) Strengthening the Capability of TISI

All these three measures are necessary and will have positive effect in the promotion of the metal and metal

product industries. The discussion to be followed is based on the above report. Only important aspects related to metal and metal product industries are discussed.

Action Plan

Establishment of the National Measurement Standard Board

Objectives

The objectives are:

(a) To establish the National Measurement Standard Board of Thailand whose principal functions are:

- To advise the Government on the national policy and plan in maintaining measurement standards;
- To coordinate activities relating to the maintenance of standards undertaken by various agencies.

(b) To establish a national scheme on measuring equipment calibration and services.

Targets

The targets are:

(a) Establishment of the National Standard Board and its secretariat office

(b) Identification of government agencies responsible for maintaining measurement standards

(c) Establish a network of calibration centers

(d) Hold local training courses for users of measurement standards.

The relevant standards and number of participant undergoing the training each year will be

Measurement Standard	Number of trainee
Dimensional	10
Mass and Associate quantities	10
Photometric and Spectro radio metric	6

Methodology and Mechanism

The organizational structure as proposed in the engineering industries report will enable the organization to support metal and metal product industries. No special unit will be required since the standards to be maintained and calibration service needed are common in most of the mechanical engineering industries.

Activities

In the activities proposed by the engineering industries report, there are a few aspects that need to be focussed for the metal and metal product industries:

(a) The office of the board should have expertise to provide information invaluable for establishing, organizing, and operating a measurement and calibration program for metal and metal product industries.

(b) Training courses and workshops in the following areas are of particular importance to the metal and metal product industries:

- Mechanical Properties Testing
- Dimensional Metrology
- Spectroradiometric and spectrochemical analysis
- Metallography
- Statistical Concepts and Procedures as applied to quality programmes.

The measurement and calibration program as mentioned in (a) should cover the same areas as mentioned in (b).

Strengthening the Capability of TISI

Objective

The Thai Industrial Standard Institute (TISI) must be strengthened to have capability to effectively support the metal

and metal product industries. Its role in standardization can be exerted through the following mechanisms.

(a) Identification of metal products of great importance and acceleration of the preparation of the respective standard specifications:

(b) Establishment and actively support of national standardization effort. The adjunct of a quality certification programme with a publicized and recognized quality mark backed up by a sound programme of initial factory inspections, product testing, surveillance inspection and testing etc. is highly desirable. The establishment of a national network of accredited public and private sector laboratories to provide services for materials/products testing is necessary to support the certification efforts.

(c) Development of programme to publicize and promote public awareness of quality and safety which leads to the use of qualified products.

Targets

The targets are

(a) Preparation of a priority list of specifications required for basic process industries (e.g. forging, casting, plating etc.) and of engineering products by 1986.

(b) Establishment of a special secretariat within TISI to coordinate the preparation of standards prioritized in (a) by 1986.

(c) Establishment of the National Scientific and Technological Testing Board by 1986 that will:

- oversee the competence and professionalism of testing laboratories;
- issue testing licenses to accredited test laboratories.

(d) Establishment of a special secretariat within TISI to coordinate activities on laboratory accreditation.

(e) Screening of all public sector test laboratories (approximately 30) authorized by TISI for products testing by 1986.

(f) Participation of accredited private sector laboratories in TISI products testing scheme. The target is 10 labs in 1986.

(g) Strengthening the capability of the laboratory under TISI's Division of Standards for pilot work on standards fixing.

Methodology and Mechanism

In addition to the organizational structure proposed in the Engineering Industries report, two more functions should be added

(a) Consultation service: there should be a unit to provide technical informations or at least identify the source of information or consultants to assist the industries to produce their products to standard.

(b) More emphasis on the campaign for public awareness of quality and safety together with the promotion of qualified products to reduce the market share of sub-standard metal and metal products. Products testing and certifying service should also be strengthened.

Activities

Six activities proposed in the Engineering Industries Report are:

(a) Preparation of a priority list of specifications for basic process industries and metal products. These basic process include forging, casting, presswork and surface finishing processes.

(b) Accelerated Program of draft standard by using local consultancy in drafting the standard.

(c) Mandatory accreditation of TISI-authorized laboratories in the public sector.

(d) Voluntary accreditation of private-sector testing laboratories.

(e) Training of TISI personnel on laboratory accreditation.

(f) Workshop on testing laboratories.

Additional activities for the metal and metal product industries are identified as

(g) Consultation program for the industries to produce their products to specified standards. The technical informations may be in the form of handbooks or consulting services local export services should be sought to produce handbooks whenever possible. TISI should be able to identify local consultant capable of providing service to industry.

(h) Promote the use of metal products that conforming to national standards.

Since one of the major problems in the metal and metal products industries is that the majority of local consumers prefer the use of low cost products. The major consumers of the products of the subsector include construction subcontractors and government agencies. Publicity of quality and safety awareness must be increased.

(i) Identification of products that should be prohibited from sale if the product does not meet the specified standards.

Some products of the metal and metal product industries are relevant to the public safety while some products of low quality have short life and resulting in high waste of natural resources. Typical examples in the group of metal and metal product industries are rerolled bars, plumber brass and pipe fittings. This type of products, if can not meet the specified standard, should be prohibited from sale.

Protection

The degree of protection on an industry may be measured superficially by the nominal rate of protection which is the percentage difference between the actual domestic price and the price that would be under free trade of the product. The effect of protection on the allocation of productive resources among industries is however, influenced by the difference between the value added of the product under the protected regime and under the free trade regime. This can be measured more accurately by the effective rate of protection which incorporates the differences in input prices as well as in output prices in the calculation.

In Thailand, the most influential protective instrument is the import duties which is applied on almost every product at varying rates. Other instruments are applied on limited numbers of products are quantitative restrictions, import surcharges, export taxes, subsidies and differential rates of business taxes between imported and domestic products. Tariff rates are generally escalated with the degree of fabrication. Among finished products, tariff rates on consumer's goods are generally substantially higher than capital goods. The wide dispersion of tariff rates creates the highly distorted regime which favors production of finished products especially consumer durables and discriminates against production of most intermediate products and production machinery.

The escalation of tariff rates with the degree of fabrication is quite obvious in the metal products industries. The lowest range of tariff rates, from 5 per cent to 10 per cent, is applied on basic metals such as steel and other metal ingots and scraps. Secondary steel products are mostly subject to the intermediate range of between 15 per cent and 30 per cent. Metal products in the final forms such as cutlery, metal furniture and fixtures, and other fabricated metal products are subject to the highest range of duties, from 30 per cent to 80 per cent.

High tariff rates on finished products and low rates on raw materials and intermediates result in very high ERPs on the former and low or even negative ERPs for the latter. The distortion created by this tariff structure allows many inefficient industries to survive and prosper at the expense of the discriminated industries. To improve the efficiency in the allocation of productive resources, it is recommended that the dispersion of the degree of protection be reduced by more uniform tariff rates.

On the economy wide basis, it has been proposed that the tariff schedule should be revised such as shown below:

Alternative sets of the proposed tariff schedules

	Set 1	Set 2	Set 3
Final products	50%	40%	35%
Intermediate products	40	30	30
Machinery	20	25	25
Raw materials	10	15	20

The results of set 3 tariff schedule on the average effective rates of protection on all sectors as classified by the I-O Table are shown in Table 4.4). This schedule is more preferable than the other two alternatives as it leads to the least dispersion in the degrees of protection among industries. However, the average tariff rate remains quite high and the tariff rates on raw materials and intermediate products are mostly increased substantially under this tariff revision scheme. Tax rebates and refunds for exports must be available and efficiently administered otherwise the export sector will be severely affected. The effect of the proposed scheme on the metal product industries will also reversed the relative degrees of protection within this group of industries, i.e. the effective rates of protection on fabricated metal products will generally become lower than the ERPs on basic and secondary metal products. At the prevailing situation, the production of major secondary steel products are viewed as highly inefficient. Increasing the degrees of protection to this sector tend to facilitate the sustenance of inefficiency in this sector. Despite relatively low tariff rates on these products at present, the effective rates of protection for them are not low due to the lower tariff rates on their inputs and low value added of the products at world prices. The increase of tariff rates on these products is likely to creates an adverse impact on the downstream industries. Therefore the tariff rates on basic and secondary metal products should be maintained at the present levels. When major revision on tariff schedule is made, gradual steps should be taken along the

Table 4.4: TARIFF RATES ON METALS AND METAL PRODUCTS

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

Source: Customs Department

direction as proposed above from set 1 to set 3. The revision must be accompanied by two additional measures. One is the readjustment among each group of industries. In the case of the metal product industries, the tariff rates on major intermediate products such as steel coils, coated and uncoated plates and sheets, bars and wire rods, pipes, aluminum ingot and other basic metals should not be raised. For the fabricated metal products, those subject to tariff rates in excess of 50 per cent should be lowered to the 50 per cent level. Another necessary measure is in the administration of tax rebates and refunds for export which must be speed up to reduce the effective cost of the exporters yet the rebate and refund amount should be as close as possible to the actual tax burden.

Basic Industry Project

A basic steel plant to supply steel from iron ore has long been dreamed about since Thailand entered the modern era. The dream came true in a modest way in 1966 when Siam Iron and Steel built the facility to produce pig iron from domestic iron ore using charcoal as fuel. The facility consisted of 3 charcoal blast furnaces with the capacity of 20 tons per day each. The project has proved to be commercially unviable and the operation was terminated since 1975.

Two alternatives are currently relevant to the basic steel development. One is the ambitious integrated steel project. The other is the sponge iron project. On the integrated steel project, a prefeasibility study was conducted in 2 phases which were completed in 1984 by the Estel Technical Services B.V. The study recommended that the project have the capacity of 1.85 million metric tons of liquid steel per year, which will be further processed into 0.87 million tons of hot rolled steel and 0.75 million tons of cold rolled steel. The investment cost of the project was estimated at 2,545 million US dollars and the rate of return would be 11.1 per cent.

The sponge iron plant project was initiated to assure reliable supply of raw material for the steel plants in Thailand. The reason for this project was cited as due to the demand for imported steel scrap at the estimated amount of about 400,000 metric tons annually. The price fluctuation of the

imported scrap has led the steel makers to seek domestic supply as an alternative source. The Siam Ferro Industry Co.,Ltd. was established in 1979 with 10 million baht of registered capital to implement the project. The investment cost was estimated at about 2,000 million baht for the sponge iron plant with the annual capacity of 400,000 metric tons. The project was postponed later on as the production cost based on the use of natural gas as fuel appeared to be uncompetitive. The project feasibility is currently reinvestigated for the use of lignite in place of natural gas.

The basic steel projects are among many large scale investment projects currently under investigation. A large amount of resource has already been committed to the development of large scale projects in the Eastern Seaboard such as the chemical fertilizer project, the natural gas separation plant, and the petrochemical project. With limited amount of financial resource available, many projects will have to be screened out or postponed. As the number of large scale investment projects accumulates, the need for an integrated mechanism to select, programme actions, and implement these projects will be intensified. The basic steel projects mentioned above should be included among all large scale projects under this integrated mechanism which may be outlined as follows:

(a) A long range strategic plan should be initiated as the main function of the Division of Industrial Economics and Planning (DIEP), Ministry of Industry. The Office of Basic

Industry Development (OBID) of the MOI should be merged with the DIE to avoid duplication of works. At present, the effort of the DIE is concentrated in studies of various individual industries which provide the basic informations about each industry, analysis of the problems related to each of them, and suggested solutions. The OBID main effort is currently in conducting the studies of the feasibility of the two basic steel projects and taking supportive actions to implement them. The two agencies should be merged and coordinated with the NESDB to formulate the long range strategic plan to be used as the guideline for all large scale investment projects. In so doing, the competence of the staff involved should be upgrade by major reorganization which consists of the followings:

- The composition of personnels should be redistributed with greater proportion of senior ranks.
- Competent analysts should be recruited mainly in the field of engineering and balanced with an appropriate number of economists.

- The status of the agency should be elevated to the same level as a department.

(b) The long range strategic planning should be translated into programmes of actions in each of the five-year National Economic and Social Development Plans.

(c) The Industrial Estate Authority of Thailand should be the main executing agency. This additional role should well complement the present function of the IEAT in development of industrial estates.

Technical Assistance

General Scenario

The metal and metal product industries, in general, are the technology - intensive industries which require an incessant technical development and high-level skill manpower. Until recently, the government intervention into industrial development has been limited. Few technology assistance programmes, if any, have been offered. The results from the survey indicated that almost all technology used in the industry are imported. Local industries still unable to unpackage and develop key technologies necessary for the subsector development. The process of importation of technologies is unrequlated. Hence, there is little effort made to develop indigenous processes and technology. Larger scale industry in the subsector, so far, has relied on purchasing technologies from abroad. The relatively open technology import policy of the country has facilitated this process. Thus, currently, large scale industry is willing to commit little, if any, resources to technology development although it has ample financial capability. None of this larger establishments reported to have in house R & D facilities and most of their investment goes to development of production facilities. Medium and small scale firms of the subsector do not have enough capital to invest in technology development of their own.

Limited technological support capability exists at source governmental agency such as universities, TISTR and some divisions in the Department of Industrial Promotion. The budgets allocated to these supporting activities are very small. In the universities, most of the research is carried out independently of the manufacturing firms and the on-going university-industry interaction is still at low level. Engineering colleges in universities such as Chulalongkorn University and King Mongkut's Institute of technology offer testing services and some consultation on the product and process development, but these services are regarded as having low priority in budget allocation and job promotion.

Engineering consulting firms offering service in metal and metal product technology are almost non existent. The existing consulting firms currently offer services mainly in the fields of civil engineering works. Engineering services companies often serve as good gate-keepers for technology transfer for an economy and their absence in the metal and metal product subsector is seen as one serious drawback. In the absence of engineering service companies, the entrepreneurs must turn to turn-key type technological imports.

There are a few testing facilities in the private sector. Some testing facilities exist in the public organizations but these are spread quite thinly and there is not a single well-equipped organization catering specifically for the technology need of the metal and metal product industry.

Subcontracting activities within the subsector is quite limited. This is not an irregular phenomenon since most of the industries in the subsector produce intermediate parts to supply to industry in other subsectors. Thus, there are only weak linkages among industries within subsector. Subcontracting activities among other subsectors especially the machinery subsector is also at low level. There are complaints that only few firms in the metal and metal product subsector can produce high standard parts.

Technical Assistance Institutions

Currently, there is no institution specializing in metal and metal product technologies. Although, there are few governmental agencies and private organizations which have some activities in supportive of the development and promotion of the metal and metal product industries. The relatively active institutions include , the Division of Industrial Service (DIS), the Institute of Skill Development (ISD), King Mongkut's Institute of Technology (KMIT), Chulalongkorn University, Thailand Institute for Scientific and Technological Research (TISTR), and Thai-Japan Technological Promotion Association (TPA). Activities of each of the above mentioned institutes normally cover a wide range of technologies and none of these institutions has direct responsibility over the promotion of the metal and metal product technologies.

Engineers

The technology fields that are in direct support to the metal and metal product industries are metallurgy, metallurgical engineering, production engineering and industrial engineering . Faculty of Engineering at Chulalongkorn University is the only institute that produce metallurgical engineers. Currently, the department of metallurgical engineers has only 6 academic staff producing 4 graduates annually on the average in the past 5 years.

King Mongkut's Institute of Technology is also the only institute to produce production engineers. Currently, the institute has produced about 50 production engineers annually in the past 10 years. These engineering graduates spread to all industrial sectors. Only few work is the metal and metal products industries.

The Industrial Engineering Departments of all universities can produce up to 140 IE graduates each year. Similar to the production engineering graduates, few of these engineers work in the metal and metal product subsector.

All engineering graduates possess basic understanding of engineering fundamentals. Further specialization is acquired on the job. Basic metal processing technologies such as casting, welding and fabrication, tools and die engineering , sheetmetal working, and metal properties etc. are taught as part of the whole curriculum. Only the IE

Department at Chulalongkorn University offers gruduate programme at master degree level.

Technician

There is a large network of technical and vocational schools which provide basic training in basic industrial processes. The Vocational Education Department runs 76 technical institutesand 68 vocational institutes. Besides, there are courses run by King Mongkut Institute of technology and by various private colleges. Almost all institutes mentioned offer training in metal technologies and/or welding and sheet metal technologies which are in direct support to the metal and metal product industries. The technician curriculum for either of the two disciplines contains only one case in materials and metallurgy. Such specialization programmes assteel making, foundry and forging which are essential to the metal and metal product industries have not been offered in any technical institution. The subjects are only taught as part of the general curriculum.

Policy Guideline

A strategy to promote technology development in the local industrial system should aim at developing an institutional set up and manpower as well as an environment that encourages research and development and facilitates its application in industry. In addition, it should also attempt to consolidate and dissiminate information about the country's resources and about technical knowhow available indigenously and aboard. Such a strategy should have many facets and should systematically modify

organizational, financial, regulatory, legal and environment related mechanism to be able to achieve its objective without creating any bottlenecks.

The pivot elements that are considered to be the key of technological development can be identified as:

(a) technology availability

(b) human resource

(c) promotion of subcontracting system.

Thus, to promote technology development, the policy should cover all of these three aspects. For the metal and metal product sector, the following key policies are proposed:

Technology Availability

Unpackaging Imported Technology

Metal processing technologies have been well developed in foreign countries and imported by local industries. Foreign dependency on technology can not be decreased if local industries do not have capability to unpackage the technology imported. Such capability can be developed in two stages. First is the digestion of the technology, second is the adaptation and improvement of the technology.

Digestion of imported technology is possible only when sufficient technical information is supplied with the technology imported and local technical personnel are extensively trained. Thus the industry that imports technology should request detaileddesign, specifications, and technical

information together with extensive training programme for local technical personnel. Any industry requesting promotion from the BOI should submit such plan indicates the training scheme of local technical personnel. BOI should also oversee if technical information or detailed design and specification are included in the imported package.

The adaptation and imp vement of technology can be achieved only through local research and development (R&D). In addition, most industries in the metal and metal product subsector are technological oriented and many of the key technologies require knowhow which can be developed effectively through local R&D activities. Therefore, promotion of R&D both in public and private sectors is essential R&D must be in harmony with the development of the industry in the subsector. The necessary measures to promote R&D, in the metal and metal product industries are identified as:

(a) built up research facilities and manpower in metallurgical engineering and production engineering.

(b) encourage large private companies to invest in research and development by tax measures.

(c) promote joint participation between the industry and public research institution by establishing regulations to allow the public research institutes to work with industries and for the research staff to earn reasonable

extra income from the industry in the research project. Also, incentives such as tax measures should also be provided to promote industry to participate in such programme.

Priority of research and development activities is set as follows:

(a) technical consultation, technology assimilation and diffusion.

(b) adaptive development (adaptation of foreign technology to suit local conditions) and mission oriented R&D.

(c) basic research.

In the first stage, the R&D should emphasize the specialized manufacturing technologies such as precision casting, metal forming processes, precision machining for tools and die making, heat treatment of metal. etc. Other areas of importance are production control techniques referring principally to process, quality and cost; design engineering; testing and inspections; and other management techniques.

Propagation and Diffusion of Information by the Improvement of information exchange network

Technology information and documentation center should be established to serve as sources of information for technological developments. The center should focus on metal technologies and could be part of larger institution such as the National Metallurgy and Industrial Materials Research and

Development Center (NCMM) or the Metal Working Industry Promotion Center (MIPC). (The proposal to establish both centers are discuss later in this chapter).

The information and documentation center should made available information on sources of technology and should circulate technical information amongs their subscribers. One good example is the metal bulletin published by the Hong Kong Productivity Center and circulated amongs its subscribers.

Engineering Service Companies

Engineering service companies provide specialized technical assistance to the industries on the case by case basis. Such companies play an important role in assisting industry in areas in which it does not have adequate skills. The engineering service companies must have specialized skills and variety which should be able to provide the wide range of engineering services needed by the industries. Such services as tools and die design, production design, weldment design, fabrication design, failure analysis can be effectively provided by the specialized engineering consultants. Larger industries which are able to pay full cost of technical consultant can use the service from these engineering service companies. However, establishing an engineering service company, may require large investment in equipment used in testing and analysis work. These engineering service company should be considered as one type of industry which can be eligible to apply for promotion from the BOI.

Human Resource Development

Technical Manpower

Although few firms in the metal and metal product subsector indicated shortage of technical manpower in some areas such as tools and die design and manufacturing, weldment design, and fabrication design, the shortage is not currently seen as a serious drawback by most industries. In general, the metal and metal product industries do not feel the shortage of technical manpower. This is mainly due to the lack of technological activities in the subsector. However, if the technical promotion plan become materialize and the industry feelsthe necessity to modernize their plant equipment, to carry on the reserach and development work and to improve their process operations to produce quality goods, more technical manpower will be required both at engineer level and technician level.

(a) Engineers; At present, the Metallurgical Engineering Department at Chulalongkorn University is capable of producing up to 10 engineering graduates annually. However, only few students enroll in the Metallurgical Engineering Programme. The programme is seen by most students as too specialize and the job opportunity is limited.

As described in earlier sections that metallurgical engineers are the most relevant technical manpower in the metal and metal product industries.[1] Thus, more metallurgical engineers will be needed in the development of the subsector. Enrollment in

the Metallurgical Engineering Programme should be encouraged, such as the provision of scholarship or the registration fee exemption programme for some students.

The Production Engineering Programme at KMIT has been operated at full capacity. The current staff to student ratio is below the given guideline. Strengthening of the department is necessary to enable the department to produce quality engineers at higher number. Specialization programmes such as casting and solidification processes, steel making processes, tools and dies design, fabrication design, weldment design, instrumentation, and metal properties should be emphasized.

Graduate programmes in metallurgical engineering and production engineering should be setup to complement the R&D activities.

(b) Technicians; The metal technology programme and sheet metal and welding program should be strengthened. More courses in metal properties or metallurgy should be added to the curriculum. There should be more specialized courses in steel making technology, foundry technology, forging technology, tool and die making technology, instrumentation, welding and fabrication techniques including sheet metal technology.

(c) Skilled labour; In addition to conventional skillssuch as the ability to read drawings and the ability to use conventional tools and equipment of the basic process, new skills in automation and utilization and maintenance of modern machineries and equipment become necessity. This is due to the difficulties arise in industry regarding training of qualified manpower and high cost of the personnel expenditure which would direct the industry toward some degree of mechanization or robotization such as automatic welding, mechanized foundry shop etc.

The training institutions must be prepared for this new technologies.

Research and Development Institution

At present, there is no R&D institute focuses on the metal and metal product technology. The National Metallurgy and Industrial Materials Research and Development Center (NCMM) proposed by MOSTE will be the only institution to have some activities directly cover the metal and metal product industries. The proposed activities of NCMM, however, ranging from mineral processing to materials technology which includes metal product, ceramics, textile and other industrial materials. Care should be taken to ensure that the activity supportive to the metal and metal product industries are not diluted. The discussion to be followed is based on the conceptual paper prepared by the working group of the MOSTE.

Objective

The objectives of NCMM are

(a) to generate new metal and material industries through transfer of technology, research and development, and engineering and economic feasibility study,

(b) to assist existing metal and material industry in problem solving, improvement of quality and productivity.

Target

NCMM will support the metal and metal product industries by carrying research and development works in the area of production technology such as metal forming, forging, metal solidification processes, production of new metal alloys etc.

Methodology and Mechanism

Organization: NCMM is to be formed as a unit in MOSTE. During the first phase of operations, NCMM will carry minimal staff and facilities. Its main activities will be to identify and cooperate between existing agencies to perform the proposed tasks. A few R&D projects will be sponsored. Foreign assistances are being sought for equipment procurement, staff development, and project funding.

Activities

The proposed activities of NCMM are:

(a) to undertake research and development of technology pertaining to metal and material industry.

(b) to act as a centre that renders industry services in testing according to internationally accepted standards as well as certification of quality.

(c) to help upgrade capability of metal and material industry so that its efficiency and product quality approaches those of advanced countries.

(d) to promote greater use of local mineral resources in local industry, both in existing industry as well as new industry to be initiated by NCMM. Thailand's natural resources will thus be given added value.

(e) to help develop spare parts industry, machine tool and machinery industry in order to meet the need of local industry and to export.

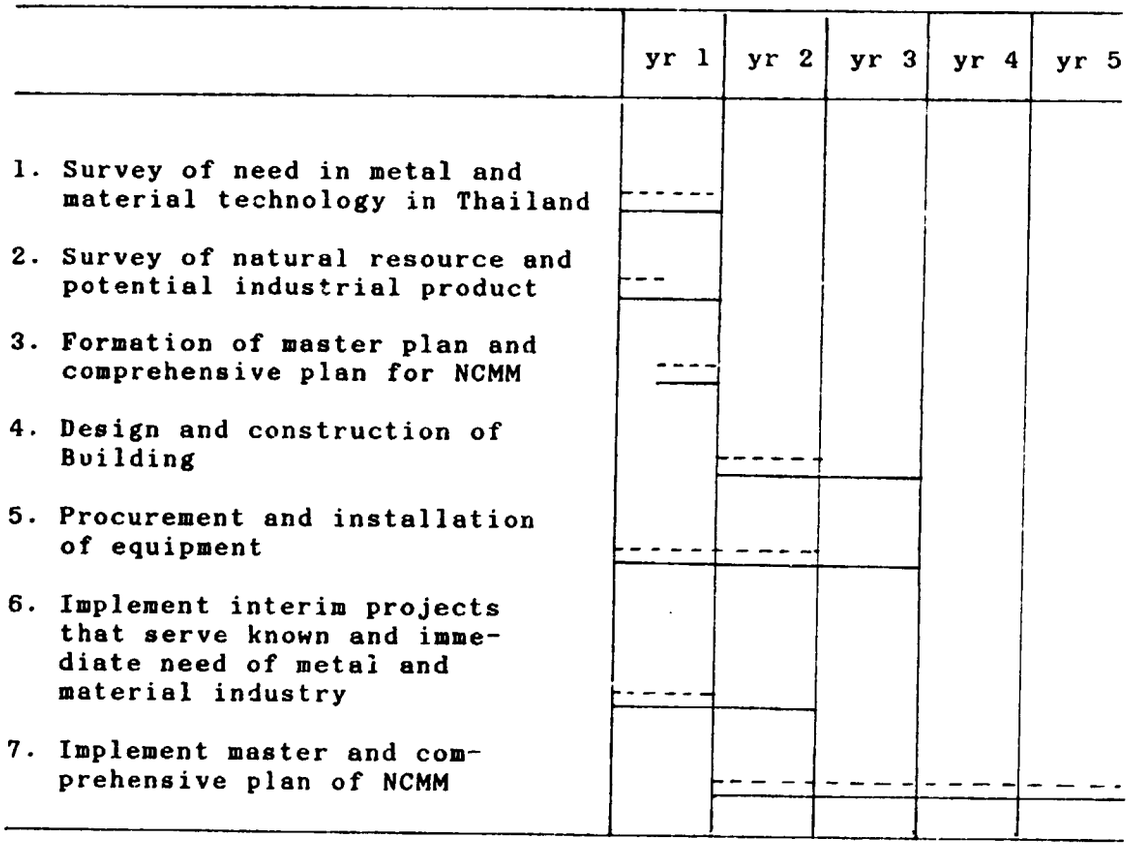
(f) to serve as a centre in transfering and transmitting information and technology pertinent to metal and material industry.

NCMM could work in closecollaboration with TTC in the promotion of technology transfer to metal and metal product industries by providing relavant information to TTC. The center could also support activities of the extension service

institutions.

Schedule of Implementation

It is proposed to implement its action plan as follows:



---------- foreign experts needed

Extension Service Institutes

The Matalworking Industry Promotion Center (MIPC) proposed for establishment by the Department of Industrial Promotion will play major role in offering extension services to the metal and metal products industries. More than half of the activities of the institute will directly benefit the industry in this subsector especially the small to medium size industries. The programme has been well planned and the summary of the project proposal has been well described in the Industrial Restructuring Study Report Volume IV, Technology Development and Promotion for the Engineering Industries.

Manpower Development

As described in earlier sections, strengthening and expansion of Metallurgical Engineering Department. Production Engineering Department and Industrial Engineering Department is relevant. The Metallurgical Engineering Department at Chulalongkorn University should be strengthened to produce at least 20 bachelor degree guaduates and 5 master degree graduates annually. Strengthening of the technical college curriculum in metal processing technology is also necessary. The skill training, upgrading and certification programme should also be expanded.

The methodology and mechanism have been well described in the Industrial Restructuring Study Volume IV.

Priority Technology

Key technologies relevant to the metal and metal product industry which need to be promoted are listed separately by processes and products as follows:

- high priority processes
  - Casting:
    - sand casting techniques for cast iron and cast steel,
    - pattern making,
    - melting and solidification process,
    - metallurgical aspects,
    - testing and quality control,
    - mechanization of foundry shop.
  - Welding:
    - weldment design,
    - skill training and certification.
  - Fabrication:
    - use of jigs and fixtures.
  - Precision Machining:
  - Heat treatment:
  - Automation:
- high priority products
  - moulds and dies:
    - improve design capability and materials selection,
    - promote production and use of standard parts,

Table 4.5: FUNCTION OF MIPC

Purpose	Function
(1) Training and education of personnel	Seminar, workshop, training, etc.
(2) Transmission and spread of technical information	Patrol guidance, diagnosis of enterprises, statistic and publishing, technical information (circular), transfer and interchange of engineering, etc.
(3) Introduction and improvement of engineering	R and D, working under consignment, trial manufacture of products/parts, test and inspection, market research, feasibility study, etc.
(4) Planning and adjustment	Drafting, adjustment and implementation of various plans, organizing field, specializing of enterprises, promotion of specialized enterprises, promotion of high precision enterprises, standardization, approval of form, qualification and certification, etc.

Source: Department of Industrial Promotion

Table 4.6: ROLES OF MIPC IN EACH OF THE 3 PHASE OF OPERATIONS

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	Sympodium (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

Source: Department of Industrial Promotion

Table 4.7: ACTIVITY PROGRAM OF MIPC DURING PHASE I (start up - 3th year)

Kind of processes/products \ Function/duty		(1) Training/education of personnel				(2) Transmission and defusion of information				(3) Introduction and improvement of engineering capability											(4) Planning and coordination			
													Test & Inspection					Research and survey						
		Enterpreneurs, Executives	Middle managements	Foremen, etc.	Extension officers	Technical information (circular)	Transfer and interchange of technology	Statistic, publishing	Extension service and diagnosis of enterprises.	Production control (process, quality, cost)	Design engineering	Management technology	Material	Nondestructive testing	Plasticity	Accuracy	Chemical	Market research, P/S	Trial product, R & D	Entrusted jobs	Organizing firms, etc.	Specializing of firms, and promotion of special metalworking sector	Modernization of industries	Standardization, authorization approval of proto type products Qualification and certification
Kind of Processes	Casting	○	○		○	○			○	○	○		○				○			○	○				
	Forging																		○		○				
	Sheetwork and welding	○	○		○	○			○	○	○		○	○	○					○	○				
	Plating				○	○			○	○	○						○			○	○				
	Machining and machine assembling	○	○		○	○			○	○	○		○			○				○	○				
	Presswork				○	○			○	○	○			-					○		○				
	Precision machinery	○	○		○	○			○	○	○		○			○			○	○	○				
	Heat treatment	○	○		○	○			○	○	○		○							○	○				
	Low cost automation	○	○		○																○				
Kind of Products	Agricultural machinery	○	○		○	○			○	○	○		○						○		○				
	Pump, valve												○								○				
	Mold/dies	○	○		○	○			○	○	○		○							○	○				
	Hand tool																				○				
	Machine tools								○	○	○								○		○				
	Automotive parts					○			○	○	○		○								○				
	Gears	○	○		○	○							○							○	○				

Source: Department of Industrial Promotion

Table 4.8: ACTIVITY PROGRAM OF MIPC DURING PHASE II (4^{th}-6^{th} year)

Kind of processes/products \ Function/duty		(1) Training/education of personnel				(2) Transmission and defusion of information				(3) Introduction and improvement of engineering capability											(4) Planning and coordination			
		Enterpreneurs, Executives	Middle managements	Foremen, etc.	Extension officers	Technical information (circular)	Transfer and interchange of technology	Statistic, publishing	Extension service and diagnosis of enterprises,	Production control (process, quality, cost)	Design engineering	Management technology	Test & Inspection					Research and survey		Entrusted jobs	Organizing firms, etc.	Specializing of firms, and promotion of special metalworking sector	Modernization of industries	Standardization, authorization approval of prote type products Qualification and certification
													Material	Nondestructive testing	Plast'city	Accuracy	Chemical	Market research, P/S	Trial product, R & D					
Kind of Processes	Casting	○	○	○	○	○	○		○	○	○		○				○			○	○	○	○	
	Forging	○	○	○	○	○			○										○		○			
	Sheetwork and welding	○	○	○	○	○	○		○	○	○		○	○	○					○	○		○	
	Plating	○	○	○	○	○			○	○	○						○			○	○	○		
	Machining and machine assembling	○	○	○	○	○	○		○	○	○		○			○				○	○	○		
	Presswork	○	○	○	○	○			○	○	○			-					○		○			
	Precision machinery	○	○	○	○	○			○	○	○		○			○				○	○	○	○	
	Heat treatment	○	○	○	○	○			○	○	○		○	-						○	○	○		
	Low cost automation	○	○	○	○																○			
Kind of Products	Agricultural machinery	○	○	○	○	○	○		○	○	○		○						○		○	○	○	
	Pump, valve	○	○	○	○				○				○								○	○		
	Mold/ules	○	○	○	○	○	○		○	○	○		○	-						○	○	○	○	
	Hand tool	○	○	○	○																○			
	Machine tools	○	○	○	○				○	○	○								○		○	○	○	
	Automotive parts	○	○	○	○	○	○		○	○	○	○	○								○	○	○	
	Gears	○	○	○	○	○							○							○	○			

Source: Department of Industrial Promotion

Table 4.9 ACTIVITY PROGRAM OF MIPC DURING PHASE III (7th Year up)

Function/duty / Kind of processes/products		(1) Training/education of personnel				(2) Transmission and defusion of information				(3) Introduction and improvement of engineering capability												(4) Planning and coordination			
													Test & Inspection					Research and survey							
		Enterpreneurs, Executives	Middle managements	Foremen, etc.	Extension officers	Technical information (circular)	Transfer and interchange of technology	Statistic, publishing	Extension service and diagnosis of enterprises,	Production control (process, quality, cost)	Design engineering	Management technology	Material	Nondestructive testing	Plasticity	Accuracy	Chemical	Market research, P/S	Trial product, R & D	Entrusted jobs	Organizing firms, etc.	Specializing of firms, and promotion of special metalworking sector	Modernization of industries	Standardization, authorization approval of proto type products Qualification and certification
Kind of Processes	Casting	○	○	○	○	○	○	○	○	○	○	○	○				○		○	○	○	○	○	○	○
	Forging	○	○	○	○	○			○	○	○								○		○				
	Sheetwork and welding	○	○	○	○	○	○	○	○	○	○	○	○	○	○					○	○		○	○	
	Plating	○	○	○	○	○	○	○	○			○					○			○	○	○			
	Machining and machine assembling	○	○	○	○	○	○	○	○	○	○	○	○			○				○	○	○			
	Presswork	○	○	○	○	○			○			○		-					○		○				
	Precision machinery	○	○	○	○	○			○	○	○	○	○			○			○	○	○	○	○		
	Heat treatment	○	○	○	○	○			○				○		-					○	○	○			
	Low cost automation	○	○	○	○																○				
Kind of Products	Agricultural machinery	○	○	○	○	○	○	○	○	○	○	○	○					○	○		○	○	○	○	
	Pump, valve	○	○	○	○								○								○	○			○
	Mold/dies	○	○	○	○	○	○	○	○	○	○	○	○					○	○	○	○	○	○		
	Hand tool	○	○	○	○														○		○				
	Machine tools	○	○	○	○				○	○	○							○	○		○	○	○		
	Automotive parts	○	○	○	○	○	○	○		○	○	○	○					○	○		○	○	○	○	
	Gears	○	○	○	○	○			○				○						○	○	○				

Source: Department of Industrial Promotion

- improve production techniques.

- Original machinery parts:
  - production technologies especially casting, forging and machining
- Gears:
  - Forging
  - Heat treatment
- Metal furnitures:
  - improve design capability of knock down furniture,
  - improve manufacturing techniques of knock down furniture:
    - presswork,
    - use of jigs and fixtures,
    - precision dies.

Financial Assistance

Formal channels of credits available to manufacturers currently consist of:

(a) 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, about 65,000 million baht of which 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. 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.

(b) 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 was allocated to the metal, metal products, and nonelectrical machinery industries.

(c) Industrial Finance Corporation of Thailand (IFCT)

The IFCT is a specialized financial institution whose main function is to finance industrial projects. The loan extended by the IFCT are mostly in financing fixed assets with maturity of up to 15 years. The IFCT's loans to all manufacturing enterprises in 1982 was about 4,900 million baht, about 600 million baht of which was lent to basic metal and metal product 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.

(d) 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.

(e) 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. The basic metal industry is among the large users of this facility taking about 675 million baht from this credit line. However, most of this amount went to a single subsector, i.e. the steel bar producers accounted for 641 million baht, leaving only 34 million baht to the rest of the industry. The manufacturers of fabricated metal products obtained even less amount, only about 5 million baht.

The allocation of the IPNs is done by commercial banks. Not surprisingly, the facility is used mostly by large scale enterprises. The commercial banks naturally try to do favor to their prime customers by allocating this low cost credit to them.

The short review of the existing financial faciliteis 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

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

- moral suasion to induce commercial banks to set up special programme of credits for small industries,
- expansion of the Bank of Thailand's fund for its rediscount facility,
- expansion of the IFCT special credit programme for small industries.

(b) 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.

(c) Transformation of the SIFO to become the Small Industrial Finance Corporation of Thailand (SIFCT). The SIFCT is proposed to have a

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/1 The details of this proposal is in "Financial Strategies for Industrial Restructuring," the Industrial Management Co.,Ltd. (1985).

similar legal status to the IFCT. The success of the IFCT should be duplicated by following the same strategy.

(d) Establishment of a new financial institution to be referred to as the Industrial Restructuring Fund (IRF). The main objective of this institution is to implement the industrial restructuring programme. If implemented, this scheme will have a leading role in the restructuring process of the metal product industry as well as other priority industries covered by the restructuring programme. For the metal industry, the restructuring programme should aim at promoting technology development and productivity improvement. The following activities should deserve high priority for long term finance by the IRF.

- budgeting for R&D programmes, technical consultancy and manpower training;
- purchasing of know how, machinery, equipment and instrument to modernize production technique;
- purchasing of testing facility, quality control equipment;

- expense on remodeling of plant to improve production efficiency or product diversification.

The criteria for loan approval should emphasize economic and technical efficiency more than financial profitability. Of course, commercial viability of the project based on a minimum allowable financial rate of return must be the most important criterion for loan approval. However, project ranking among those passing this criterion should be based on economic rate of return, i.e. allowance must be made for the effect of tariff and nontariff protection as well as for the divergence between the social and private net benefits. The task of project evaluation should be performed by competent technical personnel and guided by a realistic development programme of each priority sector. For the metal industry, special attention should be paid to:

(a) Development of the semi-integrated steel mills, ingot casting process should be gradually phased out and replaced by the continuous casting process. Diversification into high value added products such as high strength structural steels and steel sections should be promoted.

(b) Promotion of the manufacturing of fabricated metal products for exports.

(c) Modernization of production techniques particularly in forging, foundry, galvanized sheet and welded pipes.

Table 4.10: CREDIT EXTENDED BY FINANCIAL INSTITUTIONS (Outstanding Amount)

(Million of baht)

Institutions	1970	% of total	1975	% of total	1980	% of total	1981	% of total	1982	% of total
Commercial Bank	28,038.7	83.97	81,302.3	70.96	215,931.2	69.40	254,449.6	68.75	299,760.1	69.66
BOB	419.3	1.26	329.1	0.29	1,113.8	0.36	2,024.2	0.57	(2,502.6)	0.57
Finance Company	939.9	2.78	20,493.7	17.89	54,977.6	17.43	65,359.6	17.67	79,515.0	18.21
BAAC	1,206.7	3.62	4,716.0	4.11	12,464.4	3.95	14,142.0	3.82	15,741.4	3.61
GHB	168.3	0.50	311.1	0.27	8,122.9	2.57	9,410.9	2.54	9,469.9	2.17
Life Insurance	459.1	1.38	933.1	0.81	2,697.8	0.85	3,855.5	1.04	4,284.8	0.98
Agricultural Cooperatives	653.3	1.96	1,839.6	1.66	4,476.4	1.42	5,032.1	1.36	(6,342.1)	1.45
Saving Cooperatives	532.5	1.59	1,327.3	1.16	4,041.2	1.28	5,165.3	1.33	(7,063.1)	1.62
IBRD	371.3	1.11	1,333.1	1.16	3,350.6	1.06	4,355.7	1.16	4,700.5	1.09
Credit Fonciers	n.a.	-	634.8	0.55	2,419.2	0.77	2,931.2	0.79	(3,818.9)	0.88
Pawnshop	537.4	1.61	1,222.9	1.07	2,697.2	0.89	3,270.9	0.89	3,303.5	0.76
SIFO	72.6	0.22	76.1	0.07	103.4	0.03	74.6	0.02	56.2	n.01
Total	33,390.6	100.00	114,577.9	100.00	315,472.7	100.00	370,117.6	100.00	436,558.1 *	100.00

Note: Figures in parentheses are estimated

Source: Bank of Thailand

Table 4.11: OUTSTANDING LOANS FROM COMMERCIAL BANKS BY INDUSTRIES

(Million of baht)

	1976		1978		1980		1982	
	Value	%	Value	%	Value	%	Value	%
1. Food, beverages, tobacco and others	3,868	17.5	7,343	23.2	14,792	29.1	16,753	25.9
2. Textiles and garments included leather products	7,792	35.2	9,436	29.7	11,353	22.4	11,461	17.6
3. Wood and wood products	523	2.4	648	2.0	1,782	3.5	2,926	4.5
4. Paper and paper products	1,192	5.4	1,314	4.1	1,592	3.1	2,957	4.6
5. Chemicals and petroleum products	2,980	13.5	4,295	13.5	6,836	13.5	7,208	11.1
6. Non-metallic mineral products	869	3.9	876	2.8	1,325	2.6	1,769	2.7
7. Basic metals and metal products	881	4.0	1,406	4.4	2,335	4.6	6,700/a	10.3
8. Machinery and transport equipment	2,551	11.5	4,368	13.8	7,435	14.7	7,155/b	11.0
9. Others	1,467	6.6	2,006	6.3	3,280	6.5	7,956	12.3
Total	22,123	100.0	31,692	100.0	50,730	100.0	64,885	100.0

/a Including machinery

/b Only electric machinery

Source: Bank of Thailand

Table 4.12: OUTSTANDING LOANS FROM FINANCE COMPANIES BY INDUSTRIES

(Million of baht)

	1976		1978		1980		1982	
	Value	%	Value	%	Value	%	Value	%
1. Food, beverages, tobacco and others	1,217	14.5	2,053	19.0	3,198	21.7	4,184	20.8
2. Textiles and garments included leather products	2,224	25.8	2,114	19.3	2,260	15.4	3,139	15.6
3. Wood and wood products	235	2.7	341	3.1	471	3.1	479	2.4
4. Paper and paper products	330	3.8	390	3.6	708	4.8	779	3.9
5. Chemicals and petroleum products	704	8.2	768	7.0	1,014	6.8	1,645	8.2
6. Non-metallic mineral products	-	-	-	-	-	-	1,264	6.3
7. Basic metals and metal products	236	2.7	306	2.8	391	2.6	1,055/a	5.2
8. Machinery and transport equipment	1,040	12.0	1,884	17.3	2,543	17.2	3,201/b	15.9
9. Others	2,611	30.3	3,017	27.9	4,195	28.4	4,373	21.7
Total	8,597	100.0	10,873	100.0	14,780	100.0	20,119	100.0

/a Including machinery

/b Only electric machinery

Source: Bank of Thailand

Table 4.13: OUTSTANDING LOANS FROM IFCT BY INDUSTRIES

(Million of baht)

	1976		1978		1980		1982	
	Value	%	Value	%	Value	%	Value	%
1. Food, beverages, tobacco and others	293.18	17.4	380.54	19.6	589.41	18	759.66	15
2. Textiles and garments	216.90	12.9	237.81	12.3	134.23	4	239.73	5
3. Wood and wood products	53.01	3.1	45.46	2.4	76.49	2	136.79	3
4. Paper and paper products	44.07	2.7	70.89	3.6	77.84	2	117.93	2
5. Chemicals and petroleum products	232.57	13.9	200.95	10.4	390.13	12	439.49	10
6. Non-metallic mineral products	276.18	16.4	381.38	19.7	539.35	15	690.80	15
7. Basic metals and metal products	153.81	9.2	119.54	6.2	133.80	4	599.15	12
8. Machinery and transport equipment	209.48	12.4	90.13	4.6	333.57	10	400.08	8
9. Others	199.99	12.0	412.93	21.2	1,140.61	33	1,473.36	30
Total	1,679.19	100.0	1,939.63	100.0	3,415.43	100	4,856.99	100

Source : IFCT Annual Report, Various issues.

Table 4.14: INDUSTRIAL REDISCOUNTING FACILITY, BANK OF THAILAND, 1979-1982

(Million of baht, percentage share)

Item	1979	1980	1981	1982	Growth rate 1979/82	Growth rate 1981/82
Textiles and Garments	2,833.45 (39.2)	3,233.91 (30.5)	2,576.70 (57.1)	2,572.6 (37.9)	-3.2	-0.16
Nonmetalic	2,529.91 (35.0)	2,652.59 (33.2)	745.70 (15.1)	1,745.6 (25.7)	-11.6	134.25
- Cement	1,804.20 (24.9)	1,914.40 (23.0)	305.0 (6.2)	1,323.0 (19.5)	-9.8	333.77
- Concrete products	310.79 (4.3)	325.29 (4.1)	34.9 (0.7)	24.0 (0.4)	-57.4	-31.23
- Construction materials	406.43 (5.6)	404.79 (5.1)	400.20 (8.1)	396.8 (5.8)	-0.8	-0.85
Basic metalic	914.62 (11.7)	909.80 (11.4)	655.00 (13.2)	675.0 (9.9)	-9.6	3.05
- Steel bars	841.46 (11.7)	832.74 (10.4)	630.10 (12.7)	641.4 (9.4)	-8.7	1.79
Manufacture of metal products except machinery and equipment	5.10 (0.1)	5.10 (0.1)	5.10 (0.1)	5.1 (0.1)	0	0
Wood	68.69 (1.0)	85.25 (1.1)	85.40 (1.7)	77.1 (1.1)	3.9	-9.72
- Wood products	62.99 (0.9)	79.63 (1.0)	23.40 (2.7)	76.1 (1.1)	6.5	-8.75
Paper						
- Paper and paper products	142.61 (2.0)	150.41 (1.9)	142.00 (2.9)	139.9 (2.1)	-0.6	-1.48
- Printing	8.00 (0.1)	7.20 (0.1)	7.20 (0.1)	7.2 (0.1)	-3.5	0
Rubber	24.01 (0.3)	26.56 (0.3)	13.20 (0.3)	8.6 (0.1)	-29.0	-34.85
Chemical	208.58 (2.9)	245.04 (3.1)	188.60 (3.2)	167.6 (2.5)	-7.0	-11.13
- Caustic soda and salt	117.30 (1.6)	119.68 (1.5)	70.10 (1.4)	60.1 (0.9)	-20.0	-14.27
Food and beverages	467.16 (6.5)	617.39 (7.8)	525.99 (10.8)	481.9 (7.1)	1.0	1.76
- Vegetable oil	58.43 (0.3)	196.50 (2.8)	196.50 (4.8)	200.0 (2.9)	50.7	1.78
- Animal feed	231.86 (3.0)	224.08 (2.8)	235.00 (4.8)	239.6 (3.9)	1.1	1.96
Manufacture of machine, equipment & consumer electronics	42.96 (0.6)	31.30 (0.4)	2.20 (-)	2.7 (-)	-60.2	22.73
- Radio and television	23.90 (0.3)	41.70 (0.5)	- (-)	-	-	
Total	7,228.21	7,981.06	4,946.50	6,794.3	-2.0	37.36

Source: Bank of Thailand

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. Current State

The metal industries can be divided into two groups. The first group is the basic metal products (I-O Code 105-107) and the other is fabricated metal products (I-O Code 108-111). At present the potentially strong linkages within this sector and with the other sectors are much weakend by leakage to imports. Production of metal products in 1982 amounted to 33,415 million baht. In terms of value added it contributed to about 0.6% of the country's GDP or 4,855 million baht. Export from this sector in the same year was 10,146 million baht, only tin alone accounted for 7,773 million baht but import value in the same year amounted to 21,022 million baht, resulting in the trade deficit of 10,876 million baht.

Production of iron and steel products may be divided into steel making and steel using. Steel making consists of casting and rolling processes, while steel using industries are fabricated metal products, other metal working industries and construction. The cost of raw materials is the largest component in every metal product with the except of cast steel pipes. Energy cost is relatively high for cast steel pipes and rolling mills due to the casting process involved. Labour cost accounts for significant proportions in large welded pipes, cast steel pipes and LPG tanks. At present, Thailand has to import about 2.5

million tons of steel products annually. About half of this total is in the form of coil, plate and sheet, and about half of the remainder is in the form of scrap.

There are three sources of local steel scrap namely scrap from within the steel making plants, industrial scrap (from the steel using industries) and capital scrap. Scrap from the first source is estimated at 100,000 tons per year. From the estimated total of 400,000 tons of domestic scrap, the amount of industrial scrap and capital scrap can be estimated at 300,000 tons per year. The rest of the demand for scrap by the steel making industries have to be fulfilled by import. An alternative source to imported scrap is ship breaking.

Over the past few years, the rates of capacity utilization are found to be lower than 50% in the steel mills, tinplate, tubes and pipes, aluminum sections and other sectors. The low utilization rates of capacity of these industries are probably due largely to the over-expansion of industries around the end of the 1970s and the demand slump in the past few years. Consumption of metal products over the period 1978-1982 increased by only 25.4%. The slower growth of domestic production than domestic consumption was due to the increasing share of import in the domestic production. The demand for metal products are essentially derived demand. Demand for steel bars is determined by level of construction. Demand for tinplate is greatly influenced by production of canned food and demand for galvanized sheet depends on income of the rural sector.

Market Structure

As of 1983 there were 5,852 firms registered with the Department of Industrial Works as producers of metal products. The types of firms that are most commonly found are machine shops, electroplating, press work, and metal fabrication. There are a lot of firms which are supporting the metal production:

- The Steel Mills

There are 13 semi-integrated steel mills in Thailand with the combined capacity of about 700,000 tons per year. Production level was 340,000 tons in 1983, representing only less than 50% of capacity utilization rate. All of these steel mills use electric arc furnace in their production and a few larger firms have converted from ingot casting to continuous casting. Most of the other firms have the production capacity in the range of 50,000 tons per year and 150,000 tons per years.

- The Rerollers

The rerollers produce steel bars and other nonflat steels from imported scraps. They do not have steel melting facility like the arc furnace. Their products are often undersized and have unknown properties. These products are sold cheaply. There are 30-50 firms at present.

- Tinplate

There is just one tinplate producer in Thailand. The production capacity is 150,000 tons per year but the production in 1983 was about 80,000 tons, representing 53% of capacity. About 60,000 tons of tinplate was imported in the same year.

- Galvanized Sheets

There are three galvanizers in Thailand all of which use the out-of-date production line. The fourth company is under construction and will employ the modern production line. About 80% of galvanized sheets are consumed by farmers as building material.

- Tubes and Pipes

There are about 10 producers in Thailand. Their total annual capacity is 300,000 tons. Production consists mainly of water pipe and furniture pipe.

- Foundry and Casting

The number of firms engaged in foundry and casting is estimated at about 250. Grey cast iron is the most common type of products of these firms. About 30% of the surveyed firms produce nonferrous metal products and more than half of which also produce cast iron 90% of the nonferrous casting firms produce aluminum alloys and 50% produce copper alloys.

- Aluminum Sections

Between 1976-1981, production capacity of aluminum sections in Thailand increased rapidly from 12,700 tons per year to 24,400 tons per year while actual production increased from 6,200 tons to 9,900 tons. The leading firm is Alcan Thai, which captures about one half of the domestic market.

- Compressed Gas Cylinder

As of 1983, there were 4 producers of LPG cylinder in Thailand. The industry employs about 800 workers and has the total capacity of 1.5 million units per year. Between 1976 and 1980, production increased rapidly from 200,000 units to 630,000 units which commonly used for cooking by household.

Steel Cabinet

There are 6 major producers. Total production capacity is estimated at about 210,000 units per year. Nearly 1,000 workers are employed in this industry.

II. Technological Capability

General Diagnosis

Firms in the metal product industries may be divided by size into two groups. The small firms have limited technological capability. They lack basic knowledge of production technology, of metallurgy, of the use of fine measuring devices, of management techniques and of the access to industrial

information. On the other hand, the large firms have higher level of technology. They are either fairly or well equiped with machinery and personnel. Most of these firms obtained their production technology from abroad in the form of joint venture, licensing agreement or assistance through the purchase of equipment and raw materials. However the majority of the workforce in the metal product industries have only primary school education. In most firms, there seems to be a lack of standard job method and job instruction.

Operating Practice

- Foundry and Casting

The foundry industry consists of traditional iron casting and nonferrous casting, and the modern steel casting and die casting. Steel casting companies are relatively large and have modern facilities and good access to foreign technology. Die casting technology is well mastered by local companies. By contrast, most of the non-ferrous and cast iron firms still employ the same techniques that have been practiced for many decades.

- Forging

There are two or three forging firms which are fairly well equipped with modern facilities and produce replacement parts for the automobile industry.

- Presswork

The problems in presswork operating practice are improper selection and use of machine, lack of tool and die design and production. These poor practices result in high scrap rate and add secondary operations to bring the quality of products to the required standard.

- Fabrication

Most of large fabrication firms have semiautomatic or automatic welding machines together with standard manual welding machines. Jigs and fixtures are widely used then the products is up to standards. Major problems in the fabrication industry may be identified as weaknesses in the design and use of dies, and in the shortage of certified welders.

- The Steel Mills and the Rerollers

Process equipment and operating practices of the steel mills have a lot of room for improvement to reduce consumption rates of energy and electrode. Products of the rerollers are unreliable dimensionally, chemically and metallurgically. The problem is both inherited in the use of raw materials of low quality or even unknown properties and also, due to dishonesty as evident from deliberate undersizing of their products.

- Machining

Most of the machine shops use only general purpose machine tools and have low machining capability. Their production of toolsand dies are normally limited to in-factory use.

III. The International Steel Market

Steel Consumption

World steel consumption grew at the average rate of 5.6% annually between 1950 and 1974. The growth was haulted in the following four years due to the oil shock in late 1973. The new peak was reached in 1979 only to meet another oil shock which brought down the demand level again in subsequent years. Production of steel in 1984 and 1985 are expected to be just about the same levels as 1978 and 1979 respectively. Between 1977 and 1983, the share of the industrialized countries in world steel consumption was down 17.5% while the share of the developing countries increased by 17%. The causes of recession in steel demand were identified as: a shift from investment to consumption; the collapse of the ship building industry following the stagnation of oil transports; and the change in inventory management system which reduced the stocks of steel. The growth of steel consumption is potentially strong in developing countries as there are big gaps in accumulated stock and annual steel consumption between developing and industrialized countries. The stock of steel embodied in infrastructures and industrial capitals in the US is estimated at over 10,000 kg. per

capita while it is only about 600 kg. per capita in Thailand.

Specific Steel Consumption

Specific steel consumption is the amount of steel used per unit of production in each branch of industries. It has been found that specific consumption of steel has declined in various products in recent years. The amount of steel per car has declined due to replacement of heavy steel parts by lighter ones, made of high quality steel thus maintaining the required strength and a shift from steel to other materials.

Technology Development

The trend of development in steel technology in recent years has been greatly shaped by high energy cost. As an energy intensive industry, cost reduction is strategically lain on material saving since energy consumption is proportional to the amount of material input. In steel making, this has been achieved through reduction of wastage rate and improvement of quality to maximize value added. Energy cost per tonnage of steel can be reduced as well as in continuous casting versus ingot casting. In steel using industries, weight reduction becomes more important especially in production of transport equipment as it translates directly into reduction of energy consumption.

Future Outlook

The recent problem of the world steel industry has been due to overcapacity. Capacity expansion in 1970s was not matched

by the growth of demand due to the world recession following the oil shocks. It was estimated that the world capacity in the early 1980s exceeded the world demand for steel by about 150 million tons. As a result, investment in the steel industry decreased dramatically from US$ 5 billion in 1979 to US$ 1.8 billion in 1983. A number of closures in the US has reduced the steel capacity by 20 to 30 million tons. The EEC has worked out a plan to reduce capacity in its member countries by 40 million tons by the end of 1985. The streamlining effort has given a brighter prospect for the second half of the eighties than it had over the last 15 years. Some world leading producers have been able to make good profit in 1984.

IV. Development Strategy

The development strategy proposed in this study is based on the following objectives:

1) Strengthening intra-and inter-industry linkages,
2) Promoting exports of the potential products,
3) Raising production efficiency of the industries.

The following subsections provide the reviews and recommendations on major instruments relevant to the development process of the metal industries.

New Investment

The general directions for new investment should be:

1) Expansion should take place in less capital intensive industries, supported by more uniformity

in the protection system and promotion of technology development particularly in labour training and technical assistance,

2) Curbing the proliferation of inefficient industries, modernizing the plants and equipment of these industries to improve their technical efficiency and rationalizing product mix to increase economic efficiency.

At present, most forging and foundry shops are concentrated in producing low quality products. New investment in this subsector would be desirable only if it employs advanced technology to produce good quality products. As for steel making industries, the introduction of continuous casting process should be encouraged taken into account the scale economies. And the rerolling activity should be gradually phased out by toughening regulations.

Thailand is virtually self-reliant in several flat and fabricated steel products. Some of them have been exported in significant amount notably tubes and pipes and furniture. Knocked-down furniture is of special interest for further promotion.

Industrial Standard System

Industrial standards are administered by the Thai Industrial Standard Institute (TISI). The limitations of the present system of industrial standards may be identified as

follows: the rate of issuance of standards does not keep in pace with the need; testing facilities are inadequate; many producers lack the knowledge to bring their products to meet the required standards; and enforcement of the regulations on industrial standard is ineffective.

Standard system should be supported by establishment of the National Measurement Standard Board, the National Voluntary Laboratory Accreditation Scheme and strengthening the capability of TISI. The functions of the National Measurement Standard Board consists of giving advice to the government on the national policy and plan in maintaining measurement standards, coordinating the activities pertaining to the maintenance of standards as undertaken by various agencies and establishing national scheme on measuring equipment calibration and services.

The role of TISI should be strengthened by preparation of a priority list of specifications required for basic metal processing, establishment of a special secretariat within TISI to coordinate the preparation of products prioritized above, establishment of the National Scientific and Technological Testing Board to oversee the competence and professionalism of testing laboratories and screening of all public sector testing laboratories and accredited private sector laboratories.

Protection

Tariff rates are generally high on consumption goods and low on capital goods and generally escalated with the degree of fabrication. In metal products, the lowest range of tariff rates,

up to 10% is applied on basic metals. Secondary steel products are mostly subject to the intermediate range of 15% to 30%. Metal products in final forms are subject to the highest range of duties from 30% to 80%.

There is a general tendency that the effective rates of protection are high for finished products and low or negative for raw materials and intermediate products. Although the tariff rates are just moderate, the degrees of protection should be reduced or at least not increased in steel bar, billet, galvanized sheet, tinplate and metal furniture. More protection should be given to forged and cast parts, other machinery parts, cutlery and hand tools.

Basic Industry Projects

There are two basic industry projects confronting Thailand. One is the integrated steel project and the other is the sponge iron project. It has been found that both projects are not viable under the current economic constraints.

There is a need for an integrated mechanism to screen all the large scale projects simultaneously and implement them efficiently. In this regard, Division of Industrial Economics and Planning and Office of Basic Industries, MOI should play vital role and coordinate closely with the NESDB.

Technical Assistance

To effectively deliver technical assistance and promote technology development of the metal and metal product sector, the following key policies are proposed:

1. Technology availability

   i) industries requesting BOI promotion should submit detailed plan on technology transfer;

   ii) building up research facilities and manpower in metallurgical engineering and production engineering;

   iii) promoting joint participation between the industry and public research institutions;

   iv) establishing technology information and documentation centre which could be a part of proposed National Metallurgy and Industrial Materials Research and Development Centre or the Metal Working Promotion Center; and

   v) including engineering service companies in the list of eligible activities for BOI promotion.

2. Human resource development

   i) encouraging enrollment in the metallurgical programme;

ii) strengthening the Production Engineering Department at university and technical college levels.

iii) setting up graduate programmes in metallurgy; and

iv) preparing training programmes and courses to cope with industrial need and new development in technologies.

3. Key technologies relevant to the metal and metal product industry which need to be promoted are listed separately by processes and products as follows:

- high priority processes
  - Casting:
    - sand casting techniques for cast iron and cast steel;
    - pettern making;
    - melting and solidification process'
    - metallurgical aspects;
    - testing and quality control;
    - mechanization of foundry shop.
  - Welding:
    - weldment design;
    - skill training and certification
  - Fabrication:
    - use of jigs and fixtures.
  - Precision Machining:

- Heat treatment:
- Automation:

- high priority products
  - Moulds and dies:
    - improve design capability and materials selection;
    - promote production and use of standard parts;
    - improve production techniques.
  - Original machinery parts:
    - production technologies especially casting forging and machining.
  - Gears:
    - forging
  - Metal furnitures:
    - improve design capability of knock down furniture;
    - improve manufacturing techniques of knock down furniture;
      - presswork;
      - use of jigs and fixtures;
      - precision dies.

Financial Assistance

The financial problems in Thailand are scarcity in the medium term and long term credits, inaccessibility of small enterprises to the organized market credits. So the major

elements in this proposal are expansion of credits to small manufacturers under the existing institutional set up, establishment of the Industrial Credit Guarantee Scheme by IFCT, transformation of SIFO to become the Small Industrial Finance Corporation of Thailand and establishment of a new financial institution to be referred to as the Industrial Restructuring Fund (IRF). IRF should give budgeting for R&D programmes, purchasing of knowhow, machinery and equipment and expense of remodeling of plant to improve production efficiency or product diversification.

Appendix I : INDUSTRIAL CAPABILITY PRIMARY AND SECONDARY METAL SUBSECTOR.

Component	level 1	level 2	level 3	level 4
1. Process equipment				
2. Testing Facilities and quality control	See tabulations	for each processes in	the following sheets	
3. Products				
4. Majority of workforce	Compulsory education no skill training	High school graduate some skill training	Skilled labour or certificate technicians	
5. Technical manpower	No engineer	Engineers in managerial position	Engineers in technical staff	Experienced metallurgical and/or production engineers in technical staff and R & D
6. Technical informations and R& D activities	No exchange of technical information, no R& D	- Seek outside assistance such as supplier, university staff, technical reports etc. - No design capability	- Good access to technical informations through licensing, joint venturing etc. - Technical staff available - No formal R& D activities - Capable of simple design	- Good access to technical information - Formal R& D activities - Design capability - Product development capability

Foundry and casting

	level 1	level 2	level 3	level 4
1. Process Equipment				
- Furnace	- Chinese cupola (cast iron) - Crucible furnace (non ferrous metal) using coke/charcoal	- cupola with/without control system	- Induction furnace	
- Mould making	- manual	- jolt squeeze - permanent mould	- fully automatic moulding - Die casting	
- Moulding sand	- natural sand with no quality control	- synthetic sand	- hardening and self hardening moulding sand	
- Pattern making capability	- No capability	- simple pattern - use customer's pattern	- full pattern making capability	
- Design	- no design capability, copying from sample	- simple design capability (shrinkage calculation)	- full design capability (shrinkage, gating system, risering system)	- full design capability for complicated part.

2. Testing Facilities and quality control	- No quality control,	- use outside service to check chemical composition, mechanical properties etc. - random check of regular products	- full range of testing equipment available - spectometer -.C.E. meter - mechanical properties testing - on destructive testing - sand testing facilities	
3. Product	- low quality product - bad appearance - dimensional inaccurate - unknown chemical composition	- medium quality product but inconsistence in quality - inconsistency in chemical composition - can not control metallurgical structure	- good quality product - within specifications both in mechanical properties and chemical composition - unable to produce special alloys or product with complicated micro structure	- good quality products - ability to develop new products as required by customers.

Forging

	Level 1	Level 2	Level 3	Level 4
1. Process equipment				
1.1 Forging machine	- hand forging	- hammer forging	- hammer forging and drop forging	
1.2 Die use	- none	- customer supply or outside made	- simple die design and making capability	- complicate die design and making capability
- design making				
- machine use in die production			- milling machine - Radial Drill - Grinding Machine etc.	- EDM - Copy lathe, milling - j'g boring etc.
- measuring instrument			- micrometer - dial guage - height guage	- high precision instrument with digital readout
- heat treatment			- Hardening or hard chrome	- hardending or hard chrome with mechanical properties checking.
1.3 Preheating	- Charcoal furnace	- Oil/gas furnace	- Induction heating	
2. Testing facilities and quality control	- none	- mechanical properties	- complete testing facilities	
3. Products	- simple forged product such as hand tools	- inconsistence product quality	- good product quality mechnanical and metalluraical properties within tolerance limit.	- ability to forge wide range of product at good quality.

Rolling Mills

	level 1	level 2	level 3	level 4
1. Process equipment	- rolling mill without melting furnace		- rolling mill with melting furnace - concast - rolling to finish products	- concast and continuous rolling to finish product (integrated mill)
2. Testing facilities and and quality control	- no quality control	- quality control of input materials - no testing facilities, use outside service	- complete testing facilities including mechanical properties testing and chemical composition analysis - good quality control scheme	
3. Product	- rerolled bars from Cobbled plates or ship plates - unaccurate dimension - low quality product inconsistance mechanical properties and chemical composition	- roll from billets or ingots - product within dimensional tolerance and acceptable quality	- rolled from concasted ingots with controlled chemical composition - ability to product simple standard products	- ability to produce wide range of standard products and develop special products.

Fabrication :

	Level 1	Level 2	Level 3	Level 4
1. Process equipment	- simple arc welding - oxy-acetelene welding and cutting - simple metal forming - simple shear for metal cutting	- semi autometic welding machine - MIG, TIG machine - large size forming and cutting machine - some use of jig and fixture	- autometic welding and cutting - various types of forming machine (press, rolling, shearing) - use of jig and fixture	- entensive use of jig and fixture
2. Testing equipment and quality control	- none, do not have quality control scheme	- simple mechanical testing equipment	- wide range of testing equipments - mechanical properties testing - non destructive testing	
- controlling of input materials	— none	- manufacturer specification	- manufacturer specification and random checking	
3. products	- simple fabrication works	- more complicate fabrication work - good appearance - use customer design	- fabricated to customer specifications - simple design capability - licensed fabricated product.	- capability of large fabrication work - design capability to meet customer requirements.

Press work

	level 1	level 2	level 3	level 4
1. Process equipment	- local made or second-hand small mechanical press	- imported manual mechanical press - hydraulic press	- fully automatic presses (hydraulic or mechanical)	
- Press				
- Die	- Use simple die	- use simple die with some dimensional and toleranee control	- simple progressive die	- Sophilicate progressive die
2. Testing Facilities and Quality Control	- No quality control or almost eye inspection	- Go-No go guages	- Go - No go guage - Vernia Caliper - some precision measuring divices	
3. Product	- low precision inaccurate product - generally poor appearance	- better appearance and within dimensional tolerance	- Standard products	
4. Die Making facilities				
- machine tools	- locally made or second-hand - General machine	- Milling machine Radial drills, Grinding machine	- Tool room machine - Tools and culter grinder - copy milling - basic EDM.	- EDM, wire cut EDM - NC milling - precision grinding

- Measuring tools	- Ruler, Vernia Caliper	- Micrometer - guage block	- Dial guage - height guage - some precision measuring devices	- profile projector - precision measuring devices
- heat treatment	- no facility	- with heat treatment facility	- Controlled atmosphere heat treatment facility and equipment to cheek die properties after heat treatment	