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THE MACHINE TOOL INDUSTRY IN THE ASEAN REGION: OPTIONS AND STRATEGIES. ANALYSIS BY COUNTRY

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In the course of the work on major sectoral studies carried out by UNIDO, Studies and Research, several working papers are produced by the secretariat and by outside experts. Selected papers that are believed to be of interest to a wider audience are presented in the Sectoral Working Papers series. These papers are more exploratory and tentative than the sectoral studies. They are therefore subject to revision and modification before being incorporated into the sectoral studies.

This paper was prepared by TECHNONET as consultants to UNIDO. The views expressed do not necessarily reflect the views of the UNIDO secretariat.

Preface

At the recommendation of the 9th Session of the ESCAP Committee on Industry, Technology, Human Settlements and Environment held in Bangkok from 10 to 16 September 1985, UNIDO, Sectoral Studies, and the ESCAP/UNIDO Division for Industry, Human Settlements and Technology will organize a meeting on "Production and use of machine tools in the engineering industry of ESCAP developing countries". This meeting, to be held in Singapore between 17 and 21 November 1986, will be a direct follow-up of the UNIDO/ESCAP project on "Review and appraisal of industrial progress at regional level".

The meeting should formulate concrete recommendations to be followed by industrialists and policy-makers in the countries concerned and by UNIDO and ESCAP to assist in developing the use and production of machine tools in the engineering industry in the ESCAP developing countries. This study, consisting of two volumes, will be one of the background documents for this meeting. Volume I presents the main issues at regional level for the machine tool industry and volume II gives detailed country information and analyses.

The study was prepared by Sectoral Studies in collaboration with TECHNONET, Singapore, as consultant to UNIDO. Tables without specific mention of source were produced by the consulting firm.

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1. INTRODUCTION

This study on the machine tool industry in the countries of the ASEAN region aims to provide an analytical appraisal of the sector with the view to defining some possible strategies for its further development. While volume I presents the main points of discussion at regional level, volume II is an attempt to describe the situation of the machine tool industry in the context of the capital goods industry in some countries of the region viz. Indonesia, Malaysia, the Philippines, Singapore and Thailand.

In pursuit of a machine tool industry development, the Government of Indonesia promulgated specific policies to stimulate local manufacture of simple machine tool items. Recently there has been a significant growth - up to 20 per cent annually - of market demand for machine tool items. The Ministry of Industry recorded about nine local firms to have successfully produced simple machine tools for the domestic market.

The existing enterprises are mostly utilizing non-precision machine tool items in the production department. They are unable to modernize their set-up due to inadequate resource availability coupled with high interest on borrowed money from the banks. Due to a poor sales network, these firms have very slow growth rates. The raw materials are available in the market at a very high price. The support services from good quality heat treatment shops, special machining services and casting/forging facilities are very difficult to obtain.

In the short-term, it is recommended that current development projects be accelerated and further assistance be given to existing and potential manufacturers. Basic technology involving precision products, basic metal, engineering/designing and quality control should be taught, supported by extension services.

In the long-run, mass production needs to be encouraged. National programmes should be initiated in R+D. Investment by private companies should be promoted through joint venture arrangements, foreign investment schemes, licencing agreements, tax incentives and rebates, import restrictions, sales guarantees and credit assistance.

In Malaysia, strategically, the use of modern machine tool items is more emphasized in the production of capital goods rather than the manufacture of machine tools per se. A few local firms are trying to produce metal forming machine tools for the domestic markets. Malaysia is essentially dependent on importation of all major machine tool items. There has beer a significant increase in the importation of sophisticated machine tool products in recent times.

The trend in Malaysia's precision engineering development will provide a favourable condition for the promotion of machine tool industries in the near future. It is recommended that the technical capabilities of all supporting sectors of the machine tool industries like casting, forging, heat treatment, precision machining and gear cutting be upgraded gradually with the assistance of several existing promotional organizations. To increase productivity, the use of modern machine tools can be introduced through organizing special training courses on NC/CNC machine tools.

In the long run, efforts should be made to promote private investments in machine tools by measures such as tax incentives, import restrictions, sales guarantees and credit assistance. It is also recommended that a national institute (SIRIM) should provide standards and assistance in the design and development of machine tools.

In the Philippines, despite government incentives being available, since the curtailment of MATOOLS in 1979, there is no new recognized machine tool manufacturer. This was because of the pessimistic industrial outlook. Instead, there is an increase in the imports of second hand machines. However, there exist a few small enterprises which are manufacturing simple machine tools for the domestic market.

The machine tool industry in the Philippines is hit by poor demand and stiff competition from overseas producers. The high interest rate deters the import of new machines required to modernize existing set-ups. The raw materials are available at a very high cost. High rates of interest on bank loans discourage the producers from investing. Generally, the producers are

experiencing very poor demand for their products. As a long term measure to boost the performance of this sector, the Government should extend tax incentives, import restrictions, sales guarantees and credit assistance.

Manufacturing is playing an increasingly important role in the economy of Singapore primarily due to the dynamic private sector, excellent industrial infrastructure and the continuing influx of foreign investment. In recent years, Singapore has been able to establish a strong supporting industries' network for machine tool makers. The majority of the machine tool makers are foreign firms. The local firms, through associating with these foreign firms, are successfully acquiring manufacturing and managerial capability in machine tool production. Generally, the Singapore machine tool manufacturers are not affected by any major domestic problem. They are, however, finding it difficult to export their products overseas.

It is recommended that the development institutions in Singapore should pursue specific programmes for enhancing the design and engineering capability of the local firms. Specialized training courses for engineers and technicians should be organized to meet the needs of the machine tool sector. Study tours for machine tool makers in more advanced countries should be organized for the local manufacturers. The firms involved in export marketing should get latest market trend information from the trade promotional bodies.

In the long run, a national institute like SISIR, should undertake formulation of national standards. This institute should also facilitate testing and standard marks for the products. Subcontracting work in machine tool building should be encouraged and subsidies should be given to local producers to attend international fairs.

Thailand has underscored the need for developing the machine tool sector through providing various incentive schemes to the investors. There has been a significant technological improvement in the machine tool sector in the form of increased modern machine tool uses. A few promotional projects have been undertaken to accelerate the growth of the machine tool sector.

There are nearly a dozen manufacturers engaged in producing metal cutting and metal forming machine tools. Generally, however, the production volume is carried out in small batches. The manufacturers are beset by marketing problems in terms of stiff competition with the foreign brands. High rates of interest on bank loans are discouraging additional investment in the existing enterprises.

Short-run measures should be taken to assist existing manufacturers in areas of technical support, sales promotion, management improvement and marketing. Extension and training efforts should be channelled into casting, gear making, heat treatment and forging techniques.

As a long term measure, the Government should initiate broad economic measures like tax incentives, import restrictions, sales guarantees and credit asistance schemes to promote the growth of the machine tool industry.

2. THE MACHINE TOOL INDUSTRY OF INDONESIA

2.1 Background

Indonesia's metal-working industry has a long historical evolution and has, since its humble beginning, played a significant economic development role. The industry emerged from small forging shops or blacksmiths. Then gradually, these small shops started producing basic agricultural tools and implements, i.e. hoe, shovel etc. as well as the gamelan, a traditional musical instrument.

When Indonesia was still a Netherlands colony in the mid 1800s, the Dutch established large sugar factories in Central and Eastern Java. Soon, small forging and service shops emerged, producing or repairing simple spare parts and machine components for sugar milling facilities. Then further integration of the sugar factories led to the development of Java's railway system. As a consequence, more and more forging shops (some already having machining operations) emerged.

Before the last century ended, the Dutch also established rubber and palm oil estates in the island of Sumatra. This induced the gradual dispersal of metal-working industries throughout the country's heavily urbanized areas.

After gaining independence in 1945, Indonesia pursued vigorous economic development reforms, focussing on both agricultural and industrial activities. One such reform installed the five-year development planning (REPELITA) cycle, and during the Third Five-Year Plan (REPELITA III, 1979/80 - 1983/84), it emphasized manufacturing activities. This emphasis on manufactured goods yielded the basic infrastructure and an appropriate long term policy focus. Indonesia's Ministry of Industry established the Metals Industry Developing Centre (MIDC) in Bandung, the Politeknik Mekanik Swiss also in Bandung, and the Institute for Materials Research in Bandung.

Then, on the policy level, the government singled out the machinery and electronic capital industries as an industrial priority area. But, despite all-out efforts from several fronts, Indonesia's manufacturing sector remained at an infancy stage, dominated by non-engineering industries after REPELITA III.

In the present REPELITA IV (1984/85 - 1989/90), Indonesia is determined to indigenize (raising local manufacturing content to 85-100 per cent) the manufacturing activities of motor vehicles, small engines and other consumer durables. In this context, the Ministry of Industry plans to indigenize the country's machinery and and electronic capital goods industries by equitably spreading business opportunities throughout the industrial structure. Moreover, the government aims to provide a conducive business environment oriented towards meeting domestic requirements, minimizing import dependency and increasing non-oil export revenues. To do this, the Ministry of Industry organized a separate and specialized Directorate General for Metal Industry Development.

2.2 Main features of the metal-working enterprises

In its 1975 industrial census, Indonesia's Central Bureau of Statistics (CBS) adopted the following employment size definition of industrial enterprises: (a) 4 persons or less, handicraft/cottage; (b) 5 to 19 persons, small; (c) 20 to 99 persons, medium; (d) 100 persons and over, large. Among others, the census revealed the following characteristics of metal-working enterprises (see table 1):

(a) Overall, there were an estimated 19,000 enterprises in the metal-working sector. Of this, approximately 97 per cent fall under the cottage, small and medium enterprises.

(b) The entire sector employed about 135,800 people. Of this, 98 per cent were in cottage, small and medium enterprises.

(c) The sector generated $US 171 million in value added. Of this, 90 per cent were contributed by the medium and large enterprises.

Table 1. Distribution of metal-working industries by product and size (1975)

ISIC	TYPE OF PRODUCTS	LARGE AND MEDIUM			SMALL SCALE		
		No of Establishments (in units)	Employment (No of workers)	Value Added (in Million Rp)	No of Establishments (in units)	Employment (No of workers)	Value Added (in Million Rp)
37100	Iron and steel basic industry	9	933	830	2	21	-
37200	Nonferrous metal basic industry	9	1 127	3 169	4	29	8
38111	Agricultural & handtools equipment	15	886	201	5 984	25 269	1 422
38112	Cutlery, nails, screws, bolts	34	2 890	1 619	3 898	13 917	616
38113	Kitchen Apparatus	29	2 900	346	106	882	124
38114	Metal other than aluminum	36	3 332	825	224	1 680	197
38120	Metal furniture & fixtures	25	1 201	631	3 272	13 214	1 235
38130	Structural metal products	57	6 900	6 360	261	1 984	416
38140	Metal container	36	2 732	1 968	63	548	127
38190	Metal products n.e.c.	9	451	233	1 885	7 496	590
38200	Machineries & repair	68	7 311	9 236	162	1 419	301
38311	Storage batteries	9	396	141	26	228	159
38312	Dry cell batteries	11	3 015	1 792	3	16	4
38320	Radio, T.V., cassette, etc.	17	4 368	6 578	9	70	15
38330	Electrical apparatus & supplies	25	3 976	7 451	20	191	89
38340	Repair of electrical appliances	4	420	97	5	48	32
38411	Ship building and repairing	32	5 469	5 219	1 736	6 007	532
38412	Ship repairing and painting	-	-	-	-	-	-
38420	Railroad equipment	4	314	166	2	24	-
38430	Motor vehicles	31	4 306	5 570	130	1 134	262
38440	Motor cycles & 3 wheel motor vehicles	7	2 018	10 700	10	58	6
38450	Bicycles and becha	18	956	295	72	625	132
38460	Motor vehicle bodies & equipment	20	1 544	696	90	884	269
38490	Other transport equipment	-	-	-	32	175	19
38500	Scientific, Measuring, Optical & photographic equipment	13	482	155	40	390	73
	TOTAL	518	57 927	64 279	18 394	77 886	6 636

Additionally, about 18,000 small and cottage enterprises have already been organized into "sentras". Sentras are clusters of small and cottage enterprises either belonging to a particular sector, producing similar products, or employing similar processes. They are organized and recognized by the government to facilitate the delivery of financial and non-financial (technical, extension, training, etc.) assistance. Of the more than 6,000 sentras in 1983, about 26 main sentras (there are still 800 minor ones throughout the country) are directly under the metal-working sector (see table 2).

In 1981, Technonet Asia and the Japan International Co-operation Agency (JICA) surveyed 384 (about 9.6 per cent of population) Indonesian small and medium metal-working enterprises[1/] and reported that the typical enterprise (obtained by piecing together the statistical modes of the responses) has the following characteristics:

(a) The typical metal-working enterprise is a single proprietorship business and is located in urban areas (in the larger towns of Jakarta, Medan, Surakarta, Surabaya, Bandung, Tegal, Semarang, Yogyakarta and Ujung Pandang) where roads or waterways exist. It started operations some 6 to 10 years ago and has invested about $US 15,000 or less in machinery and equipment. It uses casting as the main process and produces mainly tableware, utensils and other finished consumer goods.

(b) More than 81 per cent of its 11 to 30 male workers are regularly employed and are paid daily wages averaging from $US 2,000 to $US 3,000 monthly. The average worker has attained primary school or less, gets 8 to 14 days paid vacation annually and on the average stays with the enterprise for 2 to 5 years. While it operates one production shift (8 working hours) daily, the enterprise has a 5 per cent or less average personnel turnover and a 6 per cent or less absentism rate annually.

1/ Technonet Asia - Japan International Co-operation Agency, Small and Medium Metal-working Industries in Indonesia and Malaysia (phase III), Singapore, March 1981.

Table 2. Location and number of metal-working sentras

ISLAND	PROVINCE	SENTRA	UNITS	%	SUB-TOTAL	%
Sumatera	1. Specific Region Aceh	Aceh Besar	220	2.97		
	2. North Sumatera	Siborong Borong	116	1.57		
	3. Riau	Tembilahan	67	.90		
	4. West Sumatera	Sungai Puar	90	1.21		
	5. Jambi	Jambi	45	.61		
	6. South Sumatera	Around Palembang	450	6.07		
	7. Lampung	Teluk Betung	115	1.55	1 103	14.89
Jawa	1. West Jawa	(a) Sukabumi (b) Ciwidey	1 500	20.24		
	2. Central Jawa	(a) Tegal (b) Pesayangan/ Purbalingga (c) Suruh (d) Ceper (e) Juana	1 650	22.27		
	3. Yogyakarta	Wonosari	110	1.48		
	4. East Jawa	(a) Madiun (b) Waru/Sidoarjo (c) Pasuruan (d) Banyuwangi	2 100	28.35	5 350	72.23
Bali	Bali		210	2.83	210	2.83
Kalimantan	South Kalimantan	(a) Negara (b) Banjarmasin	121	1.63	121	1.63
Sulawesi	1. North Sulawesi		270	3.64		
	2. Central Sulawesi		12	0.16		
	3. South Sulawesi	(a) Ujungpadang (b) Sirap	242	3.27	524	7.07
West Nusatenggara	West Nusantenggara	(a) Mataram (b) Kotaraja (c) Bima	100	1.35	100	1.35
		TOTAL	7 408	100.00	7 408	100.00

Source: Gema Industri Kecil, Departemen Perindustrian - Direktorat Jenderal Industri Kecil, DP/ID/BIPIK and other statistical records.

(c) On a typical day, the enterprise has about one week or less worth of production orders. It caters mostly to other private enterprises within the region or district, and consequently experiences highly localized competition. It does not employ a full-time salesman nor a cost estimator.

(d) Producing on a continuous basis,[2/] the enterprise employs mostly manual workers using simple handtool methods. The most mechanized production facility is rated from 11 to 50 horsepower and is 2 to 10 years old. Its main production facility is used from 51 to 70 per cent[3/] of the rated capacity; yielding an average of 1,500 or more pieces (of products, subassemblies, etc.) monthly. For production planning and control, it uses rough scheduling and sometimes deliveries are delayed. It repairs its mostly imported machinery during breakdowns. Its repair service to total sales volume ratio reaches 20 per cent yearly. Its production function is supervised by a foreman having 6 to 10 years of experience backed by 4 to 6 years of higher grade schooling.

(e) The average production defect is approximately 6 per cent of production volume. It does not have a person who can read and interpret technical drawings neither does it have engineers. For measuring, it uses the scale rule for main products having $\pm$1.0 mm tolerance limits. Its quality standards are based on customers' requirements and first product inspection is used to check on quality conformance. Work instructions to its workers are given either via samples, rough sketches or verbal descriptions.

(f) The enterprise's raw materials are purchased from local sources on a cash basis and are handled manually throughout the plant. It stocks from 8 to 30 days worth of raw materials. About 31 to 50 per cent of its production cost can be attributed to raw materials.

2/ Most respondents interpreted continuous with respect to time rather than production system type. In the ensuing field survey, most respondents were found to employ the batch type production system.

3/ The capacity utilization of the main production facility was confirmed to be lower than this figure during the field survey.

(g) On average, the enterprise generates $US 50,000 or less in sales, annually. Despite its inadequate record keeping, it uses its own version of cost-plus method in product costing. In financing operations, it borrowed $US 5,000 or less on long term and needs $US 10,000 or less in working capital monthly. It does not engage in subcontracting and requires $US 20,000 or less for future expansion. Its average yearly return on fixed assets is 6 times or more.

(h) Being severely undercapitalized, the typical firm considers finance-related problem as its most pressing problem. Finally, it considers the continuous use of obsolete and inefficient machines as the major production related problem. Consequently, stiff competition is its major market-related problem and it expects the Government to provide more financial assistance in the future.

As part of a bilateral agreement between Indonesia and the Indian Government in 1984, the Hindustan Machine Tools International (HMTI) reexamined the country's metal-working sector with special emphasis on machine tool industries. Essentially, the HMTI study corroborated and reconfirmed the earlier Technonet Asia-JICA study. Besides noting the dominant role of small and medium enterprises, HMTI also reported the following:

(a) Foundry (both ferrous and non-ferrous) is the more popularly employed process. Apparently, accumulated skills and know-how in this process is above average. But traditional production methods render the current technology level backward and inappropriate to produce high grade castings, specially required in the machine tool industry.

(b) Structural fabrication and sheet metal work account for the next largest number of enterprises. Again the skills developed are relatively high and are adequate for manufacturing a variety of engineering goods.

(c) Metal cutting industries are mostly restricted to job orders, manufacture of spare parts, etc. Generally, these jobs involve rough machining only and can be undertaken without sufficient regard for

tolerances. The use of carbide tools, measuring, inspection and testing equipment, etc. seems very limited, including finishing operations such as heat treatment, plating, etc.

(d) In a number of enterprises visited, the owners expressed the need for locally manufactured simple machine tools at competitive prices.

2.3 Analytical appraisal of the machine tool industry

In Indonesia, the machine tool industry, a major subsector of the metal-working industries, produces metal cutting (such as lathes, milling, drilling, boring, shaping, etc.) and metal forming (such as shearing, bending, punching, pressing, etc.) machinery and equipment. Presently, the industry produces machine tools of various quality levels. Machine tools required by small and unsophisticated workshops, etc. are in the lower quality range, while those needed by precision engineering enterprises, tool rooms, etc. are of higher quality.

2.3.1 Size and magnitude of the machine tool industry

There is a lack of substantive material describing Indonesia's machine tool industry. Of the 384 enterprises surveyed,[4/] only 9 (about 2.3 per cent of the sample) were in machine assembly and 75 (about 19.5 per cent of the sample) were in machining activities. Within the machine assembly and machining enterprises are the machine tool manufacturers. Having an imprecise industrial magnitude makes the industry's aggregate employment figures difficult to estimate. But in early 1985, the government identified 13 enterprises as qualified machine tool manufacturers in Indonesia. Interestingly, while a few local manufacturers exist, Indonesia's demand for machine tools has been mostly filled by imports.

4/ See, Technonet Asia-JICA, op. cit.

2.3.2 Machine tool manufacturing technology

The Technonet Asia-JICA Indonesian metal-working survey provides the most comprehensive description of the country's state of machine tool manufacturing technology. The study analyzed 84 respondent enterprises mainly engaged in machine assembly and machining operations, where the machine tools manufacturers are located. Briefly, the study[5/] reported the following situation:

(a) The typical Indonesian machine assembler heat treats 10 per cent or less of the materials used in manufacturing. On average, about 5 parts or less are assembled using purely manual methods aided by simple hand tools. The assembled parts could either be precisioned or non-precisioned types and are checked by static adjustment methods. A typical worker has 6 to 10 years of machine assembly experience.

(b) Likewise, the typical machining enterprise uses low carbon steel, ordinary cast iron and some aluminium alloys with a maximum weight from 5 to 100 kilograms. It employs ordinary lathes with maximum turning capacities of 300 mm or less in diameter. Electrically operated portables or bench-type drilling machines with a maximum drilling capacity of 18 mm or less are popularly used. It does not have shapers, planers, milling and boring machines. Grinding is done by bench grinders using high speed steel tool bits. Dimensions are checked using vernier calipers. A typical machine operator has 1 to 5 years of machining experience.

2.3.3 Machine tool technology level

The same study examined the technology levels of Indonesian machine assembly and machining enterprises. Initially, the study defined technology as a set of machinery and equipment (hardware), methods or procedures (software) and other auxiliary systems (management support). Then it formulated a set of technology level indicators consisting of six levels,

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5/ Ibid.

arranged from simple to complex. For example, in examining each machining enterprise's turning technology indicator, the respondents were asked to select their highest attainment from among six levels:

(a) None;
(b) Simple turner;
(c) Ordinary lathe;
(d) Turret lathe;
(e) Lathe fitted with copying device; and
(f) Automatic lathe or CNC machine.[6/]

The technology management support consists of the manufacturing aspects, technical aspects, material handling, production organization and work environment. Comparing the management support technology levels of enterprises engaged in machine assembly with those in machining revealed the following:

(a) In manufacturing, the machining enterprises' technology level is relatively higher than those of machine assembly in mechanization level, horsepower rating of the most mechanized production facility, and type of maintenance practices employed. The technology level is similar in age of machinery and equipment (about 6 to 10 years old) and frequency of delayed deliveries. Finally, the technology levels of machine assembly enterprises are higher than their machining counterparts in repair service to sales volume ratio, average monthly production volume, size of production batch, estimated utilization of main production facility and type of production scheduling employed.

(b) In technical aspects, material handling and production organization, the machining enterprises exhibited higher technology levels in the number of persons who can interpret engineering drawings, type of measuring instruments used, tolerance limit, quality control methods and material handling (manual versus skids and trolleys). The technology level is the same in average

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6/ For a full explanation of the methodology employed see annex 1, Partial listing of technology level indicator.

production defects (about 6 to 10 per cent), number of graduate engineers employed (at least one), experience level of production managers (6 to 10 years) and schooling of owner/managers (from 4 to 6 years). Finally, machine assembly enterprises posted higher technology levels in type of quality standards employed, quality control checks and method of instructing workers.

(c) Under working environment, machine assembly enterprises registered higher technology levels in type of factory lighting and quality of lighting. The levels were similar in responsibility for safety (safety committee but without an officer-in-charge); common types of safety equipment used (shoes, goggles, gloves, etc.); conditions of products, parts or materials storage; method of installing machinery, equipment and tools; type of factory ventilation, health care system (regular workers check-up); and average annual vacation leave with pay (7 days or less). The machining enterprises technology level is better in providing free medical care for regular employees (see figure 1).

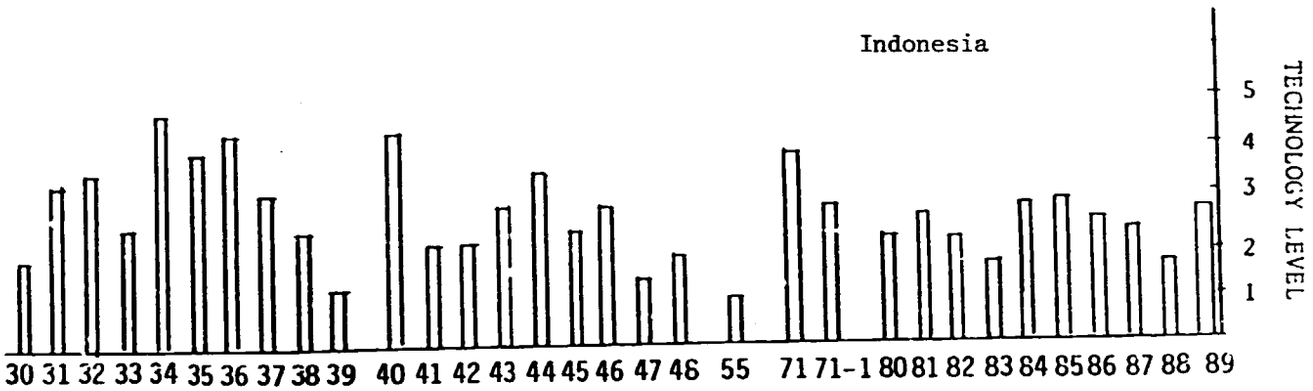
(d) The average technology levels in each element of the management support pinpoint the areas where improvements could be introduced. In a scale of 1 to 6, the overall average level in machine assembly enterprises is 2.47 and for machining enterprises 2.71 (table 3).

Table 3. Average technology levels in management supports element

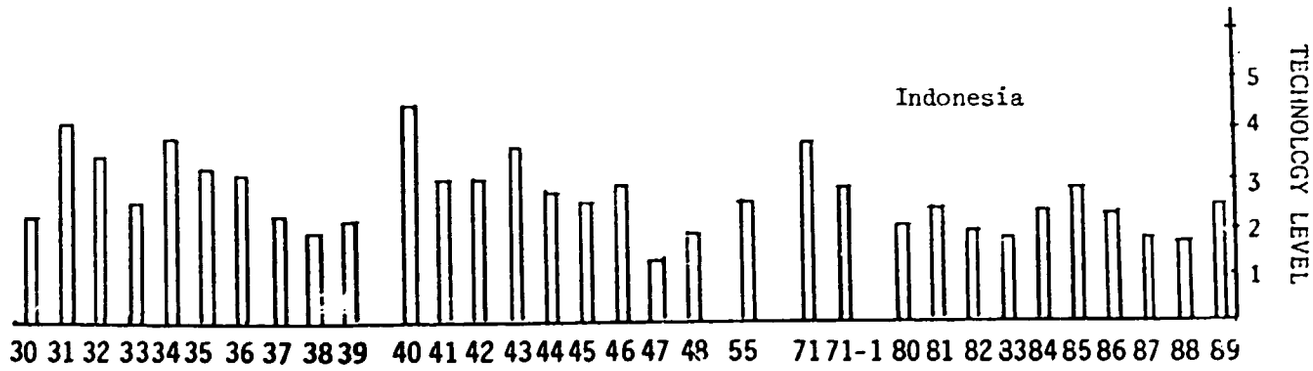
Element	Machine assembly (scale 1 to 6)	Machining (scale 1 to 6)
1. Manufacturing aspects	3.11	2.85
2. Technical aspects	2.64	2.82
3. Materials and procurement aspects	1.00	2.51
4. Management aspects	3.45	3.25
5. Working environment	2.15	2.11
Overall average	2.47	2.71

Source: Technonet Asia.

Figure 1. Technology levels in the management supports element



600. MACHINING



500. MACHINE ASSEMBLY

The technology levels with respect to hardware and software are briefly described below:

(a) The average hardware and software technology of the machine assembly enterprise is about 2.36 on a scale of 1 to 6. Generally, above 10 per cent and up to 30 per cent of the materials used in assembly is heat treated. The proportion of imported parts in the product (in monetary terms) ranges from 11 to 30 per cent. Assembly methods are basically manual with the aid of simple hand tools. About 11 to 20 precisioned and non-precisioned parts comprise a typical product; with only a few of the parts being interchangeable. It has its own standards in determining tolerances of machined parts. It checks assembled works by static adjustment.

(b) On a scale of 1 to 6, the average hardware and software technology level of machining enterprises is 2.11. Machining materials employed are essentially low carbon steel, ordinary cast iron, and aluminium alloys. The typical enterprise has developed to the turning (using ordinary lathes with 301 to 600 mm turning diameter) and drilling stages (vertical type with 19 to 30 mm drilling capacity). Generally, it does not perform shaping, slotting, planing, milling and boring operations. It has bench grinders and uses high speed steel tool bits. Design and fabrication of jigs and fixtures are done by its own skilled workers. It uses its own standards in determining the tolerances of machined parts, only a few of which can be interchanged. Dimensions of machined parts are measured through vernier calipers (figure 2).

2.3.4 Operating problems in the machine tool industry

The same study also identified the operating problems of machine assembly and machining enterprises in Indonesia.[7/] In marketing-related problems, 27.4 per cent of machining enterprises claimed unpredictable demand situations as a primary concern. About 35.6 per cent claimed stiff competition and about 15.1 per cent claimed poor access to market information. In production and technical-related problems, 39.2 per cent of the machining enterprises reported continuous use of obsolete machinery as the primary concern. About

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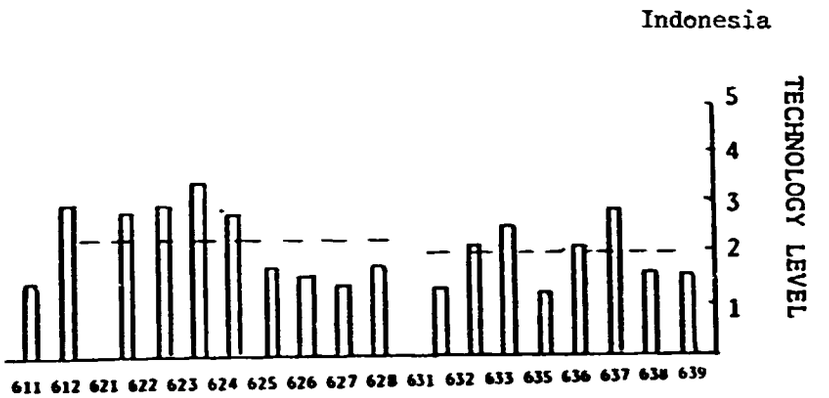
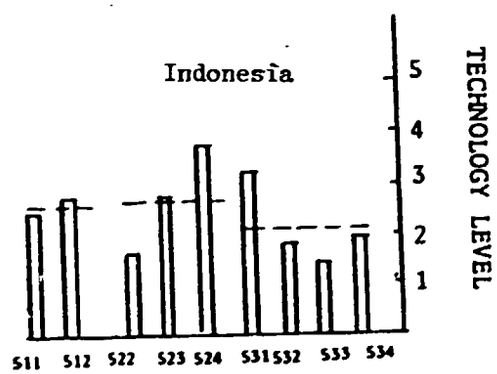
7/ See Technonet Asia-JICA, op. cit.

Figure 2. Technology levels in hardware and software



600. MACHINING



500. MACHINE ASSEMBLY

23 per cent claimed poor production planning and control system. And about 9.5 per cent claimed raw materials shortage and another 9.5 per cent reported poor or inadequate plant layout. In the area of management and labour-related problems, 22.2 per cent of the machining enterprises reported too centralized decision making as the primary concern. Another 18.2 per cent claimed inadequate administration systems. Interestingly, 15.3 per cent reported difficulties in attracting skilled labour, and another 15.3 per cent claimed poor skills in training practices. In finance-related problems, 77.8 per cent of machine assembly and 67.1 per cent of machining enterprises ranked undercapitalization as the primary concern. About 22.2 per cent of machine assembly enterprises claimed difficulties in securing loans. Moreover, 11.4 per cent of machining enterprises claimed lack of cost control procedures and another 7.1 per cent reported lack of adequate budgeting systems.

2.3.5 Importation of machine tools

At constant 1971 prices, Indonesia's aggregate machine tool importation reached $US 13.9 million in 1975 and is expected to hit $US 166.6 million at the end of 1985. The country's machine tool importation pattern may be gleaned by observing the trends in lathes and drilling machine imports.

Indonesia imports lathes from 15 major countries of origin (inclusive of the People's Republic of China, Poland and Bulgaria). Between 1977 and 1980, the country showed very high preference for lathes from Taiwan Province of China and the People's Republic of China, mostly due to relatively low prices at acceptable quality levels. Taking the 1980 lathe importation figures, the country apparently prefers Taiwan Province of China's gear and precision lathes, as well as the People's Republic of China's engine lathes (table 4). In fact, the lathes produced by these two countries captured 69 per cent of the 1977 imported lathe market, which peaked to 83.5 per cent in 1979. Thereafter, the combined market share of Taiwan Province of China and the People's Republic of China contracted to 79.6 per cent in 1980 and further to 55.4 per cent in 1981. The market contraction was largely due to the influx of the more expensive Japanese-made lathes.

Table 4. Type or brand of lathes imported from Taiwan Province of China and the People's Republic of China (1980)

Types or Brands	Quantity (sets/ units)	Net Weight (Kg)	Net Weight per unit (Kg/unit)	Cost (US$)	Cost per unit (US$/unit)
ROC					
Turret Lathe	10 set	6.665	666,5	13.462	1.346,2
San Yuen Brand Lathe	106 set	120.680	1.138,5	271.771	2.563,9
All Brand Gear Lathe	111 set	149.530	1.347,1	221.183	1.992,6
Brand High Speed Precision Lathe	75 set	77.580	1.034,4	322.163	4.295,5
Lathe Accessories Include	1 set	475	475	1.913	1.913
Precision Lathe	196 set	142.170	725,4	293.526	1.497,6
Brand Lathe	66 set	116.500	1.765,2	170.075	2.576,9
Lathe Machine	8 set	6.406	800,7	18.016	2.252
Bench Lathe	2 set	1.010	505	4.397	2.198,5
Lathe with Standar Accessories	18 unit	12.150	675	45.209	2.511,6
One Lot of Lathe	20 set	5.000	250	19.619	981
Brand High Speed Turret Lathe	1 unit	580	580	2.384	2.384
Victor Lathes	8 set	9.484	1.185,5	22.102	2.762,8
Brand Precision Bench Lathe	38 set	11.460	301,6	22.252	585,6
National Brand Heavy Duty Lathe	2 set	11.500	5.750	13.508	6.754
Sanyuen Brand All Gear Lathe	24 set	26.570	1.107,1	48.993	2.041,4
Chien Yeh Brand Lathe	60 set	78.750	1.312,5	126.575	2.109,6
Chen Wai Precision Bench Lathe	36 set	10.800	300	21.096	586
San Muen Brand Lathe	18 set	34.240	1.902,2	58.328	3.240,4
Ching Fong Brand Lathe	10 set	9.000	900	22.581	2.258,1
Precision High Speed Lathe	3 set	15.200	5.066,7	39.872	13.290,7
Lathe F W 600 AF	2 set	2.600	1.300	3.263	1.631,5
Hsiang FA Brand Lathe	10 set	9.500	150	15.049	1.504,9
Aud Lathe	5 set	1.540	308	6.978	1.395,6
Hongfa High Speed Head Machine	2 set	1.690	845	3.419	1.709,5

Table 4. Type or brand of lathes imported from Taiwan Province of China and the People's Republic of China (1980) (cont'd)

Types or Brands	Quantity (sets/ units)	Ne. Weight (Kg)	Net Weight per unit (Kg/unit)	Cost (US$)	Cost per unit (US$/unit)
Automatic Universal					
Angel Steel Former	1 unit	4.200	4.200	6.328	6.328
Motor Drive Lathe Sanshing	6 unit	5.800	966,7	6.610	1.101,7
T O T A L	839 set	871.080		1,598.672	
PROC					
Geared Head Lathe	29 set	67.235	2.318,5	170.324	5.873,2
Center Lathe	10 set	8.960	816	25.652	2.565,2
Mini Lathe Machine	10 unit	1.200	120	3.759	375,9
Engine Lathe	160 set	274.580	1.716,1	363.320	
Lathe Complete with Pumping Set	1 set	10.000	10.000	2.085	2.085
Lathe Automatic Travo Brand	17 set	3.498	205,8	17.518	1.030,5
Lathe Model C 620g	1 set	2.680	2.680	2.085	2.085
Bend Lathe	1 set	450	450	794	794
Turret Lathe	6 unit	12.342	2.057,6	20.067	3.344,5
Spinning Lathe	2 unit	2.085	1.044,5	4.430	2.215
Gap Bed Lathe Machine	1 unit	1.300	1.300	1.848	1.848
Lathe Machine Case No 9	1 set	700	700	7.776	7.776
Lathe Small	11 unit	3.010	273,6	6.125	556,8
Bench Lathe	17 set	6.752	397.2	33.889	1.993,5
Center Lathe 380	1 unit	2.502	2.502	3.924	3.924
Center Lathe Model L 5	1 set	2.430	2.430	5.342	5.342
Lathe Machine Model CW 626	1 unit	8.500	8.500	6.020	6.020
Bend Lathe	3 set	1.680	560	4.419	1.473
T O T A L	273 set	440.908		679.373	

From 1977 to 1982, lathe importation steadily increased from 775 units to 2,600 units in 1982. The average price per unit drastically declined between 1977 to 1978 due to some form of rationalization. Thereafter, the price per unit gradually increased from about $US 3,700 to $US 3,900 (in mid 1982). A similar pattern occurred in the price per ton of lathe. During the period reviewed, the most expensive lathes came from Japan, Italy, Holland, Federal Republic of Germany and India, then from the United States, the United Kingdom, Poland and Bulgaria filling the medium price spot. The relatively cheaper lathes came from the area of Hong Kong, Taiwan Province of China and the People's Republic of China. Interestingly, prices of lathes made by Taiwan Province of China, the United States, India and Holland exhibited a steadily increasing trend. While prices from Japan, the area of Hong Kong, the United Kingdom, the Federal Republic of Germany, Italy, Poland and Bulgaria showed the opposite trend. Considerable price fluctuations (table 5) were noted for lathes made in the People's Republic of China, the Republic of Korea and Singapore.

The country's drilling machines importation from 1977 to 1980 revealed a similar pattern to that of lathes. Unlike the former, however, drilling machines from Taiwan Province of China clearly dominate the market. In fact, the combined market share of Taiwan Province of China and the People's Republic of China was 86.3 per cent in 1977 and 90 per cent in 1980. Again, this indicates the country's preference for low priced drilling machines.

In terms of price per unit, the Federal Republic of Germany's drilling machine emerged the most expensive. Followed by those made in the United States, Republic of Korea, the United Kingdom, Bulgaria and Japan. The lower priced drilling machines came from Taiwan Province of China, the area of Hong Kong, Holland and Singapore. While the average per unit price doubled within the period, the price per ton dropped from $US 5,488 in 1977 to $US 4,591 in 1980 (table 6).

Table 5. Importation of lathes by source (1977-1982)

Source	1977			1978			1979			1980			1981			Jan - Jun 1982		
	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton
ROC	348	1,480	7,318	723	1,563	1,540	511	1,886	1,856	893	1,905	1,835	1,019	1,812	1,934	654	1,776	2,147
PRC	186	2,258	1,622	179	1,634	1,690	147	2,290	1,822	273	2,489	1,541	415	2,512	1,770	390	2,172	1,806
Japan	45	11,133	3,057	71	5,102	5,300	11	5,801	3,701	260	9,213	5,769	272	14,866	5,942	85	18,559	8,314
Hong Kong	51	778	808	-	-	-	11	724	12,764	-	-	-	24	1,039	3,361	6	2,897	1,792
S Korea	-	-	-	-	-	-	15	4,674	1,597	79	1,544	4,822	47	4,122	2,429	37	3,017	1,702
Singapore	15	3,206	2,679	35	782	2,458	10	2,817	5,283	4	8,130	14,648	73	1,745	4,561	1	782	3,128
India	12	7,123	5,058	11	5,510	3,518	8	3,238	3,409	15	4,850	3,040	66	4,402	2,223	1	7,379	7,306
USA	-	-	-	3	2,495	12,477	20	3,894	2,477	3	2,718	2,767	50	4,964	12,845	7	114,064	11,271
England	33	3,570	5,959	43	3,206	3,685	21	2,842	3,391	51	3,422	4,160	3	4,201	1,962	32	1,683	2,038
Holland	8	2,553	1,799	-	-	-	1	8,965	7,172	-	-	-	4	13,658	17,583	1	39,588	2,057
W Germany	28	8,951	10,730	17	10,575	3,900	10	7,078	4,460	139	2,805	14,253	455	2,573	8,558	70	4,243	4,838
Switzerland	-	-	-	-	-	-	-	-	-	5	919	6,566	3	1,615	2,159	-	-	-
Italy	-	-	-	3	17,761	9,311	14	28,448	14,531	2	6,680	14,332	1	249,376	7,200	1	3,715	5,124
Poland	-	-	-	1	3,615	1,018	-	-	-	-	-	-	-	-	-	1	7,561	2,455
Bulgaria	9	3,841	1,211	5	3,855	1,438	5	2,418	1,634	-	-	-	-	-	-	2	21,875	3,365
Total (Average)	775	(2,863)	(2,075)	1,102	(2,191)	(2,161)	788	(3,729)	(3,106)	1,464	(3,275)	(3,193)	2,586	(3,858)	(3,594)	1,296	(3,878)	(3,389)

Source: Central Bureau of Statistics

Table 6. Importation of drilling machines (1977-1980)

Source	1977			1978			1979			1980		
	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton	unit	$/unit	$/ton
Japan	34	2,340	3,788	62	5,597	6,259	53	638	3,488	93	974	6,198
Hong Kong	115	278	2,339	42	171	1,830	-	-	-	-	-	-
S Korea	13	1,283	866	-	-	-	36	1,420	1,247	-	-	-
ROC	1,104	199	1,801	1,326	232	1,645	690	276	1,567	1,160	349	2,430
PRDC	-	-	-	194	517	1,209	188	1,093	1,220	283	1,278	1,401
Singapore	-	-	-	75	305	1,268	-	-	-	2	960	4,602
India	-	-	-	2	13,044	3,506	-	-	-	9	270	1,734
USA	8	2,633	23,406	3	857	233	3	3,947	7,405	1	1,521	380,250
England	4	1,083	5,238	5	429	1,717	9	1,764	5,247	9	17,892	8,680
Holland	-	-	-	-	-	-	11	173	2,190	-	-	-
W Germany	1	781	976	21	11,214	17,243	-	6,306	7,429	42	2,155	26,245
Switzerland	-	-	-	-	-	-	9	-	-	7	720	20,164
Italy	-	-	-	9	380	2,278	-	6,039	7,411	4	260	7,150
Bulgaria	-	-	-	2	2,010	5,361	-	-	-	-	-	-
Total (Average)	1,279	(1,228)	(5,488)	1,741	(3,160)	(3,868)	999	(2,406)	(4,133)	1,610	(2,638)	(4,594)

2.3.6 Demand for machine tools: a quantification

Recently, HMTI[8/] attempted to quantify Indonesia's aggregate demand for machine tools by assuming that demand is practically met by imports. It set the 1975-1982 import figures at constant 1971 prices, and noted that imports grew by 26.9 per cent annually. Thereafter, it correlated the import data with selected dependent variables to determine the most appropriate demand predictor. The variables used were (a) importation of machinery and equipment (with correlation factor, r = 0.9749), (b) gross domestic manufactured product (r = 0.9615), (c) gross domestic fixed capital formation (r = 0.9645), (d) motor vehicles production (r = 0.9925), and (e) industrial power consumption (r = 0.9590). Then, it employed motor vehicles as machine tool demand predictor and proceeded to project the demand figures. Thereafter, it adjusted the resulting demand estimates to account for replacements (about 5 per cent of the estimated demand was added) and rate of industrialization (another 5 per cent was added). Therefore the projected aggregate demand for machine tools (at 1982 prices) is expected to reach $US 216.6 in 1992 (see table 7).

Table 7. Indonesia's projected machine tool demand, 1983-1992 (at constant 1982 prices)

Year	Projected demand (in million $US)
1983	81.4
1984	90.6
1985	100.8
1986	112.0
1987	124.8
1988	139.1
1989	155.2
1990	173.3
1991	193.5
1992	216.6

Source: HMTI, op. cit.

8/ HMTI, Hindustan Machine Tools International, Demand Estimate for the Manufacture of Standard Machine Tools in Indonesia: A Market Survey Report, Bangalore, India, March 1984.

Based on an inventory of machine tools collected during its field observation phase, HMTI derived the proportion of metal cutting to metal forming machinery. Then it estimated the proportion of each major machine tool in the metal cutting and metal forming categories. Finally, it itemized the demand for various machine tools (see table 8).

Table 8. Breakdown of the machine tool demand, 1992 (at constant 1982 prices)

		Value in million $US	Number of units
1. Metal cutting			
1.1	Lathe	45.7	10,160
1.2	Milling	8.0	1,576
1.3	Drilling and boring	12.8	21,353
1.4	Shaping, planing, slotting	0.9	586
1.5	Grinding	32.6	18,143
1.6	Cutting-off	4.4	21,980
1.7	Others	19.2	8,735
	Subtotal	125.6	83,430
2. Metal forming			
2.1	Shearing, punching, bending, etc.	18.5	10,529
2.2	Presses	71.7	16,290
2.3	Forging and stamping	0.8	n.a.

Source: HMTI, op. cit.

2.4 Indonesia's simple machine tool manufacturing policy

In December 1984, Indonesia promulgated a policy to stimulate the local manufacture of simple and standard machine tools. The policy consisted of two phases: phase 1 will focus on metal-working related machine tools and Phase 2 on wood-working related machine tools. Phase 1 will be executed during the entire REPELITA IV.

After REPELITA III, the government of Indonesia noted a 10 to 20 per cent annual growth in the demand for machine tools and, with the industrial thrust of REPELITA IV to indigenize machinery and equipment production, the demand for machine tools is likely to increase significantly. In fact, it is predicted that machine tools importation will reach $US 500 million annually during the REPELITA IV period.

In formulating the policy, the government initially identified basic machine tools imported into the country. This yielded five general types of metal-working related machine tools. These are: (a) lathes, (b) milling machines, (c) scraping machines, (d) drilling machines, and (e) hack saws. Then the likely annual demand volume was estimated (see table 9). Finally, Indonesia refined these estimates to include rough specifications of the basic machine tools required (see table 10).

Table 9. The government of Indonesia's projected demand for basic machine tools in REPELITA IV (1984 - 1989)

Type	1984	1985	1986	1987	1988	1989
Lathes	3,360	3,780	4,200	4,690	5,350	5,950
Milling machines	600	650	700	800	880	1,000
Scraping machines	135	140	145	145	150	155
Grinding machines	5,750	5,875	6,000	6,125	6,250	6,250
Hack saws	8,800	8,960	9,120	9,280	9,440	9,600

Simultaneously, the government looked into the existing indigenous machine tools manufacturing capability. It was found that nine local enterprises have already produced simple machine tools either for their own use or for sale in the open market. Of the nine enterprises, eight are general workshops, and one (PT Persero IMPI) specializes in simple lathes manufacturing, using a significant amount of local materials. Thereafter, the government surveyed the types of locally produced simple machine tools and estimated the potential annual capacity (see table 11).

Table 10. Projected specifications of basic machine tools in REPELITA IV (1984, 1989)

Type	Description measurement	1984 (units)	1989 (units)
Lathes	Total	3,360	5,950
	Measurement not more than 1,600 mm and 200 mm	1,000	1,800
Milling	Total	600	1,000
	Combined with boring	300	500
	Knee type	100	150
Grinding	Total	5,750	6,250
	Table 13 mm	1,000	1,000
	Column type	200	300
Shearing	Total	350	500
	Measurement not more than 1,270 x 2 mm	175	265
Press (hydraulic)	Total	2,000	2,500
	Not to exceed 250 tons	150	200
Hack saws	Total	8,800	9,600
	Measurement not to exceed 180 mm	200	300
Grinding	Total	600	850
	Measurement not more than 220 x 500 mm	350	500
Pipe bender	Total	450	645
	Measurement not to exceed 50 mm	200	300
Forming press	Total	300	500
	Not to exceed 80 tons	150	225
Rolling machine	Total	300	450
	Measurement not to exceed 2,500 x 3 mm	175	250
Press brake	Total	300	500
	Pressure not to exceed 80 tons	150	225

Source: Ministry of Industry, Indonesia

Table 11. Specifications and capacity for local simple machine tool manufacturing

Type	Specifications	Annual capacity (units)
Lathes	Length is less than 1,600 mm and height is less than 200 mm	700
Milling cum drilling machines	Table measurement is less than: width 250 mm, length 650 mm and drill diameter is less than 34 mm	150
Knee type milling machines	Table measurement is less than: width 300 mm and length 1,250 mm	100
Bench drilling machines	Table measurement is less than 15 mm	550
Plate press machines	Plate measurement is less than: width 2,600 mm and thickness 3.5 mm	100
Hydraulic press machines	Less than 260 cons	75
Shearing machines	Plate measurement is less than: width 1,500 mm and thickness 3.5 mm	100
Rolling machines	Plate measurement is less than: width 2,600 mm and thickness 3 mm	100
Hack saw	Measurement is less than 190 mm	100
Grinding machines	Table measurement is less than: width 230 mm and length 510 mm	175
Pipe bender	Pipe diameter is less than 60 mm	100
Press brake	Less than 61 tons	75
Vertical drilling machines	Drilling diameter is less than 34 mm	100

Source: Ministry of Industry, Indonesia

The Ministry of Industry listed the specificatons of the simple machine tools that must be locally manufactured (see table 12). Finally, some machine tools for manufacture by small enterprises were suggested (see table 13).

As envisioned, the local machine tool manufacturing policy will: (a) be led by the private sector, (b) maximize the use of local materials, and (c) produce standard or universal machine tools having the acceptable precision and duty requirements. Likewise, the policy expects participating enterprises to produce (in-house) as much of the primary components as possible, and to subcontract the non-primary ones. The policy hopes to execute a phased imported component substitution scheme consisting of taxation and other fiscal measures to ensure indigenization of simple machine tools production.

Additionally, the policy recognized the need for some essential mechanisms to guarantee effective policy execution. These include:

(a) All public and private machine tool procurements (either new or existing) will pass through the PMA/PMDN procedures;

(b) A programme which distinguishes the CKD imported machine tools from that of parts or components;

(c) Listing of all machine tools that can be produced locally and those that should be imported;

(d) Changes in the tariff and taxation structures of CKD machine tools and parts as well as components importation; and

(e) Identification of qualified local manufacturers.

The policy thus specified the following mechanisms: (a) licensing, (b) CKD importation procedures, (c) indigenization programme, (d) revised importation policy, and (e) tariff and taxation policy changes.

Given these needs and mechanisms, the policy commissioned the Ministries of Industry, Trade and Finance to facilitate execution. Essentially, the

Table 12. Specifications of machine tools for local production

Types	Specification	
	Measurement up to	Class
1. Lathes	L = 1,600 mm H = 180 mm	A
2. Milling cum Drilling Machine	B x D = 240 x 600 mm ø drill = 32 mm	A
3. Knee Type Milling Machine	B x D = 250 x 1200 mm	A
4. Grinder: (a) Bench (b) Vertical	ø drill = 13 mm ø drill = 30 mm	A
5. Plate Press: (a) Hydraulic (b) Manual	W = 1,270 mm. T = 2 mm W = 2,500 mm. T = 2 mm	-
6. Hydraulics	P = 250 Ton	-
7. Shearing	W = 1,270 mm T = 2 mm	-
8. Rolling Machine	W = up to 2,500 mm T = up to 3 mm	-
9. Hack Saw	ø180 mm capacity	-
10. Bench Grinder	220 x 500 mm Table	-
11. Punch Press	P = 3 Ton T = 3 mm	-
12. Pipe Bender	ø Pipe = 50 mm	-
13. Press Brake	P = 80 Ton	-

NOTE: L = Length
H = Height
B = Table Area
D = Length
W = Plate Length
T = Plate Width
P = Capacity
ø = Diameter
Class A = Precision up to 6.3 micron
Class B = Precision up to 12.5 - 25 micron
Class C = Precision up to 35 - 100 micron

Source: MOI

Table 13. Type of standard machine tools to be produced by small enterprises

Type of Machine	Rough Specification	Total	Remarks
A. Cutting Machine Tools Lathe	- bench type - maximum 3 KW - centre lathe up to 1000 mm (3 KW)	500 100 200	Type having unhardened beds and produced by by scraping
Drill	- bench type maximum ø 13 mm - column type maximum ø 20 mm - complex type (milling & drilling) machine maximum I HP (*)	500-750 100 150	- cost ranges US$100-$300 - will commence after bench type drill; hand feeding; bench type have attained results
Milling	- mini milling machine with table of dimension 500 mm x 200 mm	300-500	workpiece diameter o should be more than 150 mm and will be produced after accumulating experience
Shaping Grinder	- stroke 250-350 mm with 2-3 HP	100	not a primary product
	- bench grinder	500-750	single and multiple wheels
	- single point tool grinder - drill grinder	100	
Sawing Machine	- hack sawing machine with motor +2 HP ø maximum 150 mm	300-500	workpiece diameter o should be more than 150 mm and will be produced after accumulating experience
B. Forming Machine Tools Press	- fly press - mechanical press with 1-30 Ton capacity	500-750 500-750	
Bending	- bender table type	300-500	multi bender (bench type) machine, combined with shearing
	- bending thickness capacity of up to 3mm - length of workpiece 2400 mm	50	
Shearing	- capacity of up to 3mm thickness of 2400mm	50-100	must be upgraded to nibbling and vibro shearing machine

Ministry of Industry will ascertain the participating enterprises, conceive the indigenization programme, estimate local content in parts and components manufacturing, and recommend changes in the tariff and taxation structures. The Ministry of Trade, on the other hand, will issue an updated machine tool importation policy. Finally, the Ministry of Finance will update existing tariff and taxation policy on machine tool importation.

Immediately, the Ministry of Industry, on 4 January 1985, issued a letter decree (No. 1/m/SK/1/1985) listing the eleven initial participating enterprises in the simple machine tool manufacturing scheme (see table 14). Then on 11 January 1985, the same ministry issued two important letter decrees. One (No. 12/M/SK/1/1985) specified the parts and components (of lathes, knee type milling machines, vertical drilling machines and grinding machines) as well as other machine tools (CKD) which could be imported. The other (No. 28/M/SK/1/1985) detailed the indigenization programme for the manufacture of lathes, milling cum drilling machines, knee type milling machines, grinding machines, hack saws, bench drills, vertical drills, press machines, pipe benders, press brakes and shearing machines. Similarly, the Ministry of Finance also issued an update of the existing tariff and taxation policies.

The policy is expected to affect twelve industrial sectors. These are:

(a) Processing industries, i.e. coconut, sugar, rubber, tea, food processing, textiles, chemicals, etc.;
(b) Industrial machine tools;
(c) Industrial and agricultural machinery and equipment;
(d) Construction equipment, tools and implements;
(e) Electrical utilities;
(f) Electronic equipment and instruments;
(g) Motor vehicles manufacturing;
(h) Railway equipment, tools and component services;
(i) Shipbuilding and repair;
(j) Shipping industry;
(k) Ferrous metal processing; and
(l) Non-ferrous metal processing.

Table 14. Initial list of simple machine tool manufacturers approved by the Ministry of Industry

Enterprise	Product	Estimated annual production (units)
1. PT (Persero) IMPI	Lathes	400
2. PT PIMSF	Milling cum drilling machines	500
	Bench drills	2,100
	Rolling machines	500
	Plate press	400
	Shearing	500
	Press brake	100
	Vertical drills	200
3. PT SARANA IDEA UTAMA	Lathes	300
	Shearing	400
	Rolling machine	400
	Plate press	400
	Pipe bender	300
4. PT SUMBER BAHAGIA	Lathes	600
	Bench drills	400
5. PT CIPTA KARYA	Bench drills	150
6. PT MEDAN GERAK JAYA	Shearing	500
	Bench drills	150
	Press brake	150
	Knee type milling machine	300
7. PT BINTANG MAS INDUSTRI	Lathes	750
8. PT OYAMA	Hack saws	50
	Grinders	75
	Vertical drills	300
9. PT TOOLS INDONESIA	Lathes	300
	Shearing	1,200
	Bench drills	200
	Plate press	200
	Rolling machine	200
	Knee type milling machine	200
	Grinders	100
10. PT KARYA PRIMA	Hack saws	100
	Bench drills	200
11. PT (Persero) PINDAD	Knee type milling machine	250
	Vertical drills	100

3. THE MACHINE TOOL INDUSTRY OF MALAYSIA

3.1 Background

Malaysia is a typical producer and processer of rubber, tin and palm oil. The rubber and tin exports practically funded Malaysia's imports of essential foods and manufactured goods. Indeed, Malaysia's metal-working industries started with the industrialization of tin, rubber and to some extent palm oil.

A large portion of machinery and equipment used by tin, rubber and palm oil estates and processing industries were imported. Gradually, the demand for industrial services to repair the imported machinery and equipment grew. This prompted the emergence of small and general-purpose workshops inside and outside the tin, rubber and palm oil estates.

Over the years, the metal-working industry grew. Immediately visible were the small general-purpose mechanical workshops which repaired the worn out equipment and fabricated the replacement parts and components. Later, the more specialized metal-working enterprises emerged. These specialized enterprises produce a variety of durable and non-durable consumer as well as industrial products.

After gaining independence in 1957, the Government of Malaysia realized its dependency on the primary sector, then contributing 45 per cent to GDP. The tertiary sector - consisting mainly of primary sector supporting enterprises - contributed 44 per cent, and the manufacturing sector, a meagre 11 per cent. In response, the Government of Malaysia formulated and executed the First Malaysian Plan (1956-1960) which promoted vigorous industrialization and economic development initiatives. This made the manufacturing sector the country's largest source of growth. In fact in 1979, the manufacturing sector contributed 19.7 per cent of GDP. The principal manufacturing activities included food products, textiles, wood and paper products, chemicals and chemical by-products, non-metallic mineral products, and off-estate processing

of primary products. Simultaneously, the plan also initiated an organized infrastructure development in terms of roads, water, electricity, ports, communications, industrial estates, etc.

In 1983, the economy recorded a moderate growth. Real GDP increased by 5.8 per cent (against 5.6 per cent in 1982) and GNP in current prices increased by 8.4 per cent (against 8.5 per cent in 1982). Similarly, the manufacturing sector contributed 6 per cent (against 3.8 per cent in 1982) to GNP and 17.9 per cent to GDP. Within the manufacturing sector, the electrical machinery apparatus, appliances and supplies industry, with a 40.2 per cent increase in production, achieved the highest percentage increase. This growth was mainly due to higher production of radios (54.6 per cent), television sets (49.1 per cent), integrated circuits (26.1 per cent), electronic transistors (17.5 per cent), household refrigerators (12.8 per cent), insulated wires and cables (8.4 per cent), air conditioners (3.1 per cent) and electric fans (1.9 per cent).

Today, side-by-side with the manufacturing sector, Malaysia's metal-working industries can satisfy a significant portion of the demand for industrial equipment.

3.2 Analytical appraisal of the machine tool industry

In Malaysia, the machine tool industry, a major and strategic component of the entire metal-working industry sector, is still in a very early stage of development. In fact, there is no clearcut definition as yet on what the country's machine tool industry really consists of.

Apparently, the most accepted definition has been the machine tools importation classification. Hence, Malaysia's machine tool industry consists of four major subsectors. These are:

(a) Machine tools for working metals or metal carbides;

(b) Machine tools for working stone, ceramics, concrete, asbestos-cement materials and like mineral materials or for glass works;

(c) Machine tools for working wood, cork, bone ebonite (vulcanite), hard artificial plastic materials, or other hard carving materials; and

(d) Accessories and parts suitable for use solely or principally falling under the three previous classifications, including work and tool holders, self opening die-heads, dividing heads and other appliances for machine tools, tool holders for any type of tool or machine tool for working in the hand. Under this definition, Malaysia's machine tool industry will include enterprises employing the following metal-working processes: casting, cutting, forging, forming, welding, sheet working, finishing and heat treatment.

For expediency, this study adopted a less comprehensive definition of Malaysia's machine tool industry. Likewise largely based on the machine tool importation statistics, this study defines the industry as consisting of fourteen main product groupings. These are:

(a) Electro-erosion, other electric, electronic and ultrasonic machine tools for working metals or metal carbides;
(b) Gear cutting machines;
(c) Metal-working lathes;
(d) Reaming or milling machines for metal-working;
(e) Drilling or boring machines;
(f) Sawing machines for metal-working;
(g) Planing machines for metal-working;
(h) Tapping or screw cutting machines;
(i) Machines for working metals or metal carbides operated by grinding wheels, abrasives or polishing products;
(j) Forging and stamping machines;
(k) Bending, folding or flattening machines;
(l) Shearing, punching or notching machines;
(m) Other metal-working presses; and
(n) Other machine tools for working metals or metal carbides.

By process, machine tool manufacturing enterprises are those that employ machine assembly, machining, die making and press work as main metal-working processes.

3.2.1 Size and magnitude

The number of machine tool manufacturers and the aggregate employment level of Malaysia's machine tool industry cannot be estimated primarily due to the absence of a precise and widely acceptable industry definition. Available figures not only vary widely but also conflict with each other. For example, the Technonet Asia-JICA study surveyed 17 machine assembly enterprises (or 6.9 per cent of the sample) and 91 machining enterprises (or 36.8 per cent of the sample) in 1981.[9/] But the Malaysian Department of Statistics estimated a total of only 47 manufacturers of metal and wood-working machinery having an aggregate employment level of 700 and a 1985 UNIDO/ESCAP Study[10/] on Capital Goods Industry in Southeast and East Asia showed 62 manufacturers of metal and wood-working machinery and an aggregate regular employment level of 850 workers in 1985.

3.2.2 Machine tool manufacturing technology

Two major studies, the 1981 Technonet Asia-JICA metal-working survey (involving machine assembly and machine enterprises)[11/] and the 1984 MITEC-JICA survey (involving die making and presswork) provide a view of the country's machine tool manufacturing technology.[12/] The Technonet Asia-JICA study analyzed 108 machine assembly and machining enterprises, while the MITEC-JICA study examined 67 die making and presswork enterprises. Essentially, the MITEC-JICA study reconfirmed and to some extent updated the Technonet Asia-JICA study (see annex 2).

9/ Technonet Asia-JICA, op. cit.

10/ Preliminary Analysis of the capital goods industry in South-East and East Asia, UNIDO/IS.563, volume I.

11/ Ibid.

12/ MITEC/SIRIM, Metals Industry Technology Center, Standards and Industrial Research Institute of Malaysia, A compilation on the findings of MITEC about local metal-working industries of die-making, presswork, welding and electroplating, Kuala Lumpur, Malaysia, July 1984.

Initially, the Technonet Asia-JICA study defined technology as a set of machinery and equipment (hardware), methods or procedures (software) and other auxiliary systems (management supports). Then, it formulated a set of technology level indicators consisting of six levels, arranged from simple to complex. For example, in examining each machining enterprise's turning technology indicator, the respondents were asked to select from among six levels:[13/]

(a) None;
(b) Simple turner;
(c) Ordinary lathe;
(d) Turret lathe;
(e) Lathe fitted with copying device; and
(f) Automatic lathe or CNC machine.

The technology management support consists of the manufacturing aspects, technical aspects, material handling, production organization and work environment. Comparing the management support technology levels of enterprises engaged in machine assembly with those in machining revealed the following:

(a) In manufacturing, the country's machine assembly and machining enterprises have similar technology levels in degree of mechanization (semi-mechanized level), size of production batch (about 2 to 10 pieces), and average monthly production volume (from 11 to 300 varied pieces). Machine assembly enterprises registered higher technology levels in horsepower rating of most mechanized production facility, method of scheduling production, and method of maintaining machinery. Meanwhile machining enterprises showed higher technology levels in age of main production facility, instances of delayed deliveries, estimated utilization ratio of main production facility and repair service to total sales volume ratio.

(b) Generally in technical aspects, material handling and production organization, the country's machine assembly and machining enterprises have similar technology levels. Similarity exists in the following indicators:

13/ For detailed explanation of the methodology, see annex 1.

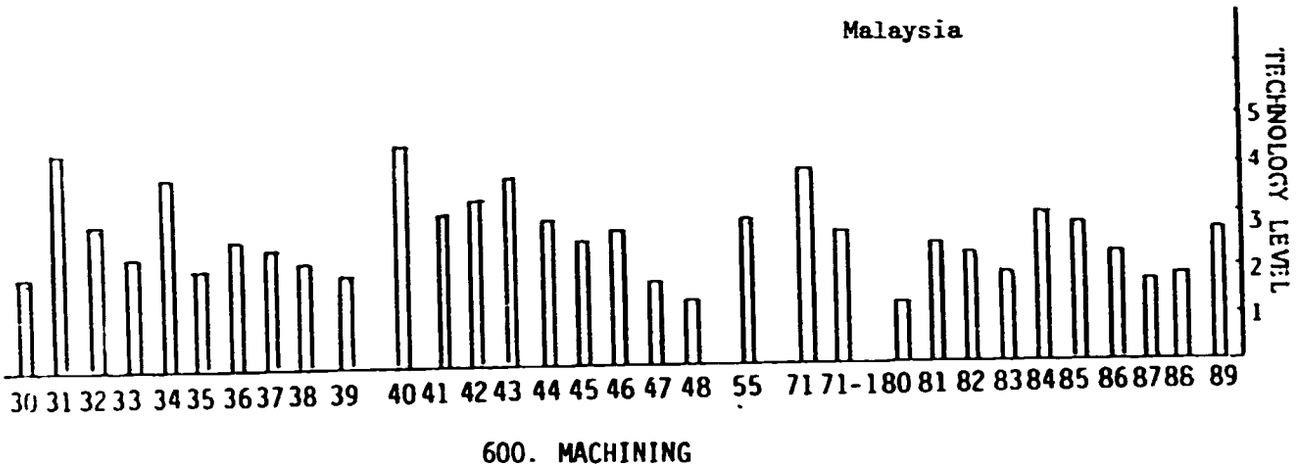
average production defects (from 21 to 30 per cent), type of measuring tools (micrometer), tolerance of main products (1/10 mm), industrial standards used (country level), product development method (market response), quality control system (first product inspection), work instructions (technical drawings), number of graduate engineers (one), and material handling method (manual chain blocks). Machine assembly enterprises obtained higher technology levels in number of employees who can read and interpret technical drawings and where subcontracting jobs are obtained, machining enterprises showed higher technology levels in the frequency of subcontracting activities.

(c) As in the technical aspects, many similarities in the work environment technology level between machine assembly and machining enterprises exist. Similar levels were noted in responsibility for safety programmes (none or at least one safety committee), common safety equipment (shoes, goggles, gloves, etc.), machinery and equipment installation (similar machines in the same place, conditions of materials, parts and product storage (kept orderly in designated floor areas), type of factory lighting (flourescent lamps), quality of lighting (adequate), and type of ventilation (movable electric fan). Machine assembly enterprises showed higher technology levels in health care schemes, provision of free medical check-up and annual vacation leave with pay (see figure 3).

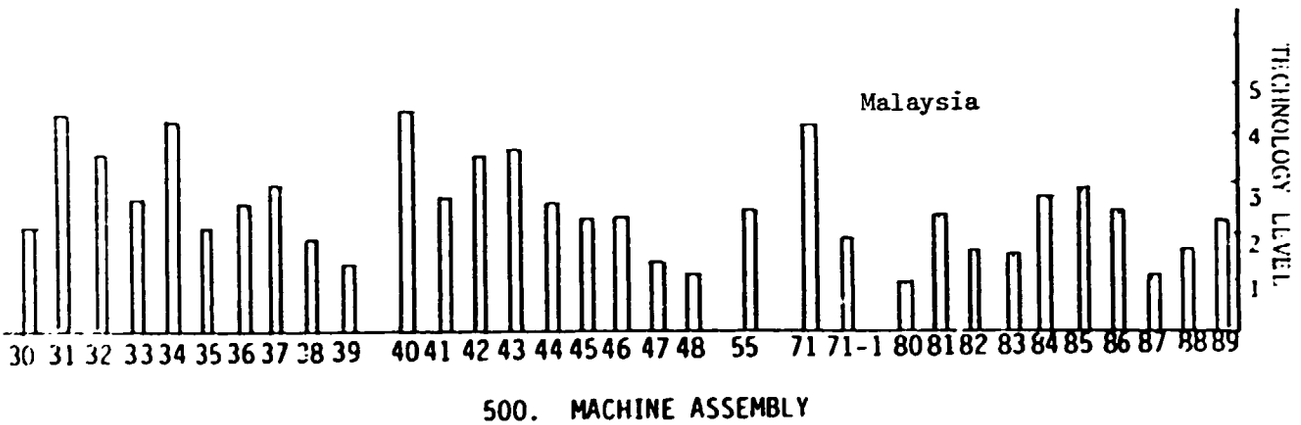
(d) Considering the hardware and software technology levels of Malaysia's machine assembly enterprises revealed that for each product consisting of 21 to 50 precision and non-precision parts, 10 per cent or less are heat treated and about 11 to 30 per cent are imported. Although only a few are interchangeable, machined parts are generally assembled by hand with the aid of wimple tools. Machined parts are checked by dynamic adjustments using the enterprise's own standards. The typical machine assembly worker has 6 to 10 years experience.

(e) Considering the hardware and software technology levels of Malaysia's machining enterprises revealed that 101 to 1,000 kilograms (maximum) of cast and stainless steel materials can be machined by the enterprise. For turning, the enterprise uses ordinary lathe for jobs having

Figure 3. Technology levels in the management supports element



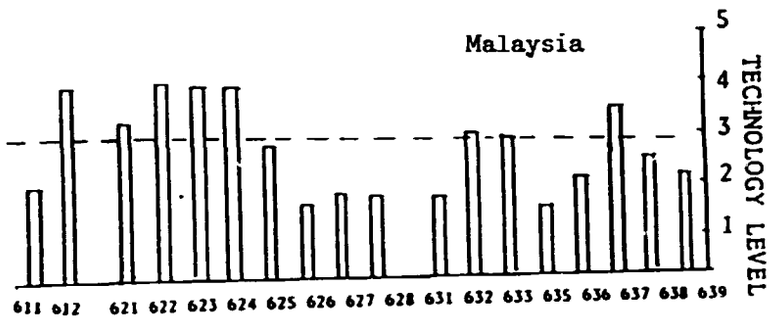
600. MACHINING



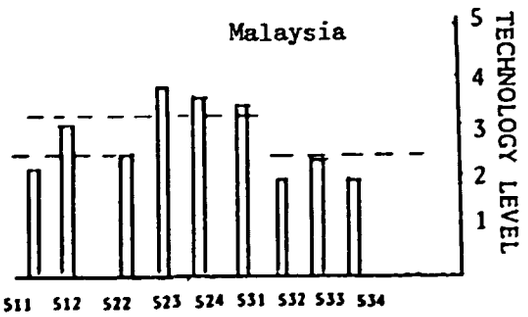
500. MACHINE ASSEMBLY

601 to 1,2009 mm diameter. For drilling, it uses radial drills with the maximum drill diameter ranging from 31 to 50 mm. It does not have shapers or slotters, planers, milling or boring machines. It has, however, a tool grinder which uses brazed carbide tool bits. It has one other machine tool which could either be gear cutting, broaching, grinding, etc. It checks the machined parts dimensions using micrometers or dial gauges, based on its own standards. Most of its machined parts are interchangeable. Its jigs and fixtures are designed and fabricated by skilled workers. Its typical worker has 6 to 10 years of machining experience (see figure 4).

Figure 4. Technology levels in hardware and software



600. MACHINING



500. MACHINE ASSEMBLY

3.2.3 Importation of machine tools

Like all other ASEAN countries, Malaysia essentially depends on importation for the supply of machine-related machinery, equipment, parts and components. The country's importation pattern may be observed from seven of the fourteen major machine tool product groups. The seven product groups include:

(a) Electro-erosion, other electric, electronic, and ultrasonic machine tools for working metals or carbides. The significance of these items to the country's machine tool industry has only been recently felt. In fact, importation grew from a low $US 9,300 in 1979 to $US 810,000 in 1983. But real machinery (perhaps EDM or EEM) importation began only in 1980 when an upsurge in importation was noticeable. For this item, Japan's products dominate the Malaysian market, maintaining a 42 per cent share during the period. Recently, products from Taiwan Province of China and Switzerland have started to increase their market shares. From an almost negligible share in 1979, Taiwan Province of China achieved 12 per cent and Switzerland 18 per cent in 1983. Similarly, Singapore products (many were perhaps re-exports) showed a similar trend, from 2 per cent to 9 per cent during the period.

(b) Gear-cutting machines. Gear-cutting machines have also begun to emerge in the Malaysian machine tool industry. In fact, importation increased rapidly from $US 106,000 in 1979 to $US 468,000 in 1983. Of the 19 countries of origin, Japanese gear-cutting machines had a 42 per cent share in 1979 which gradually rose to more than 60 per cent in 1983. To a large extent, the share of European-made gear cutting-machines (specially those from the Federal Republic of Germany) contracted while that of Taiwan Province of China expanded.

(c) Lathes. The country's lathes importation doubled from $US 3.5 million in 1979 to $US 6.8 million in 1983. Although Malaysia imported lathes from highly diversified sources (30 countries), Taiwan Province of China clearly dominated the market. Lathes made in Taiwan Province of China captured and persistently maintained 26 per cent of the

market from 1979 to 1983. The shares, however, of Japanese-made lathes have been steadily expanding from a mere 6 per cent in 1979 to an impressive 24 per cent in 1983. Apart from Taiwan Province of China and Japan, lathes from the United Kingdom, the Federal Republic of Germany and the People's Republic of China obtained significant shares. Although seemingly insignificant, Malaysia also imported lathes from two ASEAN countries, Singapore and Thailand.

(d) Reaming or milling machines. The country's importation of milling machines practically tripled from $US 1.0 million in 1979 to $US 2.6 million in 1983. While Malaysia imported milling machines from 23 countries of origin, a strong preference for United Kingdom products was noticeable. Similarly, while the share of People's Republic of China-made machines remained very small, a steadily expanding trend was noted. Significant market shares were likewise captured by milling machines originating from Japan, the Federal Republic of Germany and Taiwan Province of China. Singapore-made machines captured 10 per cent of the 1979 to 1982 market, but showed a sharp decline in 1983. Thailand-made machines held a negligible share.

(e) Drilling or boring machines. Malaysia imported drilling or boring machines from 30 countries. The size of the country's imports of drilling or boring machines was relatively steady between $US 1.8 and 2.2 million yearly from 1979 to 1982. Machines from Japan and Taiwan Province of China equally shared 40 per cent of the market. Likewise, machines from the People's Republic of China and United Kingdom showed significant shares. Machines from the Federal Republic of Germany and United States steadily maintained their relatively small shares. Machines from Thailand and Singapore also captured a small share of the market.

(f) Planing machines. The country imported planing machines from 15 countries during the 1979 to 1982 period. Clearly, planing machines from European countries (particularly the Federal Republic of Germany and the United Kingdom) obtained significant shares between 1979 to 1980. Then preference gradually shifted in favour of machines from Asia (particularly Japan, Republic of Korea and Taiwan Province of China). Machines from Thailand and Singapore obtained small shares of the market.

(g) Other metal-working presses. Malaysia's importation of presses showed a fluctuating trend. Importation increased from $US 3.6 million in 1979 to $US 6.4 million in 1982 and fell sharply to a mere $US 730,000 in 1983. Presses from Japan captured a hefty 50 per cent of the 1979 market but this has since contracted to 25 per cent between 1980 to 1983. Presses from the People's Republic of China had a steady share of $US 440,000 annually. The same applies to presses from the United Kingdom which persistently maintained a sizable share. Presses from Singapore and Thailand obtained small shares of the market.

Generally, the same trend was noted in the importation of other minor machine tool related machinery, equipment, components and parts imported by Malaysia between 1979 to 1983. These included: (a) sawing machines; (b) tapping or screw-cutting machines; (c) machines for working metals or carbides operated by grinding wheels, abrasives or polishing products; (d) forging and stamping machines; (e) bending, forming, folding or flattening machines; (f) shearing, punching or notching machines; and (g) other machine tools for working metals or carbides.

3.2.4 Machine tool exports

Besides importing machine tool-related product, Malaysia has - to a limited extent - been exporting machine tool machinery, equipment, parts and components. In fact, from 1978 to 1981, the export volume increased from $US 840,000 to $US 1.4 million. Most items exported, however, are parts and components. During the period, other machine tools for working metals and carbides topped the list obtaining a total share of 30 per cent, followed by parts for forging and stamping machines.

3.3 Opportunities and development trends

In Malaysia significant opportunities definitely exist for the development of a metal-working industry in general and the machine tool industry in particular. In the machine tool industry for example, only six manufacturers have been identified by the [illegible]ant institutions (see annex 3.1 and 3.2), but a number of supporting enterp[illegible]xist.

In its 1981 study of Malaysia's precision engineering activities, the German Agency for Technical Co-operation (GTZ) outlined some of the existing favourable and unfavourable conditions in promoting the machine tool industry in Malaysia.[14/] The favourable conditions were:

(a) Workers' efficiency and willingness to work;
(b) Good working conditions;
(c) Some enterprises with experience in precision engineering;
(d) Well trained engineers with broad basic knowledge;
(e) High population growth and expanding consumer market;
(f) Relatively stable economy;
(g) Protection of patents, utility models and trademarks; and
(h) Permitting repatriation of capital, gains and profits.

The unfavourable conditions were:

(a) In some locations, skilled labour (such as toolmakers) and managerial personnel are difficult to find;
(b) Workers' industrial efficiency training is unsufficient;
(c) Ancilliary industries' technical positions must be improved;
(d) Product and sales engineering activities have been mostly handled by foreigners; and
(e) Only a few enterprises have been organized for exports.

14/ DEG - German Development Company for GTZ, Precision Engineering in Malaysia, Kuala Lumpur, Malaysia, September 1981.

4. THE MACHINE TOOL INDUSTRY OF THE PHILIPPINES

4.1 Background

Ship repair and sugar milling industries were instrumental in starting the country's metal-working industry. The need for ship repair prompted the establishemnt of Honiron Philippines, Inc. in 1879. Then, just before Honiron expanded into foundry and machining operations, Atlantic, Gulf and Pacific, Inc. (AG & P) - an industry pioneer - was established in 1900, followed immediately by Cebu Shipyards and Engineering Works, which installed a drydocking and ship repair facilities in 1904. In 1909, Iloilo Drydock and Engineering Co. erected a naval shipyard and fabrication shop. In 1915, AG & P established the first machine shop for machining of castings and repair of machinery and equipment and before 1975, AG & P bought Honiron and has since became an industry leader.

The large scale industrialization of sugar prompted the emergence of metal-working enterprises to service, repair and maintain sugar milling machinery and equipment. In Pampanga, the Valencia Machine Shop started operations in 1908. Shortly thereafter, the Valentino Service Machine Shop emerged, followed by many others. Before World War II ended, there were 35 metal-working enterprises throughout the country. Then in the late 1950s, foreign exchange became so scarce that the Government of the Philippines imposed import and foreign exchange controls. Contrary to many expectations, however, this strengthened rather than weakened the metal-working industry. Soon, surplus machines became an instrument in saving foreign exchange. Thus as importation decreased, small enterprises began producing machinery replacement parts and to a large extent, this propelled the industry's vigorous expansion and proliferation from 1960 to the early 1980s.

In 1983, four main product groups dominated the country's metal-working industry. These were:

(a) Automotive and motor vehicles, having significant subcontracting activity which attains more than 60 per cent local content in locally-made passenger cars and light utility vehicles;

(b) Steel structures, tanks and accessories, including extensive overseas erection works in the Middle East;

(c) Sheet metal and wire products; and

(d) Metal castings and foundries.

However, after 1983, the industry suffered from the economic difficulties that beset the country. Although no official figures exist, it is estimated that from 1983 to 1984, employment, production and volume of business in general declined by as much as 20 per cent. Most seriously affected was the automotive and motor vehicles sector. In fact, two of the Progressive Car Manufacturing Programme (PCMP) participants (Delta Motors Corporation and Ford Philippines, Inc.) have ceased operating and so did many other small machining, foundries and fabricating shops.

4.2 Main features of the metal-working industry

Today, the metal-working industry transforms metal resources into durable and non-durable consumer as well as industrial products. It now consists of the following main product groupings:

(a) Iron and steel basic industries, limited to casting and forging of machinery and equipment parts;

(b) Non-ferrous metals industries, limited to casting and forging of machinery and equipment;

(c) Manufacture of fabricated metal products, except machinery and equipment;

(d) Manufacture of electrical machinery, except electricals;

(e) Manufacture of electrical apparatus, appliances and supplies;

(f) Manufacture of transport equipment; and

(g) Manufacture of professional and scientific control and measuring equipment as well as photographic and optical goods.

The most recent study on the country's metal-working industry was conducted by FGU-Kronberg for the Philippine-German Joint Industrial Promotion Project (JIPP) and the Metal-working Industries Association of the Philippines (MIAP) in 1984.[15/] Briefly, the study reported the following:

With casting, forging as well as enterprises having 20 workers or less, the country had some 7,500 metal-working enterprises in 1981, equivalent to about 9 per cent (compared to 7 per cent in 1975) of the estimated 80,000 total manufacturing enterprises. Of the 7,500 enterprises, 4,600 (or 64 per cent) fabricate various metal products but employ only 2.5 per cent of the industry's 170,000 workers. About 4 per cent manufacture electrical machinery, but employ 28 per cent of the total workforce. Thirty-one per cent are in Metropolitan Manila and employ 71 per cent of the total workforce.

The country's manufacturing is predominantly performed by small enterprises. In fact, 90 per cent of the manufacturing enterprises employ less than 10 workers, about 8 per cent employ 11 to 99 and only 1.3 per cent employ more than 100 workers. A similar pattern prevails in the metal-working industry. About 75 per cent of metal-working enterprises employ less than 10, 21.1 per cent employ 11 to 99, and only 3.8 per cent employ more than 100 workers. Most enterprises having less than 10 workers (3,078 enterprises or 72.4 per cent of the total) manufacture low technology metal products. The same is true for non-electrical machinery enterprises (13.6 per cent of those having less than 10 workers) which produce or repair simple agricultural machinery and implements.

Almost 31 per cent of metal-working enterprises employing 200 or more workers (about 3.1 per cent of all metal-working enterprises) produce electrical machinery, 20 per cent produce non-electrical machinery,

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15/ FGU-Kronberg, The Metal-working Industry of the Philippines: Possibilities of Co-operation between Enterprises in the Philippines and the Federal Republic of Germany, DEG Study, 1980.

17.8 per cent produce transport equipment and other metal products, and 2.8 per cent produce professional and scientific instruments.

Caused by the worsening economic conditions, the industry's employment grew by only 2.7 per cent between 1979 and 1981, compared with a 14.8 per cent annual growth from 1974 to 1977. Although in the transport equipment manufacturing sector for example the Progressive Car Manufacturing Programme (PCMP), Progressive Truck Manufacturing Programme (PTMP) and Progressive Motorcycle Manufacturing Programme (PMMP) have induced the emergence of subcontracting and service industries (primarily stamping, forging, casting, surface treatment, tool making and heat treatment), the recent economic slowdown forced many subcontractors to idle their facilities. Moreover, the 19 per cent annual domestic market growth rate of the expansive 1974 to 1978 years decreased sharply to only 9 per cent from 1979 to 1981. Interestingly, the 44 per cent of the domestic demand filled by domestic production in 1978 increased to 51 per cent in 1981. In 1983, total metal-working products exported reached $US 39.5 million (CIF) with the transport sector accounting for 65 per cent. Machine building or original equipment manufacturing is still underdeveloped.

4.3 Analytical appraisal of the machine tool industry

The machine tool industry is a major but one of the least developed subsectors of the country's metal-working industry. Machine tools consist of three main product groupings:

(a) Metal-working machinery including lathes, presses (mechanical and hydraulic), shearing, forming, shaping, grinding, drilling, broaching, sawing, filling and mechanical appliances for treating (sintering, pickling, etc.) metals;

(b) Cutting tools, jigs, fixtures and dies; and

(c) Moulds (for glass, rubber, metal and buttons).

Despite its strategic importance, there has been no significant attempt to examine the country's machine tool industry. The available studies on the whole metal-working industry merely mention the subsector in passing. The

first attempt was conducted by the Metals Industry Research and Development Centre (MIRDC) in 1979.[16/] Then, the Technonet Asia-JICA Metal-working Survey in 1979,[17/] and most recently, the 1984 FGU-Kronberg Study.[18/]

4.3.1 Size and magnitude

Small enterprises (in 1979 estimated by MIRDC to exceed 50 enterprises) manufacture a small but nonetheless significant amount of machine tools, particularly tools, dies, moulds, saw blades, clamps and power presses. There was only one local lathe and drill manufacturer in 1979 and four in 1984.

Machine shops and large manufacturing enterprises are the primary machine tool consumers in the country. From 1974 to 1978, local machine tool consumption rose sharply from $US 23.2 to $US 51.2 million. As expected, imports met a significant portion of the local machine tool consumption. In fact, during the expansive 1974 to 1978 years, the share of imports fluctuated between 76 to 95 per cent. While local production grew by 18 per cent yearly, imports grew by 27 per cent yearly. Of the total value of 1978 imports, 44 per cent was for moulds and dies, and 27 per cent was for lathes. The United States supplied 32 per cent and Japan 30 per cent.

4.3.2 Machine tool manufacturing technology

The 1979 Technonet Asia-JICA metal-working survey provided a comprehensive description of the country's state of machine tool manufacturing technology. The study examined the technology levels of the country's machine

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16/ MIRDC, Metals Industry Research and Development Centre, The Metal-working Industry of the Philippines, Philippines 1979.

17/ TECHNONET ASIA-JICA, Survey of Small and Medium Metal-working Industries of the Philippines and Thailand (Phase I), Republic of Singapore, 1979.

18/ FGU-Kronberg, The Metal-working Industry of the Philippines, 1984. Two volumes, DEG, Manila, Philippines, December 1984.

assembly and machinery enterprises. Of the 372 metal-working enterprises surveyed, only 11 (or 3.0 per cent of the sample) were in machine assembly and 161 (or 43.3 per cent of the sample) were in machining operations. Initially, the study defined technology as a set of machinery and equipment (hardware), methods or procedures (software) and other auxiliary systems (management support). It also formulated a set of technology level indicators consisting of six levels, arranged from simple to complex. For example, in examining each machining enterprise's turning technology indicator, the respondents were asked to select their highest attainment from among six levels:[19/]

(a) None;
(b) Simple turner;
(c) Ordinary lathe;
(d) Turret lathe;
(e) Lathe fitted with copying device; and
(f) Automatic lathe or CNC machine.

The technology management supports consist of the manufacturing aspects, technical aspects and material handling. Comparing the management supports technology of enterprises engaged in machine assembly with those in machining revealed the following:

(a) In manufacturing, the technology levels of machine aasembly and machining enterprises were similar in total horsepower rating of most mechanized production facilities (betwen 11 to 50 horsepower), age of main production facility (between 1 to 15 years), estimated utilization ratio of main production (51 to 70 per cent), and method of controlling process schedules (man-hour distribution control). The machine assembly enterprises registered a higher level of mechanization than those in machining.

(b) In technical aspects and material handling, the technology levels of machine assembly and machining enterprises were similar in product tolerance employed (1/100 mm) and quality standards used (national standard). Machine

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19/ For a detailed explanation of the methodology, see annex 1.

assembly enterprises registered higher levels in average claims for product defects, number of workers who can understand and interpret engineering drawings, method of product research and development as well as a system for quality checks compared to machining enterprises. The latter showed, however, higher levels in type of measuring tools and mode of material handling (see figure 5).

The technology levels with respect to hardware and software are briefly described below:

(a) Practically none of the machine assembly enterprises heat treats the materials used. Sanding is the prevailing hand finishing method. On the average, about 10 to 20 parts constitute a product. The average worker has 6 to 10 years of machine assembly experience. Assembled products, generally consisting of O-ring, oil-seal key (wedge), gear (spur), electric wiring, reamer bolts and/or equivalents are checked by dynamic adjustments.

(b) Generally, machining enterprises use low carbon steel, ordinary cast iron, aluminium alloys, etc. The simple turner with a swing-bed capacity ranging from 300 to 600 m/m prevails in the turning technology. Likewise, vertical drilling machines, with a maximum drilling diameter capacity of 30 to 50 mm, prevail. The typical machining enterprise does not have a shaper or slotter, planer, boring and tool grinding machine. If at all, the enterprise uses carbide or brazed steel alloy tool bits. Design and fabrication of jigs and fixtures are performed by outside specialists. Dimensions of machined parts are checked by the 12-inch scale. The typical operator possesses 5 to 10 years of machining experience (see figure 6).

In the actual field survey, the Technonet Asia-JICA experts reported the following observations on the country's machine assembly and machining enterprises:

(a) Machining was done through lathes, shapers and upright drilling machines and a more frequent use of milling machines is desirable;
(b) Proper selection and use of cutting oils were taken for granted in most cases;

Figure 5. Technology levels in management supports element

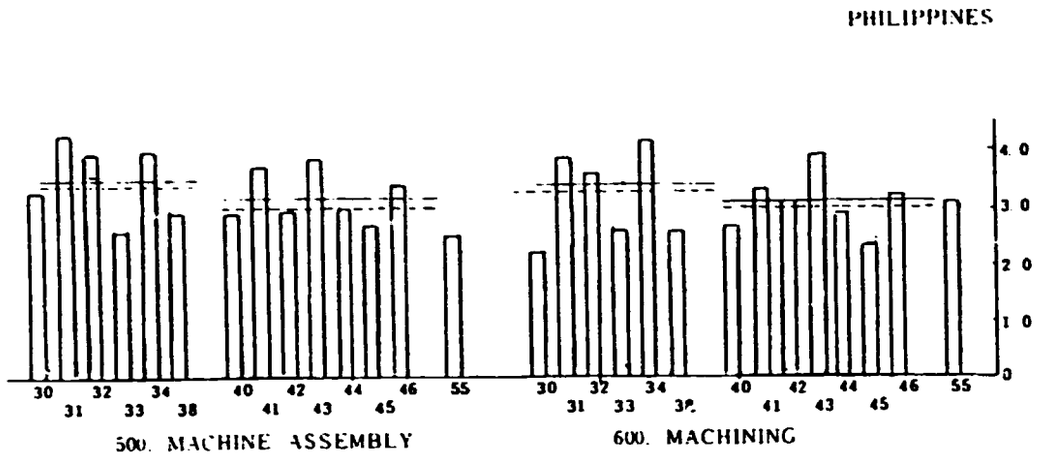
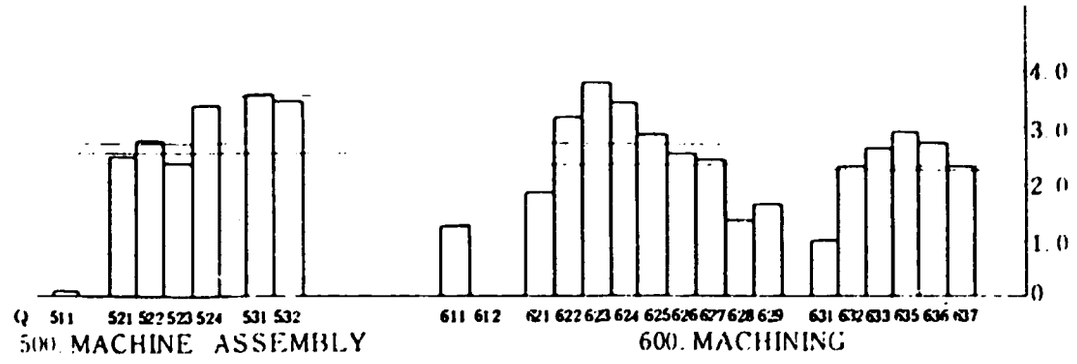


Figure 6. Technology levels in hardware and software



(c) Cutting tools with broken edges were still occasionally used;

(d) Chatterings and vibrations were commonly observed;

(e) Relationships between cutting speed and depth of cut were seldom understood;

(f) Cutting, drilling and grinding operations were seldom performed with accuracy;

(g) Most machines and equipment were not in good working condition;

(h) Most machines and equipment were not brand-name products;

(i) Micrometers and vernier calipers were seldom used;

(j) Jigs were seldom used in machinery;

(k) Feed rates of cutting tools were too high in most instances;

(l) Turret lathes were not used where they should be;

(m) In most cases, drilling angles were not accurately set and none employed drill gauges;

(n) Undesirable vibrations of drilling heads while drilling were observed;

(o) Due to improper drill bits grinding, resulting drill holes were poorly finished; and

(p) In many cases, work pieces were not properly secured to the shaper's vice.

Finally, for the machine assembly enterprises visited, the team claimed that the machine assembly area was in most cases not properly kept, making it difficult to secure levels (horizontally and perpendicularly) of parts to be assembled.

4.3.3 Conditions of the metal-working machines

Except for a few undiscernible improvements, the conditions of the country's metal-working machines were almost the same as observed by MIRDC in 1979. The MIRDC study reported that most metal-working machines were bought second-hand. Particularly for small enterprises, the preference for second-hand machines was due to lower acquisition costs, lower operating costs, shorter delivery periods and locally manufactured parts. Second-hand machines have disadvantages, too. These are: (a) shorter economic life,

(b) higher risk of breakdown, (c) higher maintenance costs, (d) inability to attain accurate tolerances, and (e) need for highly skilled operators to compensate for equipment shortcomings. The second-hand machines appear in a wide spectrum of physical conditions. Some may have never been installed or installed but never used. Others may have been partially or totally impaired, soiled or rusted. Still, others may have been reconditioned, rebuilt and upgraded.

Consequently, the age of equipment - a major technological obsolescence indicator - cannot be used in the Philippines. It is, however, safe to claim that 60 per cent of all metal-working machines are more than 10 years old. The rest may be 10 to 20 years old and some others may even go beyond 20 years. Despite their relatively old age, many metal-working machines are in fair running condition. In fact, except for inaccuracy, a considerable percentage is in a condition ranging from fair to good. Some others may have been rebuilt to improve efficiency and accuracy. Others are said to be in really bad condition (a few may be unserviceable), most are underpower, underspeed, inaccurate and in some cases parts were used in other machines, making the original machine unusable.

Functionally, metal-working machines may be classified as follows:

(a) Metal-cutting machines which are those that perform turning, drilling, broaching, boring, milling, gear-making, threading, grinding, honing, polishing and buffing operations.

(b) Metal-forming machines which perform bending, forming, pressing, punching, shearing, forging, rolling, wire forming, extruding, spinning, drawing, vacuum forming, etc. operations

(c) Metal-joining machines which perform operations such as welding, brazing, soldering, mechanical joining, etc.

Still about 60 to 70 per cent accurate, the MIRDC study revealed that a little more than 50 per cent of the country's 27,000 pieces of metal-working machines in 1979 were metal-cutting ones (see table 15).

Table 15. Distribution of metal-working machines, 1979

Type of machine	Number	Percentage distribution
Metal-cutting machine	13,346	50.26
Metal-forming machine	5,925	22.31
Metal-joining machine	7,280	27.43
Total	26,551	100.00

Source: MIRDC.

Both specialized- and general-purpose machines are used by the local metal-working industry. Few very large metal-working enterprises producing cars, appliances and other intricate machinery parts use specialized machines like turret and automatic lathes, slotting, gear-making, special milling machines and CNC machines. Small enterprises, particularly service industries, prefer general-purpose machines, such as engine and bench lathes, drill presses, planers, shapers, etc.

In 22 industrial subsectors considered in the MIRDC study, only four (pulp and paper mills, mineral processing, printing and bookbinding, as well as professional, scientific and control instruments) have not significantly employed metal-working machines. Expectedly, the majority of the machines are in service industries and metal products manufacturing (structures, containers, pressure tanks, wire, fasteners, hand tools, cutlery, household items, ornaments, hardware, lamps, furniture, safes, cabinets, springs, etc.).

The most frequently used metal-working machines are: lathes, shapers, milling machines, bending machines, welding equipment, drill presses, cutters and shears and mechanical presses (see table 16). Despite a minor double counting of machines (overlapping in equipment utilization due to preferences for general-purpose machines prevailed), the study noted that there were 2,120 lathes in the service industries for general machinery parts repair, maintenance and replacements rather than component mass production. Surprisingly, there were more welding machine (375 units) than lathes (369),

Table 16. Industrial dispersion of metal-working machines

	Lathes	Shapers	Milling machines	Bending machines	Welding equipment	Grinders	Drill presses	Cutters/ shears	Mechanical presses	Other machines
Service industries	2,120	205	261	77	2,977	1,002	838	73	528	115
Metal product manufacturing	1,076	454	266	502	1,743	606	1,235	365	1,279	486
Agricultural machinery & equipment	205	43	49	35	244	78	152	26	28	10
Power generating machinery	11	11	11	10	34	10	-	-	12	71
Civil engineering & construction equipment	120	85	82	81	212	90	108	96	101	89
Textile & leather machineries	113	79	-	-	90	91	84	79	100	231
Pulp & paper mill	-	-	-	-	-	-	-	-	-	-
Sawmill, logging & wood-working machineries	22	14	12	-	16	13	14	12	-	33
Food processing	87	64	65	65	136	76	99	69	84	88
Printing & book binding machinery	-	-	-	-	-	-	-	-	-	2
Mineral processing	-	-	-	-	-	-	-	-	-	-
Chemical processing	51	25	26	21	46	26	33	23	31	23
Machine tool	369	243	252	214	375	254	276	260	259	297
Mechanical engineering	194	97	113	91	121	160	132	103	117	114
Mechanical/ materials handling equipment	99	63	59	56	104	63	74	57	67	54
Office machinery & equipment	21	14	13	12	12	13	12	11	15	10
Communication equipment	19	-	7	-	25	13	10	-	9	-
Appliances manufacturing	182	113	116	154	242	130	171	109	231	138
Electrical machinery	237	144	151	144	191	157	164	150	348	207
Medical apparatus	7	-	-	7	-	-	-	6	7	30
Transport machinery & equipment	380	119	178	84	697	168	360	200	404	420
Professional scientific & control instruments	-	-	-	-	-	-	-	-	-	3

Source: MIRDC.

drill presses (276), shears and cutters (260), mechanical presses (259), grinders (254) and milling machines (252) in the country's machine tool industry.

4.3.4 Machine tool exports

Between 1974 and 1978, the country exported a limited amount of machine tools to neighbouring ASEAN countries. The machine tools export volume rose sharply from $US 50,000 in 1974 to $US 166,600 in 1978 (see table 17). The share of machine tool exports, however, remained insignificant compared to the total metal-working product exports. The machine tool share ranged from a low of 0.07 per cent to a high of 0.63 per cent during the period.

Table 17. Exports of machine tools - Philippines, 1974-1978
(thousand $US)

Year	Total metal-working product export	Machine tools	Share of machine tools
1974	39,816	50	0.12
1975	60,861	381	0.63
1976	108,329	210	0.19
1977	158,150	110	0.07
1978	94,754	166	0.18
		Average share:	0.24

Source: MIRDC.

According to MIRDC, the period witnessed a significant shift in the country's metal-working product exports. In 1974, for example, the United States absorbed 37 per cent of the country's metal-working exports. In 1978, the United States' share drastically declined to only 7 per cent. In the same year, exports shifted in favour of Asian countries (which absorbed 24 per cent), Eastern and Western Europe (18 per cent), Middle East (16 per cent) and other countries, notably Africa as well as North and South America (5 per cent).

4.4 Opportunities and development trends in the machine tool industry

Generally, the country's machine tool industry opportunities remain bright. As in the past, the tight foreign exchange conditions causing importation difficulties present significant product substitution opportunities for local manufacturing enterprises. The following opportunities could be tapped:

(a) Fabrication of replacement parts, tools, machinery and equipment. A further decline is expected in the country's domestic capital formation (which reached $US 3.4 billion in 1982) due to tight economic conditions. Consequently, enterprises will postpone procurement of new machinery and hold on to their existing ones. Fabrication of replacement parts represents a significant market if:

(i) Local consumers will accept locally made parts;
(ii) Quality consistency and reliability are maintained;
(iii) Raw materials are available;
(iv) Costs of local production will remain lower than those of imported goods; and
(v) Working capital will be accessible to local producers.

Additionally, the Updated Philippine Development Plan, 1984-1987, calling for a balanced agroindustrial development consistent with prevailing social and economic conditions might render imported machinery and equipment inappropriate for local needs. The tapping of this opportunity, however, requires infusion of technological resources, i.e. machine designs, specifications, parts listings, production data and other reference materials are required.

(b) Exports of machine tools. While the Philippines' exports of metal-working products peaked at $US 39.4 million in 1983, the machine tool share remained insignificant. However, the country's experience in the successful transport equipment exports (which reached $US 25.8 million in 1983) could be duplicated for machine tools. Many agree that the success transport equipment exports was largely due to: (i) prevalence of multinational enterprises having global marketing influence, (ii) the

implementation of PCMP, PTMP, PMMP by the Government of the Philippines, and (iii) transport equipment exporters who built up a considerable track record in the local market first before entering the export markets.

(c) Development of special projects. Undoubtedly, the country's metal-working industry needs small but certainly critical inputs (such as hand tools, special cutting tools, grinding wheels, small electric motors, etc.) that could only be obtained from foreign resources. With the current difficulties in importing such inputs, special projects may be established by the Government of the Philippines to undertake local production.

4.4.1 Product development opportunities

Suitable product development strategies for three of the country's main machine tool product groups, i.e. (a) simple machine tools, (b) machine reconditioning, and (c) clamping tools were already suggested by the 1984 FGU-Kronberg study. Each product group prospectus lists the important manufactures (profile of some in annex 4), specifies supply markets, pinpoints sales markets and assesses future potentials.

(a) Simple machine tools. Three major enterprises (Marsteel Corporation, JSB Metal Works Corp. and Maspe Machinery Co., Inc.) manufacture simple machine tools consisting of engine and bench lathes as well as bench and column drills.

Acceptable quality castings and machine beds may be obtained from 3 or 4 large foundries. Finishing must be done by the machine tool manufacturer together with the production of the shafts, spindles, axles, trunnions, etc. All bearings are imported from either Japan, European countries (EEC) or the United States. Gears, including bevel gears of various sizes (but excluding ground gears) can be produced, heat treated and surface finished (except surface hardening of large gears) by 3 enterprises including MIRDC. All motors must be imported from either the European countries, the United States, the area of Hong Kong or Japan. Completely finished handles and handwheels can be bought locally. All other standardized components may be obtained from the European countries, Japan or the United States.

Marketwise, the local market is still the most lucrative. In 1978, the Philippines imported $US 39.5 million worth of metal-working machines consisting of 1,640 lathes (1977: 1,280), mainly from Japan, 2,080 drills (1977: 2,572) mainly from Taiwan Province of China and 1,720 machine saws (1977: 1,516) mainly from Japan and the Federal Republic of Germany.

The South-East Asian market which is currently dominated by Japan (for high quality), the Republic of Korea (for medium quality) and Taiwan Province of China (for low quality).

The market of the Federal Republic of Germany, which in 1978 imported $US 52.5 million worth of simple machine tools consisting of 2,800 lathes (a quarter originated from COMECON), 3,200 small lathes (half from Austria) and 20,000 drills (about 60 per cent) from Taiwan Province of China.

Good prospects exist for a Philippine-Federal Republic of Germany joint venture collaboration. Success, however, hinges on the supply of special components, level of manufacturing know-how, availability of technical advisory services and use of known brands.

(b) Machine reconditioning. Although many small enterprises have used reconditioned or self-built equipment, there is no organized overhauling of metal-cutting (lathes, milling, gear-cutting, etc.) and metal-forming (hydraulic, mechanical, punching, drawing presses) in the Philippines. On a commercial basis, at least four enterprises (Creative Trade Center, JSB Metal Works Corp., MIRDC and Maschinewerk Philippines Inc.) occasionally overhaul machines.

Supplywise, more extensive machine reconditioning is hampered by difficulties in obtaining spare parts. Most machines requiring overhauling are over 30 years old, hence technical specifications, spare parts lists, engineering drawings and technical manuals exist very seldom. Consequently, machine reconditioners manufacture their own spare part requirements on a relatively non-economical basis. Bearings and standardized parts must be imported. As in simple machine tools, castings, machine beds, gears and motor overhauling can be done locally.

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Marketwise, as long as reconditioning prices remain sufficiently below those of new machinery, the Philippines represent a reliable and permanent market. A significant market also exists for enterprises who buy old and sell reconditioned machines. This opens the possibility of importing second-hand machines for reconditioning and recommissioning.

Machine reconditioning may be considered a preliminary stage to the mass production of standardized machine tools. As such, significant prospects exist for technical joint ventures in this area.

(c) Clamping tools. While many enterprises fabricate for their own use, no commercial manufacturer of clamping tools (supports, chocks, clamping blocks, machine vices, hand vices, screw clamps, etc.) exists.

Three enterprises (A.N.I. Philippines Forge Inc., Marsteel Corporation and Acme Tools Mfg. Co. Inc.) can supply adequate quality die forgings. Six local enterprises can provide iron and steel castings and 3 or 4 enterprises can heat treat and surface finish all small parts. Standardized components, machine screws and tool steel must be imported.

The Philippines import $US 300,000 worth of clamping tools (excluding the less popular parallel vices) yearly (35 per cent from the United States, 25 per cent from Japan and 12 per cent from the area of Hong Kong). The small and medium enterprises which use makeshift clamps (often causing high rejection rates) offer a lucrative medium to long term market potential.

Clamping tools manufacturing cannot be a stand alone activity but should supplement simple machine tool and machine reconditioning enterprises.

4.4.2 Some policy issues affecting the machine tool industry development

Late in 1984, MIAP and other important associations, institutes and authorities of the country's metal-working industry outlined some policy issues affecting metal-working industry development, most of which have direct bearing on machine tool industry development, as follows:

(a) Steel tariff duties and sales tax. Steel materials accounting for some 40 to 50 per cent of machine tool production costs have relatively high tariff duties and sales tax. For example, the tariff duty for rolled sheets is 25 per cent with an additional 10 per cent sales tax. Generally, this rate conflicts with the Government of Philippines' policy to impose the lowest rates (5 to 10 per cent) on raw materials and the highest rates (30 to 50 per cent) on finished products. Other ASEAN countries impose from zero to 5 per cent duty for steel materials. Interestingly, locally produced steel sheets are usually priced at the same level as imported ones (inclusive of duties and taxes).

(b) Manufacturing and other taxes. A very high gross manufacturing tax of 10 per cent is imposed on machinery manufacturers. While taxes imposed on raw materials for subcontracted components are deductible, this is not always possible since material dealers and subcontractors refuse to itemize the taxes they have already paid for. Moreover, the Government of the Philippines imposes a 10 per cent sales tax on the landed cost of imported machinery plus a 25 per cent mark-up. The same applies to locally-produced machinery. The Government of the Philippines imposes a 10 per cent sales tax based on selling price (generally higher than production costs, since this includes distribution, marketing and financing costs) plus a 25 per cent mark-up. Considering other local taxes, such as real property tax (2.5 per cent of all plant equipment's appraised value), PAG-IBIG (akin to a social security system) and contributions of 3 per cent of employee's salary, municipal taxes, garbage collection fees, energy tax, etc. locally-produced machines can cost more than imported ones.

(c) Power costs. Power costs in Luzon and Metro Manila are relatively high. Although electric power costs approximately Philippine peso 1,15 per kilowatt-hour, power cost adjustments (cost of oil, foreign exchange, distribution charge, demand charge and power factor) increase the effective cost to Philippine peso 1,85 per kilowatt-hour. Besides a high energy tax, the high power cost is due to the subsidies granted to small consumers. In spite of the high power costs, the country's power supply system is prone to unannounced shutdowns and sudden failures (generally 3 to 5 per cent and exceptionally up to 10 per cent of the time).

(d) Financing. Due to the accessibility of Letter of Credit (L/C) and Trust Receipt lines, it is easier for machinery importers to finance machinery procurement than for local manufacturers. Generally, machinery importers can completely finance their requirements when opening a Letter of Credit. Then when the goods arrive, financing is transformed into a Trust Receipt which extends the period of grace from 90 to 180 days. In effect, importations could be financed until the goods are sold. The local manufacturer, however, can only have the customer's initial downpayment with the balance payable upon delivery or 30 days thereafter, while manufactured export financing is readily available at relatively low interest rates.

(d) Government procurement. To some extent, government procurement discourages local machinery producers. In international bidding, for example, local manufacturers lose the initial 15 per cent advantage to higher duties and taxes of locally-produced machinery. Then import financing permits the importers to get 90 per cent of the payment upon shipment, while local manufacturers get paid after pilot testing and commissioning.

4.4.3 Existing government programmes

While there exist a number of government programmes for the metal-working industry development, none specializes in the machine tool industry. But most metal-working directed programmes claim to also look after the needs of machine tool industry. Some of the more important programmes are:

(a) BOI Progressive manufacturing programmes. Since 1973, BOI has formulated various programmes, which to a considerable extent helped strengthen the metal-working industries. Essentially, these programmes aim to save foreign currency, encourage domestic manufacturing, stimulate small and medium enterprise development, upgrade skills and technical know-how and promote manufactured exports. The current economic crisis, however, is impeding programme execution.

(b) BOI Investment Priority Programme (IPP). BOI's IPP has created significant investment interest in manufacturing of agricultural machinery (power tillers, implements, dryers, pumps, etc.) and industrial machinery

(compressors, etc.). For the 1984 IPP, BOI included some machine tool related investment areas, which were granted export and domestic markets. These were: (i) machine tool accessories, (ii) metal and wood-working machinery, (iii) precision tools, dies and parts of semi-conductors, manufacturing equipment, and (iv) dies, moulds and tooling.

(c) MIRDC. To develop and expand the country's metal-working industries, MIRDC was established in 1966 initially under the supervision of the Government of the Philippines' National Science and Technology Authority and then later with the Ministry of Trade and Industry (MTI). Its current emphasis is on support of cottage, small and medium industries through information, product design and development, quality assurance and special projects to stimulate local market development. Unfortunately, many enterprises including industry associations regard MIRDC as a direct competitor in the manufacture of certain products.

(d) Industrial extension. MTI's Bureau of Small and Medium Industries (BSMI) maintains a network of Small Business Assistance Centers (SBACs) throughout the country to provide extension services. For machine tool industry development, however, SBAC should offer a programme similar to that of the Ministry of Agriculture and Food - International Rice Research Institute (MAF-IRRI) - which promotes local manufacturing of agricultural machinery. Initially starting with IRRI designed implements, the MAF-IRRI project now promotes a number of different types of agricultural machinery. The project, however, ends in 1985.

5. THE MACHINE TOOL INDUSTRY OF SINGAPORE

5.1 Background

In just over two decades, Singapore has dramatically transformed itself from a mere entrepot to a highly diversified commercial, industrial, financial and communications centre having practically Asia's highest standard of living next to Japan.

Other than its deep water harbour, Singapore has no significant natural resource base. Capitalizing, however, on its strategic geographic location, Singapore over the years developed its physical and communications infrastructure, pool of trained labour force, financial and services systems and international trading linkages. Presently, it has become the second busiest port, third largest oil refining and a major oil rig and ship building and repairing centre in the world.

In spite of the troubled world economy during the 1970s, Singapore's real economic growth from 1970 to 1980 averaged 9.5 per cent yearly, and in 1980 reached 10.2 per cent. No other country, outside the petroleum producing ones, achieved such a respectable growth rate. The growth of the manufacturing, transport and communications, as well as financial and business services was striking. In 1980, manufacturing, transport and communication grew by 11.9 per cent each, while financial and business services grew by 16.6 per cent.

Manufacturing is playing an increasingly important role in the economy, primarily due to the Government of Singapore's development thrust, a dynamic private sector and a continuing influx of foreign investments. In 1980, manufacturing accounted for 29 per cent of GDP. Presently, of the more than 500 major international companies operating in Singapore, 400 are in the manufacturing sector. Singapore now manufactures a wide variety of medium to high technology products including electronic components, transport machinery and equipment, precision tools and pharmaceuticals.

Now recognized as a competitive manufacturing base for global markets, Singapore plans to further strengthen its industrial infrastructure with higher skill, technology, capital and knowledge intensive industries. Singapore is particularly interested in the following industrial priority areas: heavy engineering, electronics, chemical processing, metal engineering and machinery and electrical industries.

5.2 Analytical appraisal of the machine tool industry

Considered as a vital element of any industrial manufacturing infrastructure, Singapore's machine tool industry is apparently the most advanced among the ASEAN countries. Like all other ASEAN countries, however, Singapore does not have a precise and widely accepted definition of the machine tool industry.

This study adopted a machine tool definition based on importation statistics. In Singapore the machine tool industry consists of seven major product groupings. These are:

(a) Electro-erosion and other electric or ultrasonic tools for metals;
(b) Metal forging and stamping machines;
(c) Milling machines;
(d) Press machines;
(e) Lathes;
(f) Drilling machines; and
(g) Gear-cutting machines.

Moreover, the study assumed that the industry heavily relies on machine assembly and machining processes.

5.2.1 Size and magnitude

In December 1984, the Department of Statistics of Singapore released some statistics on the metal cutting and machine tool manufacturing enterprises. The statistics reported that there were two metal forming and five metal cutting machine tool enterprises producing lathes, milling machines and other machine tools.

Essentially, the five enterprises employed 553 workers and generated total sales of $US 2.7 million locally and $US 13.9 million from exports. Of the locally generated sales, $US 2 million were sold to retailers, $US 500,000 to direct consumers and $US 200,000 to others. Of the export sales, $US 700,000 were exported to Malaysia, $US 300,000 to other ASEAN countries and $US 13.6 million to other countries.

In the process, the five enterprises consumed $US 8.2 million worth of inputs, $US 8.1 million of which were for materials and $US 700,000 for other inputs. Additionally, the enterprises spent $US 3.7 million for other production costs, paid out $US 4.1 million in employees' remuneration and subcontracted out $US 400,000. Moreover, the enterprises spent $US 600,000 in capital expenditures. Finally, the aggregate value added amounted to $US 8.0 million.

5.2.2 The machine tool manufacturing technology

The Technonet Asia-JICA metal-working survey (involving machine assembly and machining enterprises) of 1981 which was prepared in co-operation with the National Productivity Board provides a glimpse of the country's machine tool manufacturing technology.[20/] The survey analyzed 11 machine assembly (11 per cent of the sample) and 23 machining (23 per cent of the sample) enterprises.

Initially, the survey defined technology as a set of machinery and equipment (hardware), methods or procedures (software) and other auxiliary systems (management supports). Then it formulated a set of technology level indicators consisting of six levels, arranged from simple to complex. For

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20/ National Productivity Board, A Survey of the Small- and Medium-Scale Metal-working Industries in Singapore, 1980-1981, Singapore.

example, in examining each machining enterprise's turning technology indicator, the respondents were asked to select their highest attainment from among six levels:[21/]

(a) None;
(b) Simple turner;
(c) Ordinary lathe;
(d) Turret;
(e) Lathe fitted with copying device; and
(f) Automatic lathe or CNC machine.

The technology management supports consist of the manufacturing aspects, technical aspects, graduate engineers employed, subcontracting and working environment. Comparing the management supports technology levels of enterprises engaged in machine assembly with those in machining revealed the following:

(a) In manfucturing, similarities between machine assembly and machining enterprises existed in the mechanization level (semi-mechanized), average age of main production facility (2 to 5 years), instances of delayed deliveries (rarely), size of production batch (11 to 20 pieces), repair service to total sales ratio (51 to 80 per cent), mode of production scheduling (man-hour distribution), and machine maintenance practice (unplanned). Machine assembly enterprises registered higher technology levels in the estimated utilization ratio of the main production facility (including running and set-up times in normal shift). Finally, machining enterprises showed higher technology levels in the total rated power of the most mechanized production facility and the average rate of monthly production.

(b) In technical aspects, material handling, production organization and work environment, similar levels were noted in more than half of the indicators. Similarities existed in the average production defects (below

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21/ For a detailed explanation of the methodology see annex 1.

6 per cent), number of employees who can understand and interpret technical drawings (5 to 10 persons), type of measuring tools used (block gauge), tolerance of main products (1/100 mm), industrial standards employed (own factory standards), product development method (market response), quality control system (simple checklist plus sampling), responsibility for safety first programme (safety committee), mode of installing machinery, equipment and tools (similar machines are set up in same place), factory lighting (fluorescent lamps), quality of lighting (adequate), and type of ventilation (fixed electric fans). Machine assembly enterprises displayed higher technology levels in the number of graduate engineers, condition of materials, products and parts storage, health care system, and average annual vacation leave with pay. Machining enterprises, however, excelled in the method of instructing workers, material handling, frequency of subcontract works, where these are obtained, and type of safety equipment employed (see figure 7).

(c) On the other hand, the machining enterprises use case hardened steel, malleable cast iron or ductiles, etc. as machining materials. The maximum weight of the product that can be machined ranges from 5.1 to 100 kg. For turning, the enterprises use ordinary lathes with turning diameters ranging from 301 to 600 mm. For drilling, radial type machines with a maximum drilling capacity of 31 to 50 mm are widely used. The enterprises also have horizontal or vertical milling and boring machines, drill grinders (using throw-away carbide bits), and two other machine tool types which could be used for gear-cutting, grinding, broaching, etc. The average machinist has 1 to 5 years of work experience. Generally, the skilled workers of the enterprises design and fabricate their jigs and fixtures requirements. Micrometers and dial gauges are commonly used to check the machined parts' dimensions (see figure 8).

5.2.3 Importation of machine tools

While Singapore imports from more than 44 countries, a significant volume was imported from Japan, the United States and the Federal Republic of Germany. In fact, Japan-made machine tools virtually held 30 per cent of the market. The United States and the Federal Republic of Germany captured 20 per

Figure 7. Technology levels in the management supports element

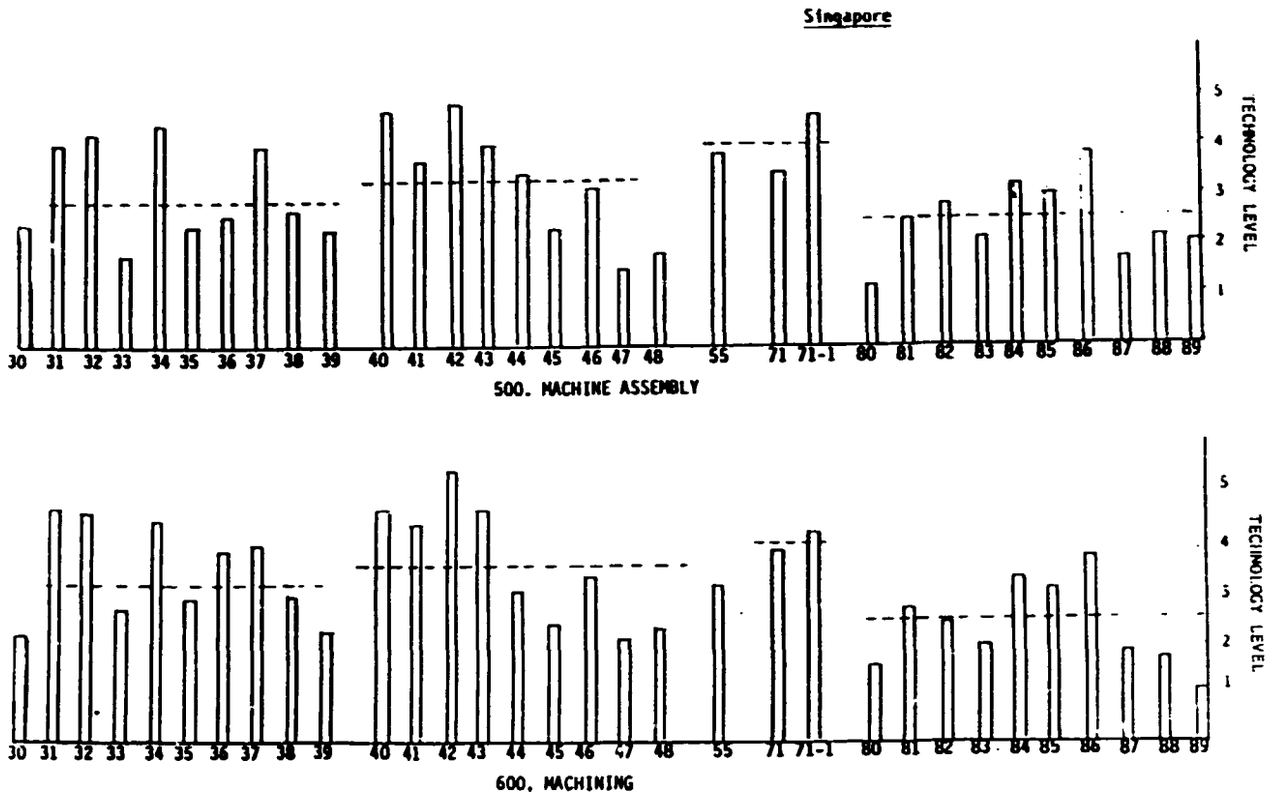
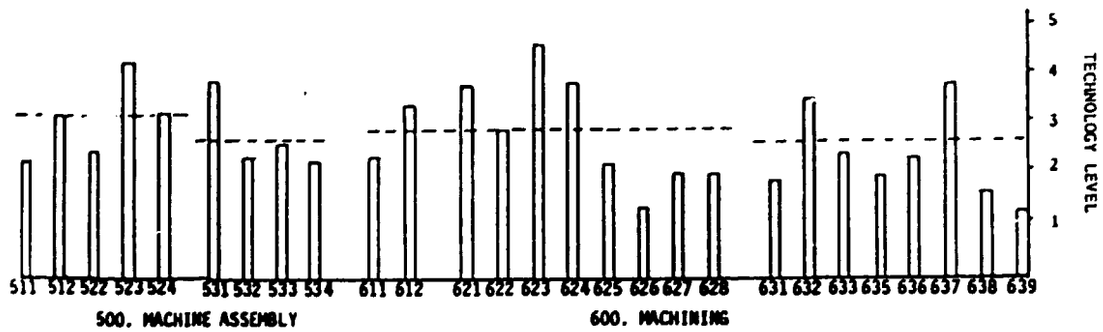


Figure 8. Technology levels in hardware and software



cent and 10 per cent, respectively. Machine tools from Switzerland, United Kingdom, Taiwan Province of China, and the People's Republic of China also obtained respectable shares. This trend is significantly different to the situation of other ASEAN countries, which collectively prefer cheaper and less sophisticated machine tools. Although insignificant volume-wise, Singapore also imported machine tools from Brunei, the Philippines, Malaysia and Thailand.

Singapore's overall machine tool importation increased slightly from $US 137.2 million in 1980 to $US 143.2 million in 1984. Generally, importation of traditional machine tool types (forging, stamping, lathes, planing, gear-cutting, machines, etc.) declined. A similar pattern may be observed in the imports of specific machine tools. For example:

(a) Electro-erosion and other electric or ultrasonic tools for metals. Singapore imported these items from 9 countries. Overall, importation declined from $US 2.4 million in 1980 to $US 1.3 million in 1984. Most of these items are imported from Japan, Switzerland and the United States.

(b) Metal forging and stamping machines. Singapore imported metal forging and stamping machines from 13 countries. Importation showed a declining trend, that is from $US 2.3 million in 1980 to $US 1.7 million in 1984. Machines from the Federal Republic of Germany and Japan have the bigger market shares, other countries registered negligible shares.

(c) Milling machines. Singapore's milling machines importation from more than 36 countries gradually increased from $US 6.5 million to $US 7.0 million from 1980 to 1984. Before 1983, the market was shared by many countries, such as Japan, the United States, United Kingdom, Spain and the Federal Republic of Germany. From 1983 to 1984, milling machines from Japan captured almost 50 per cent of the market.

(d) Press machines. Singapore's importation of press machines from more than 40 countries grew from $US 9 million in 1980 to $US 14 million in 1984. Essentially, press machines from Japan and the United States dominated the

market. Those from Japan covered 50 per cent of the market, while those from the United States covered 10 per cent. To some extent, press machines from the People's Republic of China, United Kingdom, Federal Republic of Germany and Taiwan Province of China also got considerable shares.

(e) Lathes. Singapore's importation of lathes from more than 31 countries declined from $US 26.0 million in 1980 to $US 15.8 million in 1984. Overall, lathes from Japan and the United States captured more than half of the market. Similarly, lathes from the People's Republic of China, the United Kingdom, and the Federal Republic of Germany posted significant shares.

(f) Drilling machines. Singapore's importation of drilling machines (including boring machines and accessories) from more than 34 countries slightly grew from $US 5.9 million 1980 to $US 7.0 million in 1984. Drilling machines from Japan, the United States and West Germany clearly dominated the market. Drilling machines from Taiwan Province of China and Switzerland also obtained considerable shares.

(g) Planing machines. Singapore's importation of planing machines from more than 7 countries decreased from $US 490,000 in 1980 to $US 330,000 in 1984. The preference from relatively simple and cheaper planing machines from the People's Republic of China, Taiwan Province of China, Malaysia and India shifted to the more sophisticated planing machines from the Federal Republic of Germany.

(h) Gear-cutting machines. Gear-cutting machines imported by Singapore from more than 10 countries slightly fluctuated in the vicinity of a $US 190,000 level from 1980 to 1984. Clearly, gear-cutting machines from Japan, the United States and the Federal Republic of Germany dominated the market.

5.2.4 Exportation of machine tools

Singapore's strategic location offers both domestic and re-export machine tool markets. In fact, Singapore's machine tool exports consistently exceeded local production. In 1981, for example, machine tool exports amounted to $US 33 million, but aggregate local production reached only $US 21 million. The 1982 figures further confirmed this. Machine tool exports decreased to $US 24.5 million, but local production reached $US 20.4 million.

Singapore's machine tool exports increased from $US 21 million to $US 33 million between 1980 to 1984. It is interesting to note that besides being the largest exporters to Singapore, Japan, the United States, and the Federal Republic of Germany were also the largest machine tool importers of Singapore's machine tools. The diversity of Singapore's export markets, 49 industrialized and less industrialized countries, proves the significant global marketing strength. It is also apparent that Malaysia, because of traditional trade links, is an important machine tool market for Singapore.

5.3 Trends and development

Singapore's machine tool industry continued to grow steadily. In 1984, total metal cutting and forming machines outputs rose to $US 21.8 million. A major advance was achieved when the local production of Bridgeport and LeBlond Makino CNC vertical machines centres were started. A number of local enterprises began producing machine tools including CNC milling machines, NC grinders and CNC machining centres.

No reliable statistics on existing CNC/NC machines are available. Unconfirmed Economic Development Board (EDB) estimates claim that about 700 CNC/NC machines are deployed in Singapore's manufacturing sector. Of these, 30 per cent are machining centres. Despite the lack of quantitative information, qualitative trends and development prove some optimism in the local machine tool manufacturing activity. Some examples are:

(a) Automation and new manufacturing technology. The Government of Singapore continues the promotion of industrial automation - for example, the Product Development Assistance Scheme (PDAS) and Automation Applications Centre - obtained an effective response. A quarter of all manufacturing projects committed in 1984 incorporated a significant degree of automation. Since 1982, the number of manipulators and robots (including automatic insertion machines) tripled. At the end of 1984, more than 850 robots and manipulators were used in plastic injection moulding, diecasting, metal stamping, spray painting, arc welding and printed circuit board assemblies. These efforts were matched by an increasing number of automation consulting enterprises, automation engineering services, special purpose equipment design, robotics and microprocessor-based control systems design. In future, the Government of Singapore will encourage the adoption of flexible manufacturing non-traditional machining processes, surface mounting techniques in printed circuit board assembly, machine vision and lasers in manufacturing.

(b) Precision engineering. More and more precision engineering enterprises - such as Minebea, Walbro, SMC Pneumatics, Festo Pneumatics - provide design, turnkey engineering and application systems in light industrial automation schemes to upgrade some maturing manufacturing industries. It is expected that more precision product and process rationalization will create a demand for mechatronic devices and components.

(c) Aircraft-related industries. The 1984 global aerospace industry optimism facilitated a healthy 19.7 per cent growth in the output of Singapore's aircraft related industries. Despite this, however, various restructuring initiatives were undertaken, such as the selling of the fixed-wing aircraft repair/overhaul division to Singapore Aeronautical Services; the rationalization of Hypercoat Enterprises, Pte. Ltd.; Singapore Aero Engine Overhaul Ltd.'s shift of ownership from Singapore Airlines to Singapore Aircraft Industries; etc. It is expected that from this restructuring new projects will emerge, e.g. specialized aero engine repair and overhaul facilities, manufacture of aircraft components and subsystems engineering.

(d) Automotive industry. Several leading enterprises are geared to make Singapore a competitive component parts production base for the global automotive industry. With the increasing importance of electronics into the car, automotive electronics of technologies - including hybrid thick film sensors and control devices - will be promoted in the future.

(e) Process engineering. In the future, many small enterprises in the region will require new process equipment and engineering services. Singapore's major process instrumentation enterprises - Fisher Controls, Ltd., Foxboro Far East, Honeywell Control Systems - are preparing up for this need.

(f) Supporting industries. In the near future, supporting industries (particularly moulds and dies and specialized engineering workshops) will upgrade their operations (especially heat treatment, precision machining and stamping processes). Many enterprises, particularly those engaged in moulds and diemaking, have installed CAD/CAM systems to upgrade design capability and reduce delivery time. Moreover, demand for such services as tool and die design, prototyping, short-run metal stamping, magnesium diecasting, fine sheet metal-working and heat treatment will become more durable.

Perceiving a bright machine tool market globally and locally, the Government of Singapore has undertaken several measures to promote high technology manufacturing activities. The initiatives of the Government of Singapore included:

(a) The establishment of a metal engineering training centre. This is presently equipped with 12 Japanese made CNC machines and in the future will be equipped with the latest tool and die computerized design and manufacturing systems (CDM).

(b) The conduct of two CAD/CAM related training courses, the first by Computervision and the second by ASEA on Robotics.

(c) The planning of the $US 2.0 million JAPAX Project (in co-operation with the Government of Japan) for the installation of the most modern CNC machine tool training centre.

Essentially, the Government of Singapore has five institutions that directly or indirectly promote machine tool industry development. These are: (a) Vocational and Industrial Training Board (VITB), (b) Economic Development Board (EDB), (c) National Productivity Board (NPB), (d) Singapore Institute of Standards and Industrial Research (SISIR), and (e) Materials Technology and Applications Centre (MTAC).

6. THE MACHINE TOOL INDUSTRY OF THAILAND

6.1 Background

For many years Thailand relied heavily on its agricultural sector. During the last three decades, however, the Government of Thailand initiated and organized efforts to promote industrialization. In 1960, the government promulgated relevant industrialization policies including national economic development plans and various industrial investment promotion acts.

From 1960 to 1980, Thailand's GDP fluctuated between 5.8 per cent (1980) and 10.1 per cent (1978). Before this period, the manufacturing sector grew (in real terms) by only 4 per cent to 5 per cent yearly. But after the 1960s, the manufacturing growth rate gradually increased to 10 to 11 per cent yearly. During the Fourth Economic Development Plan (1977-1981), the average growth rate slowed down to 8.7 per cent yearly, and in 1982, the growth rate further decreased to a mere 5.8 per cent. Interestingly, the sector's value added contribution to GDP expanded from a mere 12 per cent in 1960 to 21 per cent in 1982, ranking the sector side by side with agriculture.

Similarly, the manufacturing sector underwent some basic structural changes during the period. Considering the value added contribution (at 1972 constant prices) as proxy for structural changes revealed that while the major industrial consumers of metal-working products - textiles, transport, petroleum refining and petroleum products, as well as electrical machinery and supplies - expanded, metal-working was left behind. In fact, textiles moved from seventh rank in 1960 to fourth in 1970 and to second in 1981. Similarly, transport equipment jumped from sixth in 1960 to fourth rank in 1981. Petroleum refining and petroleum products climbed from nineteenth in 1960 to ninth in 1981 and electrical machinery and supplies gradually eased from fourteenth to thirteenth rank from 1960 to 1981. Surprisingly, however, metal products went down from thirteenth in 1960 and 1970 to eighteenth rank in 1981 and essentially the same happened with basic metal industries and machinery (see table 18).

Table 18. Structural changes of value added by type of industry (at 1972 constant prices)

(Unit : %)

Year	1960			1970			1981		
Rank	Industry	Share	Cumulated Share	Industry	Share	Cumulated Share	Industry	Share	Cumulated Share
1	Food	42.1	42.1	Food	20.6	20.6	Food	14.3	14.3
2	Tobacco & Snuff	10.1	52.2	Beverages	13.0	33.6	Textiles	14.2	28.5
3	Beverages	7.8	60.0	Tobacco & Snuff	10.3	43.9	Wearing Apparel	10.0	38.5
4	Wearing Apparel	7.5	67.5	Textiles	9.2	53.1	Transport Equipment	8.6	47.1
5	Chemicals & Chemical Products	6.7	74.2	Chemicals & Chemical Products	6.3	59.4	Beverages	8.4	55.5
6	Transport Equipment	4.6	78.8	Petroleum Refining & Petroleum Products	6.1	65.5	Chemicals & Chemical Products	8.3	63.8
7	Textiles	4.6	83.4	Transport Equipment	5.1	70.6	Tobacco & Snuff	7.6	71.4
8	Wood & Cork	4.0	87.4	Non-metallic Mineral Products	5.1	75.7	Non-metallic Mineral Products	5.7	77.1
9	Non-metric Mineral Products	3.8	91.2	Wearing Apparel	4.7	80.4	Petroleum Refining & Petroleum Products	5.0	82.1
10	Printing, Publishing & Allied Industries	3.4	94.6	Wood & Cork	3.2	83.6	Printing, Publishing & Allied Industries	2.9	85.0
11	Furniture & Fixtures	1.2	95.8	Machinery	2.3	85.9	Miscellaneous n.e.c.	2.6	87.6
12	Rubber & Rubber Products	0.8	96.6	Printing, Publishing & Allied Industries	2.2	88.1	Rubber & Rubber Products	2.5	90.1
13	Metal Products	0.7	97.3	Metal Products	1.9	90.0	Electrical Machinery & Supplies	2.0	92.1
14	Electrical Machinery & Supplies	0.6	97.9	Basic Metal Industries	1.7	91.7	Machinery	1.9	94.0
15	Machinery	0.5	98.4	Rubber & Rubber Products	1.6	93.3	Paper & Paper Products	1.5	95.5
16	Basic Metal Industries	0.3	98.7	Electrical Machinery Supplies	1.4	94.7	Wood & Cork	1.3	96.8
17	Leather, Leather Products & Footwear	0.3	99.0	Furniture & Fixtures	1.3	96.0	Basic Metal Industries	1.0	97.8
18	Paper & Paper Products	0.2	99.2	Leather, Leather Products & Footwear	1.0	97.0	Metal Products	1.0	98.8
19	Petroleum Refining & Petroleum Products	0.0	99.2	Paper & Paper Products	0.7	97.7	Leather, Leather Products & Footwear	0.6	99.4
20	Miscellaneous n.e.c.	0.8	100.0	Miscellaneous n.e.c.	2.3	100.0	Furnitures & Fixtures	0.6	100.0

Source: NESDE, National Income of Thailand.

In the second half of the 1980s, however, Thailand looks forward to a continuing economic growth. It has enough potential to rapidly increase food production and exploit its newly discovered natural resources in the 1980s. In accordance with its Fifth National Economic and Social Development Plan (1982-1986), Thailand has become Asia's foremost food producer and is expected to further increase its agricultural production dramatically. Likewise, the discovery and development of natural gas deposits in the Gulf of Thailand will significantly reduce its dependence on imported energy resources besides opening a number of gas-related basic industries development opportunities.

Such a business environment assures ample opportunities for the metal-working industry in general and the machine tool industry in particular.

6.2 Main features of the metal-working industry

Undoubtedly, the government began to realize the significance of the metal-working industry in the manufacturing sector. In fact, the metal-working industry contributed 3 per cent to GDP in 1981, and the current economic and social development plan provides significant emphasis on metal-working industry promotion and development.

While a significant number of studies were made on Thailand's metal-working industry, the Technonet Asia-JICA metal-working survey of 1979 remains the most comprehensive.[22/] The study examined 316 of the then estimated 1,000 small and medium metal-working enterprises. Another JICA study - the promotion of metal-working industries in the Kingdom of Thailand - conducted in 1985 essentially confirmed the results of the earlier study.[23/]

Using the statistical modes of the frequency tables derived by the 1979 Technonet Asia-JICA study, it reported that the typical metal-working enterprise in Thailand has the following characteristics:

22/ TECHNONET ASIA-JICA, op. cit.

23/ JICA, Japan International Co-operation Agency, The Study of the Promotion of Metal-working Industries in the Kingdom of Thailand, Bangkok, 1985.

(a) It is a single proprietorship enterprise which was established some 4 to 5 years ago in the urban area of Bangkok, Haadyai or Chiang Mai. Using general machining operations, it fabricates subassembly parts for industrial machines. Its fixed capital investments on machinery and equipment range from $US 35,000 to $US 60,000.

(b) The enterprise employs a production head or chief foreman having 6 to 10 years work experience. It employes 31 to 50 workers, mostly male, 81 to 100 per cent of whom are regulars. Its workers render 201 to 250 working hours monthly, each month having 21 to 25 working days. Most of its workers completed at least two years of secondary school and have stayed with the enterprise from 2 to 5 years. It does not have a formal labour union and experiences very high annual personnel turnover (31 per cent and above).

(c) The enterprise competes with others in servicing the needs of individual consumers within the province. Except for its internal needs, it does not provide repair services. It does not employ a full-time salesman and sometimes manufactures for stock. It relies on the estimating ability of the owner in establishing prices. At any time, it maintains about one week worth of production orders.

(d) Generally, the enterprise enjoys less than two months' credit in procuring raw materials from within the province. Its raw materials procurement varies from 11 per cent to 50 per cent of total production (in monetary terms). Inside its plant, all materials are handled manually.

(e) In producing industrial parts averaging 6 to 10 pieces per batch of more than 1,500 pieces monthly, the enterprise employs semi-mechanized facilities with total rate capacities ranging from 11 to 50 horsepower purchased within the country. It uses rough scheduling in controlling production and experiences some instances of delayed deliveries.

(f) The enterprise does not have a person who can read and interpret technical and engineering drawings and generally uses calipers to measure its products' common tolerances ranging from $\pm$ 1/10 mm. It uses simple checklists and its own standard to maintain quality level. Its average claim for defects ranges from 1 per cent to 9 per cent of total production volume.

6.3 Analytical appraisal of the machine tool industry

As in the other ASEAN countries, there seems to be no precise or widely-acceptable definition of the machine tool industry in Thailand. Presently, the machine tool industry - as defined by Thailand's Foreign Trade Statistics (FTS) - consists of the following product groupings:

(a) Metal-working lathes;
(b) Planing, shaping, slotting machines;
(c) Drilling machines;
(d) Milling machines;
(e) Sawing machines;
(f) Grinding machines;
(g) Riveting machines;
(h) Wire drawing;
(i) Other machine tools for working metals or carbides;
(j) Machine tools for working stone, ceramics, concrete, etc.;
(k) Machine tools for working glass;
(l) Sawing machines for working wood, cork, bone, ebonite, etc.;
(m) Lathes for working wood, cork, bone, ebonite, etc.;
(n) Drilling machines for working wood, cork, bone, etc., and
(o) Other machine tools for working wood, cork, bone, etc.

6.3.1 Size and magnitude

Mainly due to imprecise industry definition, the number of machine tool manufacturers, more so their employment and production levels, cannot be ascertained. A study by the Ministry of Industry's Industrial Service Institute (ISI) claimed that in 1977, there were 18 machine tool makers who produced approximately 1,000 metal-working tools and filled 5 per cent of the local demand.[24/] Of these, 9 manufacture cutting machines (lathes, shapers, drills etc.) and the others manufacture forming machines (presses, shears,

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24/ ISI, Industrial Service Institute, List of Metal-working Industries, Bangkok, 1985.

etc.). Many, however, believe that presently about 13 enterprises could be considered as machine tool makers, since they are producing pressing and shearing machines. Of these, only three have the capability to manufacture chip-removing machines (lathes, shapers, drill, etc.).

In 1980, a German consultancy firm conducted a comprehensive survey of Thailand's machine tool industry in collaboration with the Industrial Finance Corporation of Thailand (IFCT) and the Board of Investment (BOI). Specifically, the report underlined the need for intensive government guidance and promotion measures to stimulate machine tool production. The report also noted that as a consequence of the 1979 oil shock Thailand drastically reduced capital investment. This coupled with the inability to compete with more industrialized developing countries, many machine tool manufacturers either closed or changed their business during the period.

6.3.2 Machine tool manufacturing technology

The two studies mentioned above - the 1979 Technonet Asia-JICA metal-working survey and the 1985 JICA study on the promotion of metal-working industries in the Kingdom of Thailand - provide a view of the machine tool manufacturing technology level.

The Technonet Asia-JICA study examined the technology levels of 42 machine assembly (13.3 per cent of the sample) and 84 machining enterprises (26.6 per cent of the sample) considered as seedbeds of machine tool manufacturing. Initially, the study defined technology as a set of machinery and equipment (hardware), methods or procedures (software) and other auxilliary systems (management supports). Then, it formulated a set of technology indicators consisting of six levels, arranged from simple to complex. For example, in examining each machining enterprise's turning technology indicator, the respondents were asked to select their highest attainment from among six levels:[25/]

25/ For detailed explanation of the methodology, see annex 1.

(a) None;
(b) Simple turner;
(c) Ordinary lathe;
(d) Turret lathe;
(e) Lathe fitted with copying device; and
(f) Automatic lathe or CNC machine.

The technology management supports consist of the manufacturing aspects, technical aspects and material handling. Comparing the management supports technology of enterprises engaged in machine assembly with those in machining reveals the following:

(a) In manufacturing, the technology levels of machine assembly and machining enterprises were similar in practically all indicators except in mechanization level, where machine assembly enterprises showed higher levels than their machining counterparts. Similar patterns existed in the rated capacity of most mechanized production facility (11 to 50 horsepower), age of main production facility (6 to 10 years), estimated utilization ratio of main production facility (51 per cent to 70 per cent), and method of controlling process schedules (man-hour distribution).

(b) In technical aspects and material handling, similarities between the technology levels of machine assembly and machining enterprises existed in the average claims for defects on products (1 to 9 per cent), number of employees who can understand technical drawings (2 to 4 persons), common tolerance of products (1/10 mm), industrial standards employed (national), and system of quality checks (first product inspection). Machine assembly enterprises showed higher technology levels in the mode of research and development. Machining enterprises, however, registered higher levels in the type of measuring tools and mode of materials handling (see figure 9).

The technology levels with respect to hardware and software are described below:

(a) Generally, machine assembly enterprises use sanding for hand-finishing. They use pneumatic systems in assembling 5 to 10 pieces of machined parts (O-ring, oil seal key, gear, reamer bolts, or equivalent). Overall, the average worker has 3 to 5 years experience.

(b) Apparently, machining enterprises use case hardened or malleable steel machining materials. Simple turners with a swingbed capacity ranging from 300 to 600 mm diameter prevail in the turning technology. Likewise, electric, bench or portable drills with a maximum drilling diameter capacity of 18 to 30 mm are widely used. These enterprises use shaper or slotter machines, planers, universal/copying milling machines, honing machines and two others which could be gear-cutting, grinding, drilling, broaching machines, etc. These enterprises do not have boring machines and tool grinders. The average worker has 5 years or less of machining experience. Some workers fabricate and design their own jigs and fixtures (see figure 10).

Examining 13 machine tool makers (see annex 6), the more recent JICA Promotion of Metal-working Industries study provided more details on the sources of design and engineering know-how, measuring instruments used, quality control system, and trends in capital investments.

(a) To examine the sources of design and engineering know-how, the study formulated a matrix consisting of the type of design and engineering skills (conceptual design, specification, basic design, functional design, etc.) needed by machine tool manufacturers and overlaid this with the common sources of know-how (copying, buying from outside, supply from customer, supply from licensor, etc.). The study reported that no manufacturer obtains from a licensor and a few buy from outside. The majority rely on their own capacity (self engineering), information from suppliers and copying imported ones (reverse engineering). For those having self-engineering capacity, their strengths lie in materials flow planning, production engineering, functional design and procurement engineering (see table 19).

(b) With respect to measuring instruments, temperature was seldom included as a measurement concern. The study further claimed that with the available measuring instruments, no accurate measurement was possible. Checks

Figure 9. Technology levels in management support element

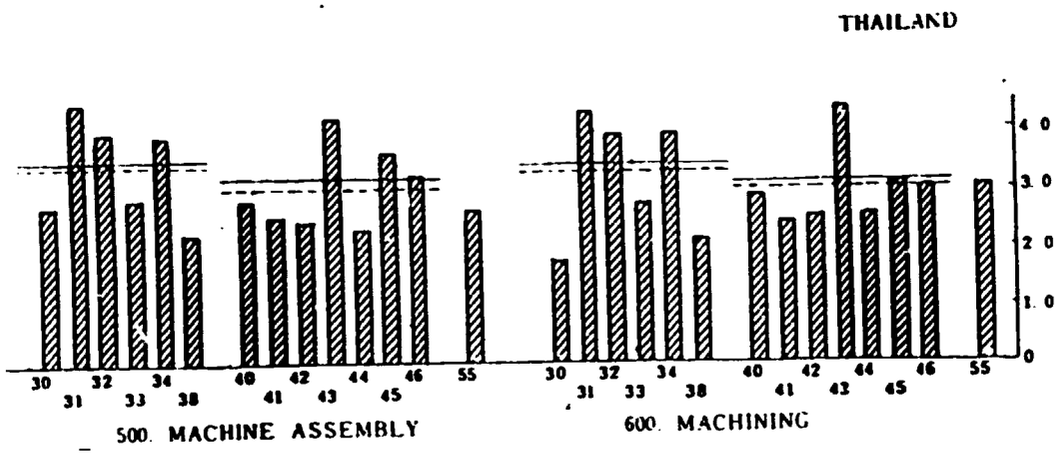


Figure 10. Technology levels in hardware and software

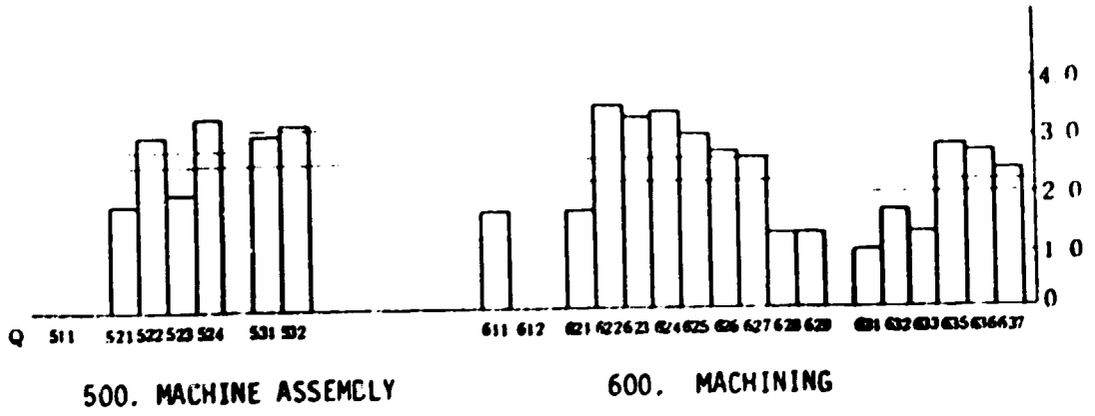


Table 19. *Sources of Design and Engineering Know-How*

Items \ Engineering Source	(1) None		(2) Copying		(3) Buying from outside		(4) Supply from customer		(5) Supply from licencer		(6) Self-engineering occasionally		(7) Self-engineering partially		(8) Self engineering fully own		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
03-01. None	3	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	100.0
03-02. Conceptional design	-	-	5	55.6	-	-	5	55.6	-	-	-	-	3	33.3	-	-	9	144.5
03-03. Specification	-	-	-	-	-	-	5	71.4	-	-	2	28.6	-	-	3	42.9	7	142.9
03-04. Basic design	-	-	-	-	-	-	3	50.0	-	-	2	33.3	2	33.3	1	16.7	6	133.3
03-05. Functional design	-	-	-	-	-	-	1	16.7	-	-	-	-	1	16.7	4	66.7	6	100.1
03-06. Structural design	-	-	1	14.3	-	-	5	71.4	-	-	-	-	-	-	4	57.1	7	142.8
03-07. Detail design	-	-	1	16.7	-	-	3	50.0	-	-	-	-	1	16.7	3	50.0	6	133.4
03-08. Production engrg	-	-	1	14.3	-	-	-	-	-	-	1	14.3	-	-	5	71.4	7	100.0
03-09. Procurement engrg	-	-	-	-	-	-	1	20.0	-	-	1	20.0	-	-	3	60.0	5	100.0
03-10. Selection of mat.	-	-	1	14.3	2	28.6	3	42.9	-	-	2	28.6	1	14.3	1	14.3	7	143.0
03-11. Material flow plan	-	-	-	-	-	-	1	16.7	-	-	-	-	-	-	5	83.3	6	100.0
03-12. Team engrg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	100.0	5	100.0

Source: JICA

on surface roughness and hardness - indispensable in precisioned products - are seldom used. The same applies to surface plates, working jigs, and inspection jigs (see table 20).

(c) Under the quality control system, the manager - and to a large extent, the workers - perform most of the dimension checking activities. Generally, no checks for surface roughness, surface hardness and materials' internal defects are conducted. Moreover, there seems to be no concern for the prevention of defects recurrence (see table 21).

(d) Finally the study also noted that no significant research and development investments were made by the machine tool makers. A few, however, invested less than 0.5 per cent of their total sales volume.

6.3.3 Importation of machine tools

Having an insignificant local production, Thailand's machine tool requirements are almost wholly filled by imports. From 1971 to 1984, Thailand's total importation of machine tools (consisting only of lathes, planing, drilling, milling, and grinding machines) soared from $US 2.6 million to $US 30.1 million. The machine tool importation pattern and their sources may be observed from the importation of lathes, planing, shaping and slotting machines, milling machines, drilling and boring machines, and grinding machines.

(a) Lathes. Thailand's importation of lathes from 27 countries dramatically grew from $US 4.2 million in 1980 to $US 37.7 million in 1984. On the average, lathes from Japan and Taiwan Province of China captured 25 per cent and 20 per cent of the local market, respectively. From 1981 to 1982, lathes from the United States and France reached 60 per cent and 36 per cent but gradually lost their gains to lathes made in Japan and Taiwan Province of China.

(b) Planing, shaping and slotting machines. There has been an unprecedented growth in the country's planing, shaping and slotting machines. In fact, importation grew from $US 1.7 million in 1980 to $US 8.5 million in

Table 20. Types of measuring instruments used

	Freq	%
Length/Flatness		
1. Tape measure	10	76.9
2. Carpenter ruler	5	38.5
3. Steel ruler	13	100.0
4. Caliper	12	92.3
5. Varier Caliper	12	92.3
6. Micrometer	5	38.5
7. Depth meter	1	7.7
8. Dial gauge	2	15.4
9. Cylinder gauge	2	15.4
10. Optimeter	-	-
11. Microscope	-	-
12. Thickness caliper	-	-
13. Precision level	-	-
14. Special purpose gauge (jig)	-	-
15. Thickness gauge	-	-
Angle/Squareness/Parallelism		
21. Angle plate	3	23.1
22. Steel protractor	1	7.7
23. Universal bevel protractor	-	-
24. Square	3	23.1
25. Straight edge	-	-
26. Combination square set	2	15.4
27. Micro protractor	-	-
28. Optical protractor	-	-
29. Iron level	-	-
30. Precision level	-	-
31. Box precision level	-	-
Profile		
33. Radius gauge	1	7.7
33. Screw pitch gauge	4	30.8
34. Taper gauge	2	15.4
35. Drill gauge	-	-
36. Gear tooth gauge	1	7.7
37. Projector	-	-
38. Roundness tester	-	-
Temperature		
41. Etched-stem thermometer	-	-
42. Thermo-electric thermometer	1	7.7
43. Registance thermometer	-	-
44. Optical pyrometer	-	-
45. Surface thermometer	-	-
46. Temperature recorder	1	7.7
47. Immersion pyrometer	-	-

	Freq	%
Hardness		
51. Brinell tester	1	7.7
52. Vickers tester	-	-
53. Rockwell tester	1	7.7
54. Shore tester	1	7.7
55. Harmester	-	-
Machined surface roughness		
61. Standard piece for surface roughness (Surface roughness scale)	-	-
62. Optical roughness tester	-	-
63. Electrical roughness tester	-	-
64. Interference roughness tester	-	-
65. Surface measuring instrument	1	7.7
Electric performance testing		
71. Wattmeter	1	7.7
72. Voltmeter	4	30.8
73. Ammeter	4	30.8
74. Power-factor meter	-	-
75. Torque meter	-	-
76. Insulation resistance meter	-	-
Testing		
81. Colour checker	-	-
82. Magna flux tester	-	-
83. Ultra-sonic tester	-	-
84. Tensile strength tester	-	-
85. Chemical analyser	1	7.7
86. Tachometer	-	-
87. Stop watch	-	-
88. Dynamometer	-	-
89. Noise meter	-	-
90. Vibrometer	-	-
91. Stroboscope	-	-
Miscellaneous		
95. Surface plate	4	30.8
96. V-block	4	30.8
97. Magnetic V-block	-	-
98. Surface gauge	2	15.4
Total	13	815.8

Source: JICA

Table 21. Quality control methods

	Freq	%
The inspection system is (are):		
1. Systematic inspections are not available, "When trouble occurs check"	5	38.5
2. First articles inspection	2	15.4
3. Single sampling inspection	1	7.7
4. Multiple sampling inspection	3	23.1
5. Sequential sampling inspection	1	7.7
6. Total (100%) inspection	6	46.2
7. Without acceptance or purchasing inspection	-	-
8. With acceptance or purchasing inspection by standard inspection documents	-	-
Whom is it inspected by?		
11. Workers themselves	7	53.8
12. Manager or the owner	8	61.5
13. Professional staff, patrol	1	7.7
14. Professional staff, stationary	1	7.7
Checking methods and items are:		
21. Visual check	11	84.6
22. Sensory check	5	38.5
23. Dimensional check	11	84.6
24. Clearance check for moving parts	3	23.1
25. Hardness check	1	7.7
26. Surface roughness check	-	-
27. Colour check	-	-
28. X-ray check	-	-
29. Magna flux check	-	-
30. Noise check	-	-
31. Vibration check	-	-
32. Life test/running test	-	-
Feedbackd of the results of inspection is:		
41. Only in file, no feed back	4	30.8
42. Notice on the boad	1	7.7
43. Circulating notice or inspection record to workers/managers	3	23.1
44. Establishing counter measures by workers/managers	1	7.7
45. Establishing counter measures by professional staff, statistical quality control system	-	-
Total	13	577.1

Source: JICA

1984. As with lathes, planing, shaping and slotting machines from Japan and Taiwan Province of China maintained the first and second highest sales level, respectively, during the period. Machines from Japan practically captured more than 60 per cent of the market from 1981 to 1984. Those originating from the People's Republic of China and the Federal Republic of Germany likewise held significant and steady shares.

(c) Milling machines. Thailand's importation figures for milling machines were erratic during the period of 1980 to 1984. Imports of milling machines from 27 countries reached $US 2.6 million in 1980, declined to $US 1.9 million in 1981, soared to $US 28.0 million in 1982 and plummeted to a mere $US 2.0 million in 1984. Milling machines from Japan and Taiwan Province of China performed well in the market. Those from India captured 60 per cent of the 1980 market but thereafter achieved only negligible shares. Moreover, milling machines from the Federal Republic of Germany, United Kingdom, Spain and Australia also obtained respectable shares.

(d) Drilling and boring machines. Thailand imports drilling and boring machines from 28 countries. As with milling machines, drilling and boring importation figures from 1980 to 1984 were erratic, ranging from $US 1.7 to $US 1.9 million. The combined shares of drilling and boring machines from Japan and Taiwan Province of China covered 75 per cent of the market. Among others, those from the People's Republic of China and the United Kingdom also captured significant shares.

(e) Grinding machines. Thailand imports grinding machines from 25 countries. Importation figures from 1980 to 1984 slumped to $US 1.3 million in 1981, peaked to $US 3.4 million in 1983 and finally declined to $US 1.0 million in 1984. As with the other machine tools, grinding machines from Japan (averaging 35 per cent yearly) and Taiwan Province of China (averaging 20 per cent yearly) dominated the market. While grinding machines from the United States and India captured 56 per cent and 15 per cent of the 1983 market, respectively, their shares drastically declined in 1984.

Annex 1

Technology level analysis

Technology level analysis is a detailed examination of the existing state of technological development in the small and medium metal-working industries. Here, the term technology may be considered as a set of elements, composed of the process (hardware) and the management supports that are necessary in the generation of the desired products in a manufacturing concern.

It should be noted that the three elements (hardware, software and management supports) of a specific technology must be interdependent and inseparable. This means that if one element, e.g. process or hardware, is of a relatively higher (or more advanced) level compared to the levels of the two other elements, then the technology as a whole may not generate the desired results. This kind of imbalance in the levels of advancement of the various technological elements is prevalent in the context of the small and medium metal-working industries in developing countries. As a consequence, the small and medium metal-working firms must deliberately initiate technology development activities. Technology development refers to that purposeful step-by-step process of continually upgrading the overall advancement of the technology or the selected elements of the technology.

In general, the first step in any technological development initative, either on an overall industry or firm level, is to describe the existing state of advancement of the technologies and processes employed. The technology level analysis is an attempt to generate such a description, which is necessary in plotting the step-by-step development of the technologies currently employed by the small and medium metal-working industries.

Specifically, technology level analysis attempts to assess and quantify the state-of-the-art or levels of advancement of the various metal-working processes as well as the various elements of each of these processes in the selected countries. Strictly, the term technology level may not have any physical significance, but is used within the context of this survey, as a hypothetical indicator of the average level of advancement of a technology and its elements.

The technology level analysis seeks to answer the following questions:

(a) What is the technology level in the management supports of the small and medium metal-working industries in each of the metal-working processes employed?

(b) What is the technology level in the hardware and software elements of the metal-working processes employed by the respondents?

(c) How does the technology levels for each of the metal-working processes behave with respect to the varying employment sizes of the respondents?

(d) How does the technology level for each of the metal-working processes behave with respect to the location (urban or rural areas) of the respondent firms?

In performing the technology level analysis, the questionnaires used in this survey have been designed to indicate, although roughly, the levels in the state-of-the-art of the process. A partial listing of technology level indicators is attached as annex 1.1 for illustration purposes. An example may prove this point: for the firms using predominantly machinery as a process, question code 632 was asked in the questionnaire, as shown below:

Question Code 632: Specify the type of tool bits employed.

1. Carbon steel
2. High speed steel
3. Carbides (brazed)
4. Carbides (throw away)
5. Diamond
6. Ceramic.

In this question, the respondents were asked to select from each of the six categories, the most frequently employed cutting tools in their machining jobs. From the arrangement of the categories, it was obvious to indicate that

level 1 is low level technology compared to level 6. Thus, each firm responded according to their range of tool bits usage. If the levels selected by each of the respondent firms (by direct interviews) from each country are aggregated, the average level obtained will indicate the national level of tool bits usage in machinery workshops.

For example if the technology level in this element is 3, the firms are not employing improved types of tool bits for machining jobs. The advantage of utilizing improved types of tool bits is that it will assist the SMI firms in turning out better quality jobs. The result of these numerical indicators for each element is depicted in the figures. These figures reflect the state-of-the-art in terms of common practices of the respondent firms with respect to the entire process of manufacturing the derived products.

Annex 1.1

Partial listing of technology level indicators

30 - Manufacturing aspects

Q30 Indicate the level of mechanization of the firm?

1. Pure manual
2. With simple hand tools
3. Semi-mechanized
4. Mechanized
5. Conveyorized

Q31 What is the total rated capacity of mechanized production facilities?

1. Zero hp
2. Less than 1 hp
3. 2-10 hp
4. 11-50 hp
5. 51-100 hp
6. More than 101 hp

Q32 What is the average age of main production facilities?

1. More than 21 years
2. 16-20 years
3. 11-15 years
4. 6-10 years
5. 2-5 years
6. Less than 1 year

Q33 Have there been instances of delayed deliveries in the past?

1. Not at all
2. Rarely
3. Sometimes
4. Very often

Q34 What is the estimated utilization ratio of main production facilities?

1. Less than 10 per cent
2. 11-30 per cent
3. 31-50 per cent
4. 51-70 per cent
5. More than 71 per cent

Q35 What is the size of the production batch?

1. One piece
2. 2-5 pieces
3. 6-10 pieces
4. 11-20 pieces
5. 21-50 pieces
6. Continuous production

Q36 What is the rate of average monthly production (accumulation of different kinds of products is acceptable)?

1. Less than 10 pieces
2. 11-50 pieces
3. 51-300 pieces
4. 301-600 pieces
5. 601-1,500 pieces
6. More than 1,500 pieces

Q37 What is the ratio of your repair service to total factory work in monetary terms?

1. None
2. 1-20 per cent
3. 21-50 per cent
4. 51-80 per cent
5. 81-100 per cent

Q38 How do you control process schedules?

1. Does not apply
2. Rough scheduling
3. Man-hour distribution
4. Man-hour distribution and utilization rates of facilities
5. Others, specify

Q39 How do you check machines for maintenance?

1. None
2. During breakdown
3. Unplanned
4. Periodic
5. According to operations manual of machines

40 - Technical aspects

Q40 What is your average claim for defects of the products?

1. More than 30 per cent
2. 10-29 per cent
3. 1-9 per cent
4. Others - specify

Q41 How many employees can understand the technical drawings?

1. None
2. One person
3. 2-4 persons
4. 5-10 persons
5. More than 11 persons

Q42 What kind of measuring tools does your factory use?

1. Scale
2. Calipers
3. Micrometer
4. Dial gauge
5. Block gauge
6. Others - specify

Q43 What is the common tolerance of your products?

1. 100 mm or rough tolerance
2. 10 mm
3. 1 mm
4. 1/10 mm
5. 1/100 mm

Q44 What kind of Industrial Standards do you use?

1. None
2. Your factory's own standards
3. Your country's national standards
4. International Standards
5. Others - specify

Q45 Do you do any research and development activities for your products?

1. None
2. Perceptive motivation
3. Customers' preference
4. Extension officers & advisers
5. Information by public R+D
6. Market research

Q46 What is your system of quality checks?

1. None
2. "When trouble occurs" checks
3. First product inspection
4. Simple checklist
5. Control chart
6. Others - specify

50 - Purchasing and material procurement aspects

Q50 From where do you obtain your primary raw materials?

1. Province
2. Region
3. Country
4. Developing countries
5. Industrialized countries

Q51 What is the percentage of materials purchased to volume of production on a monetary basis?

1. Less than 10 per cent
2. 11-30 per cent
3. 31-50 per cent
4. 51-60 per cent
5. More than 61 per cent

Q52 Do you buy raw materials in cash or credit?

1. Material exchange
2. Cash
3. Credit (less than 1 month)
4. Credit (2 months)
5. Credit (3 months or more)

Q53 From where did the manufacturers of your machines and equipment come?

1. Province
2. Region
3. Country
4. Developing countries
5. Industrialized countries

Q54 Where do you repair the machines when broken down?

1. Self repair
2. Province
3. Region
4. Country
5. Developing countries
6. Industrialized countries

Q55 How is material handling done?

1. By hand only
2. Skid/trolley
3. Chain block-manual
4. Forklift
5. Crane/hoist
6. Others - specify

500 - Machine assembly industries

Q511 What is the proportion of heat treated material?

1. None
2. 10 per cent or less
3. Above 10 per cent up to 30 per cent
4. Above 30 per cent up to 50 per cent
5. More than 50 per cent

Q521 What is the kind of hand-finishing done?

1. None
2. Sanding
3. Filing
4. Scraping/spotting
5. Spotting by diamond particles

Q522 How do you assemble machined parts?

1. By hand only
2. By hand and simple tools
3. By pneumatic system
4. By hydraulic system
5. By electric system

Q523 What is the average number of parts per completed product?

1. 5 pieces or less
2. 5-10 pieces
3. 10-20 pieces
4. 20-50 pieces
5. 50 pieces or more

Q524 What is the average experience of your assembly workers?

1. None
2. 2 years experience or less
3. 3-5 years
4. 6-10 years
5. 11 years or more

Q531 How do you check assembly?

1. No
2. Dummy
3. Static adjustments
4. Random
5. Dynamic adjustments

Q532 Specify assembly parts needs for your products?

1. Bolt and nut, washer, handle screw and/or equivalents
2. Spring pin, gasket (asbestos and rubber)
3. Valve, cylinder, chain, belt, motor flange, pipes (curves, straight)
4. O-ring, oil-seal key (wedge), gear (spur), electric-wiring, reamer-bolt and/or equivalents
5. Control-panel, bearing bush gear (bevel), pressure pipes, pressure pipe joint and/or equivalents
6. Programme control equipments, copying device and/or equivalents

600 - Machining industry

Q611 What kind of machining material is used?

1. Low carbon steel/ordinary cast iron, aluminium alloys, etc.
2. Case hardened steel/malleable
3. Stainless steel/cast steel

Q612 Specify the maximum machining weight?

1. 0.5 kg or less
2. 0.5 kg to 5 kg
3. 5 kg to 100 kg
4. 100 kg to 1 ton
5. 1 ton and above

Q621 What type of lathes do you use?

1. None
2. Simpler turner
3. Ordinary lathe
4. Turret lathe
5. Fitted with copying device
6. Automatic lathe

Q622 What is the swing-bed capacity of your lathe(s)?

1. None
2. 300 mm ϕ or less
3. 300 to 600 mm ϕ
4. 600 to 1,000 mm ϕ
5. Over 1,000 mm ϕ

Q623 What type of drilling machines do you use?

1. None
2. Manual
3. Electric/bench portable
4. Vertical
5. Radial
6. Multiple spindle

Q624 What is the maximum drill capacity (diameter of drill)?

1. Zero
2. 18 mm or less
3. 18 to 30 mm
4. 30 to 50 mm
5. 50 mm and above

Q625 Do you have shaper/slotter machines?

1. None
2. Dummy
3. Yes

Q626 Do you use a planer/planomiller?

1. None
2. Dummy
3. Yes

Q627 Specify the type of milling machines used:

1. None
2. Horizontal/vertical
3. Universal/copying

Q628 What type of boring machine is used:

1. None
2. Vertical
3. Horizontal
4. Vertical/horizontal

Q629 Specify the spindle of your boring machine:

1. None
2. 5 mm or less
3. Above 5 mm to 90 mm
4. Above 90 mm to 130 mm
5. 130 mm and over

Q631 Do you use a tool grinder?

1. No
2. Drill grinder
3. Universal/cutter grinder
4. Others - specify

Q632 Specify the type of tool bits employed:

1. Carbon steel
2. High speed
3. Carbide alloy steel (brazed)
4. Carbide alloy steel (throw-away)
5. Diamond
6. Ceramic

Q633 What is the average experience of your operators?

1. None
2. 5 years or less
3. 5-10 years
4. 10 years and over

Q635 Do you design and fabricate your own jigs/fixtures?

1. No
2. Done by some workers
3. Done by some operators
4. Done by the specialist
5. Done by a few specialists

Q636 Are there any other type(s) of machines/tools used in the factory? Enumerate and count the total number of machines (gear cutting, grinding, drilling, broaching machines, etc., aside from the ones already discussed above)

1. None
2. One type
3. Two types
4. Three types
5. More than three types

Q637 How do you check the dimensions of machined parts?

1. None
2. Scale
3. Slide
4. Vernier caliper
5. Micrometer, dial gauge (1/100)

Annex 2

Profile of two Indonesian machine tool manufacturers

PT PIMSF Pulogadung

PT PIMSF Pulogadung, established in 1976, manufactures drilling/milling machines, however, it manufactures only 50 units per year. The share of machine tools in the total sales is less than 10 per cent.

Main products of this company are miscellaneous machines depending on job-orders, agricultural machines and machine parts. They also provide repairing or overhauling services for prime mover engines.

The total number of employees was 370, of which 147 were directly productive skilled workers, 11 indirectly productive skilled workers and 49 others performing administrative functions.

The factory located in the Pulogadum Industrial Estate Jakarta, is equipped with a number of machines including precision machines and NC-machines. The gear shop is equipped with modern machine tools and heat treatment equipment as well as the necessary know-how for the manufacture of gears of good quality.

Recently they have completed prototype models of a boring machine, a grinding machine and a shaper. These machines are under evaluation in comparison to imported machines from mainly Taiwan Province of China and the People's Republic of China. The demand situation and technological opportunities are carefully watched.

C.V. Sumber Bahagia

Established in 1954, C.V. Sumber Bahagia located in Bogor, 145 km southeast of Jakarta, has developed a prototype model A-750 of a simple lathe with centre distance 750 mm.

The company is one of the local manufacturers specializing in the manufacture of agricultural machines such as the thresher, vibro cutting machine, cement mixer and other kinds of machinery parts.

Over the past year, this company has expanded its factory premises to about 5,000 sq. m., with a land area of about 18,100 sq. m. They expect to produce 360 lathes annually for several years to serve the domestic market.

Specification of model A-750 by C.V. Sumber Bahagia, Indonesia

Type	A-750	
Nominal size	Distance between centres	750 mm
	Swing over bed	360 mm
	Swing over gap	580 mm
	Swing over cross slide	190 mm
Spindle	Spindle bore	35 mm
	Taper of spindle bore	No. 5 morse
	Taper of center	No. 3 morse
Feeds	Number of spindle speeds	6
	Range of spindle speeds RPM	98, 159, 253, 376, 605, 900
	Number of feed changes (Long & Cross)	32
	Range of feeds (Long & Cross)	0.04-0.6/rev.
Threads	Inch threads	4-56/inch
	Metric threads	0.45-7 mm pitch
Tool slide	Cross slide travel	230 mm
	Compound rest travel	140 mm
Tail stock	Spindle travel	100 mm
	Taper of center	No. 3 morse
Motor horse power		2 hp
Net weight		825 kg

Summary profile of machine tool manufacturers in Indonesia

Details	Sumber Bahagia	PT PIMSF Pulogadung
Registered capital	Rph 9,000,000	Rph 1,321,204,000
Established/legal status	1954 Limited Partnership	1976 Corporation
Location	Bogor, Indonesia	Jakarta, Indonesia
Type of production		- Drilling machine
Lathes	Model A-750: Rph 1,750,000	- Prototype of:
Drilling machines	-	Lathe
Shapers	-	Shaper
		Boring machine
		Milling machine
		Grinding machine
Sales (total)/year	Rph 200,000,000	Rph 1,451,127,000
Sales/man	Rph 5,700,000	Rph 3,922,200
Sales for machine tools	Future	Drilling machine
Quantities	(360) plan	50 a.n.
Sales amount	(Rph 630,000,000)	Rph 145,112,700
Customers percentage of direct sales	-	
Number of subcontractors	-	
Employees		370
Total	35 (graduates)	157 Administration
Skilled	10 (university: 4)	164 staff 49
Un/semi-skilled	25 (high school: 31)	
Factory		
Estate(m^2)	17,500 + 600 = 18,100	19,000
Building (m^2)	5,000	10,000
Production facilities		
Lathes machines	17	
Drilling machines	6	
Boring machines	3	
Milling machines	8	Uncountable
Planing machines	1	(many machines)
Grinding machines	4	
Gear cutting, hobbing finishing machine	1	
Gear shaping machine	-	
Shaping machine	1	

Summary profile of machine tool manufacturers in Indonesia (cont'd)

Details	Sumber Bahagia	PT PIMSF Pulogadung
Production facilities (cont'd)		
Key cutting machine	-	
Slotting machine	-	
Honing machine	-	
Metal sawing machine	1	
Comments	Electro chemical machine: 1 Electrolylic grinding machine: 1 NC lathe: 1, ordered to Taiwan equipped FANUC Flame hardening machine: 1 - Institute Technologi Bandung - Completed a prototype lathe - Factory under construction - Agressive to diversify to the machine tools industries	Modernized factory equipped with high quality machines: - Machining - Gear cutting - Heat treatment - Repairing Complete machines and parts, component supply

Annex 3

Summary of MITEC-JICA study, Malaysia

I. Results of survey on companies/factories with diemaking facilities in Malaysia

Based on the information collected from the survey questionnaires on local metal-working factories distributed in November 1983, a summary of the results collected has been compiled.

A total of only 24 factories responded to the survey conducted.

A. General information

Figure A.1. Location - general distribution of factories in Malaysia

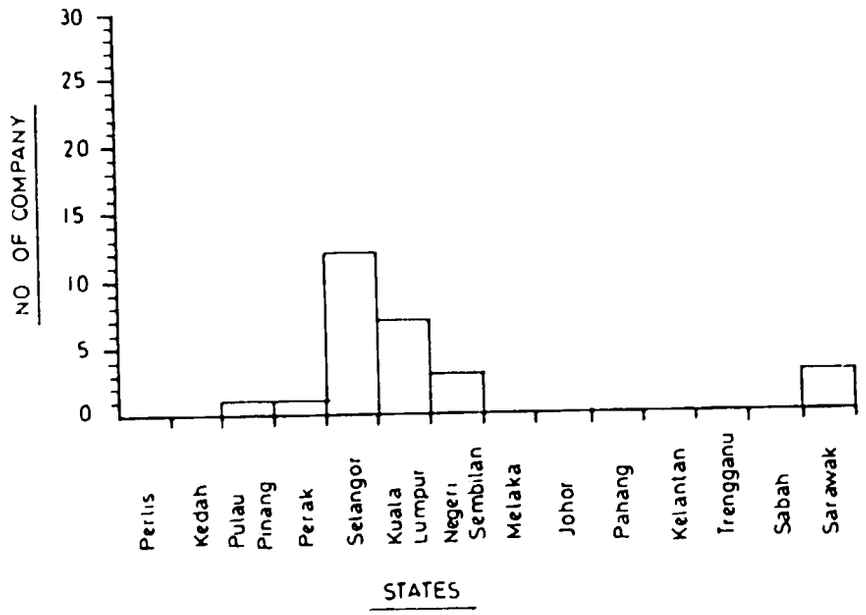


Figure A.2. Year of establishment

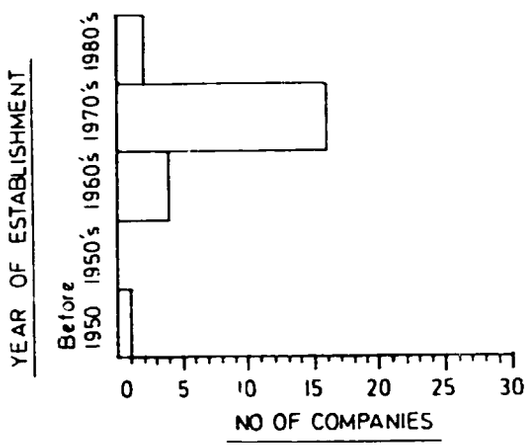


Figure A.3. Paid-up capital- distribution of factory's status according to paid-up capital

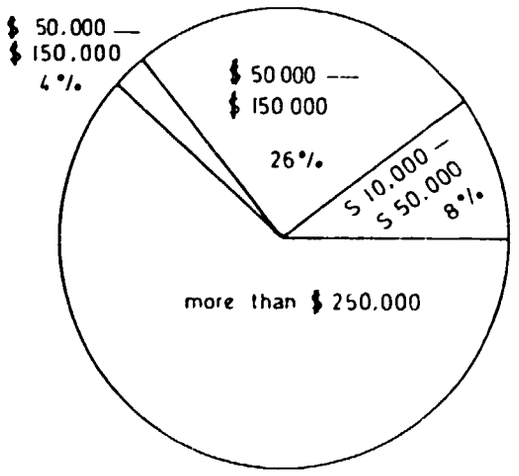
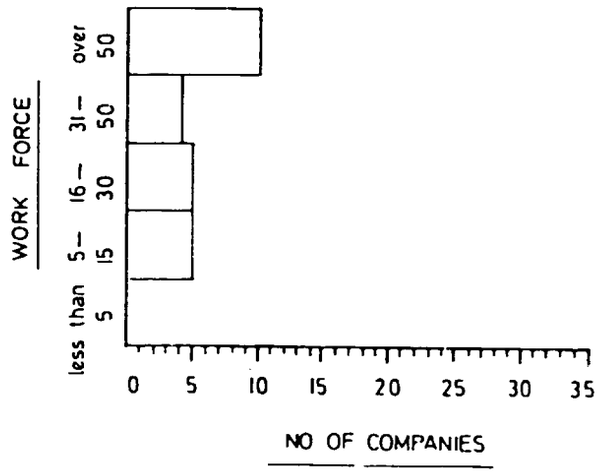


Figure A.4. Work force



B. Specific information

1. Main business activities: Frequency of answers

(i) Types of die and quantity used per month:

Single die for metal stamping	05
Progressive die for metal stamping	04
Injection mould	03
Others	03
Compression mould	-

(ii) Pressed parts/components related to:

Electrical appliances	06
Others	04
Automobile	04
Household appliances	02

2. Types of machine/equipment and their quantity:

Drilling machine	11
Lathe machine	10
Milling machine	08
Band sawing machine	07
Shaping machine	06
Surface grinding machine	06
Tool grinder	06
Others	06
Wirecut EDM	05
Electrical discharge machine	03
Copy milling machine	02
Cylindrical grinding machine	02
Profile grinding machine	01
Jig boring machine	01
Heat treatment furnace	01
Jig grinder	-
Form grinding machine	-

		Frequency of answers
3.	Source/supply of raw materials:	
	Malaysia	10
	Japan	06
	United Kingdom	04
	Others	03
	India	01
	Federal Republic of Germany	01
	Taiwan Province of China	01
	United States	01
	Republic of Korea	01
	Area of Hong Kong	-
	Australia	-
4.	Sales turnover/year ($):	
	Over 1 million	03
	$ 300,000 - $ 500,000	02
	$ 500,000 - 1 million	01
	$ 150,000 - $ 300,000	01
	$ 50,000 - $ 150,000	-
	Less than $ 50,000	-
5.	Main customer:	
	Local company	07
	Foreign based firm in Malaysia	07
	Government	03
	Export	02
	Others	01
6.	Work/production/contract order:	
	2-3 months	06
	1 month	02
	4-6 months	01
	More than 6 months	01
7.	Any personnel in charge of quality control:	
	Yes	09
	No	02
8.	Measuring equipment:	
	Vernier	10
	Micrometer	09
	Hardness tester	06
	Height gauge	06
	Projector	05
	Block gauge	05
	Others	02

		Frequency of answers
9.	Other activities:	
	Presswork	09
	Welding	08
	Electroplating	03
	Others	01
10.	Machine/equipment and their quantity:	
	Welding machine	08
	Hydraulic press machine	06
	Crank press machine	05
	Electroplating equipment	03
	Others	02
	Compression moulding machine	01
	Injection moulding machine	01
11.	Working hours/week:	
	43-47	08
	More than 48	03
	38-42	01
	Less than 37	-
12.	Any personnel in charge of safety in work place:	
	Yes	12
	No	-
13.	Years of working experience of workers:	
	1-2 years	12
	3-4 years	12
	Less than 1 year	11
	5-10 years	11
	Over 10 years	08
14.	Source of technical information:	
	Material and equipment supplier	20
	Books and magazines	17
	Consultant (private/government)	10
	Seminar	07
	Others	02
15.	Kind of technology/information of interest:	
	Progressive die making	07
	Latest equipment/machines	07
	Deep drawing die making	07
	Transfer die making	06
	Heat treatment	05

	Frequency of answers
15. (continued)	
Quality control	05
Compression/injection mould	03
Others	01
16. Future prospects envisaged:	
Manufacturing of new product	10
Expansion of factory	09
Automation/labour saving	08
Export	06
Development of own technology	05
Starting business with foreign firms in Malaysia	02
Satisfied with present business	01
Others	-

II. Results of survey on companies, factories with pressworking facilities in Malaysia

Based on the information collected from the survey questionnaires on local metal-working factories distributed in November 1983, a summary of the results collected has been compiled.

A. General information

Figure A.5. Location - general distribution of factories in Malaysia

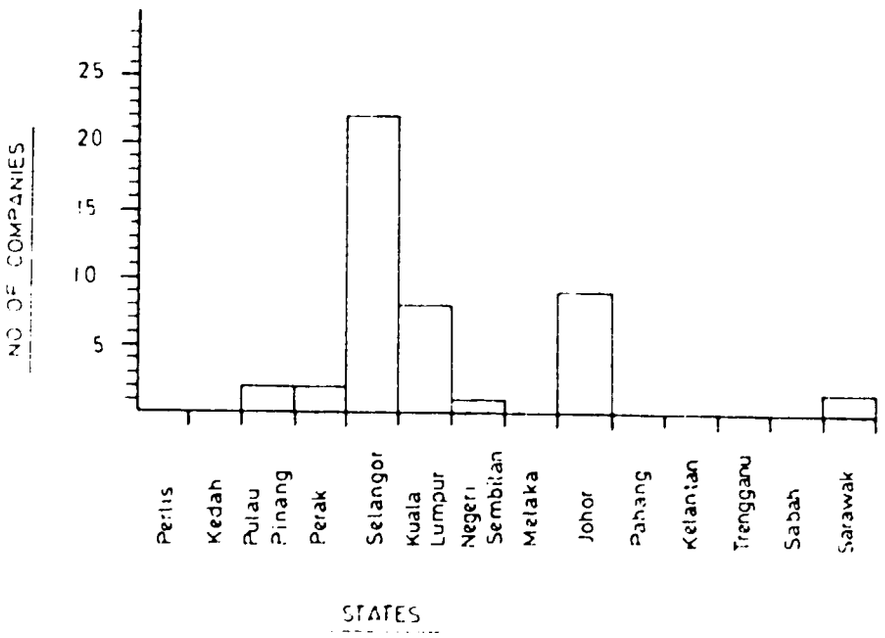


Figure A.6. Year of establishment

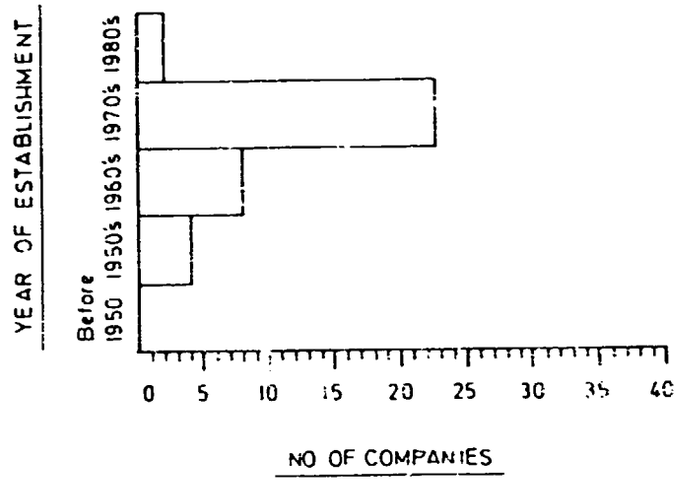


Figure A.7. Paid-up capital - distribution of factory's status according to paid-up capital

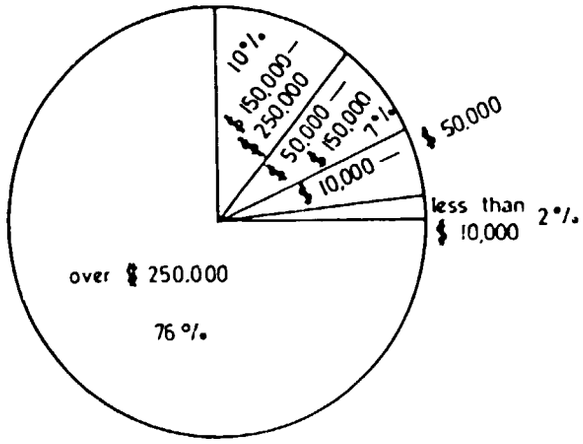
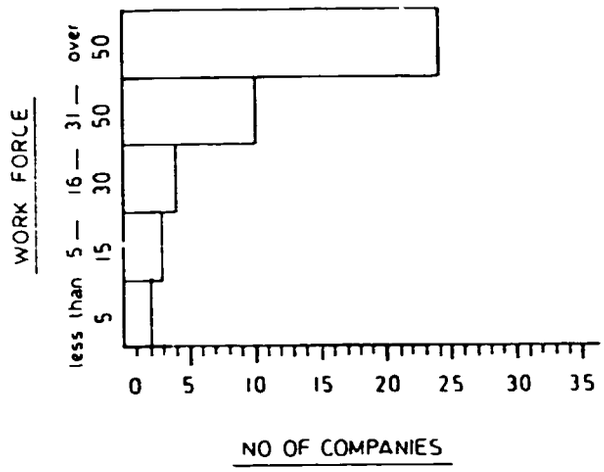


Figure A.8. Work force



(B) Specific information

1. Main business activities:	Frequency of answers
(i) Pressed parts/components related to main main business activities:	
Others	17
Electrical appliance/equipment	09
Household appliance	08
Automobile	08
Others	03
(ii) Types of press dies used:	
Single stage dies	24
Progressive dies	12
Transfer dies	04
Others	02
(iii) Supply of dies:	
Local die maker	16
In-house	14
Overseas	14
Customer	04
Others	-
(iv) Quantity of pressed parts/components produced per month:	
Over 300,000	15
50,000 - 100,000	06
10,000 - 50,000	04
100,000 - 300,000	04
Less than 10,000	01

	Frequency of answers
2. Types of press machines and quantity:	
Shearing machine	21
Crank press or hydraulic press whose capacity is less than 50 ton	19
Crank press or hydraulic press whose capacity is 50 ton to 200 ton	13
Eccentric press or manual press machine	10
Press brake	06
Crank press or hydraulic press whose capacity is over 200 ton	04
Others	04
Transfer press machine	02
Compression moulding machine whose capacity is less than 100 ton	02
Compression moulding machine whose capacity is over 100 ton	02
Injection moulding machine whose capacity is less than 100 ton	-
Injection moulding machine whose capacity is over 100 ton	-
3. Source/supply of raw materials:	
Malaysia	23
Japan	23
United Kingdom	08
Others	07
Australia	06
Taiwan Province of China	02
United States	02
Area of Hong Kong	02
Federal Republic of Germany	02
Republic of Korea	01
4. Sales turnover/year ($):	
Over 1 million	25
$ 500,000 - $ 1 million	04
$ 50,000 - 150,000	01
$ 300,000 - $ 500,000	01
$ 50,000 - $ 150,000	-
Not more than $ 50,000	-
5. Consumers/main customers:	
Local industry	26
Export	10
Others	04
Foreign based firms in Malaysia	04
Government	03

		Frequency of answers
6.	Work/production/contract order:	
	1 month	14
	2-3 months	14
	Over 6 months	04
	4-6 months	03
7.	Any personnel in charge of quality control:	
	Yes	29
	No	04
8.	Measuring equipment:	
	Micrometer	26
	Vernier	25
	Height gauge	13
	Hardness tester	12
	Projector	09
	Block gauge	04
	Others	02
9.	Other activities:	
	Welding	28
	Repair/maintenance of dies	25
	Diemaking	17
	Electroplating	08
	Others	-
10.	Machines/equipment used and their quantity:	
	Drilling machine	29
	Lathe machine	28
	Welding machine	27
	Grinding machine	23
	Shaping machine	22
	Milling machine	21
	Electroplating equipment	18
	Others	05
11.	Working hours/week:	
	43-47 hours	25
	Over 48 hours	07
	38-42 hours	02
	Less than 37 hours	-
12.	Any personnel in charge of safety in work place:	
	Yes	30
	No	02

		Frequency of answers
13.	Years of working experience of workers:	
	5-10 years	759
	1-2 years	742
	Less than 1 year	571
	3-4 years	561
	Over 10 years	497
14.	Source of technical information:	
	Material and equipment supplier	31
	Books and magazines	27
	Consultant (private/government)	12
	Seminar	10
	Others	08
15.	Kind of technology/information of interest:	
	Latest equipment/machines	27
	Quality control	26
	Progressive pressworking	15
	Deep drawing	13
	Others	12
	Transfer pressworking	11
	Compression moulding	04
	Injection moulding	02
16.	Future prospects envisaged:	
	Automation/labour saving	24
	Export	19
	Expansion of factory	16
	Development of own technology	15
	Manufacturing of new product	14
	Technical tie-up with overseas firms	12
	Starting business with foreign firms in Malaysia	07
	Satisfied with present business	03
	Others	-

Annex 3.1

Listing of machine tool enterprises

1. Machine Products Sdn Bhd
   95, Jalan Sungei Besi
   Kuala Lumpur

2. See Sun Engineering Works
   12, Batu 10, Jalan Kelang
   Sungei Way
   Selangor

3. Hory Enterprises
   36, Jalan 79
   Kepong Bahru
   Kuala Lumpur

4. Wing Fatt Power Industries Sdn Bhd
   A-565, Jalan Padang Lallang
   Pahang

5. Seong Hin Engineering Work
   A-17, 4 1/2 miles
   Jalan Kelang
   Kuala Lumpur

6. Tan Engineering Works
   23, Jalan Segambut Atas
   Segambut
   Kuala Lumpur

Annex 3.2

List of supporting enterprises for machine tool manufacturing

	Name of Company	Production Process									
		(1) Foundries/ Castings	(2) Solid Metal Forming	(3) Sheet Metal Forming	(4) Metal Cutting	(5) Heat Treatment	(6) Surface Treatment	(7) Joining Technique	(8) Packaging	(9) Plastic Processing	(10) Tool Making
199	Aik Hin Plastic Co									●	
63	Aluminium Company of Malaysia Bhd.		●				▲				▲
81	Ambadi Engineering Bhd.			●	▲	▲	▲	▲			▲
201	Anson Styroform (M) Sdn. Bhd.									●	
203	Buan Soon Plastics (Bros) Sdn. Bhd.									●	
171	Chan Fatt Engineering						▲	●			
205	Chiga Light Industries Sdn. Bhd.									●	
207	Chong Wah Plastic Sdn. Bhd.									●	
209	Daibochi Plastic & Packaging Industrial Sdn. Bhd.									●	
65	De Consolidated (Metal) Works Sdn. Bhd.		●		▲						
83	Diethelm (M) Sdn. Bhd.			●			▲	▲			
211	Dulon Industries Sdn. Bhd.									●	
213	Eastern Plastic Industry									●	
173	Eurako Industries Sdn. Bhd.							●			
85	Excel Alugraphics Sdn. Bhd.			●	▲		▲	▲			▲
215	Far East Industrial Mfg.				▲					●	▲
87	Far East Metalworks Bhd.			●	▲		▲	▲			
67	Federal Aluminium Sdn. Bhd.		●		▲		▲				▲
89	Federal Iron Works Sdn. Bhd.			●			▲	▲			
177	Federal Packages Sdn. Bhd.								●		
179	Federal Paper Products Bhd.								●		
91	Fong Lian Ironworks Co. Sdn. Bhd.			●	▲		▲	▲			
15	Foong Seong Foundry Sdn. Bhd.	●			▲						
217	F&N Containers (Malaya) Sdn. Bhd.				▲				●		
141	Gajra Gears NS Sdn. Bhd.				●	▲					▲
143	German-Malaysian Precision Engineering Sdn. Bhd.				●		▲				▲
93	Godrej (M) Sdn. Bhd.			●			▲	▲			
95	Good Friend Cutlery & Utensils (M) Sdn. Bhd.			●							
17	Gopeng Foundry Sdn. Bhd.	●						▲			
219	Great Wall Plastic Industries Sdn. Bhd.									●	

● Main Production Process ▲ Secondary Production Process

List of supporting enterprises for machine tool manufacturing (cont'd)

	Name of Company	Production Process									
		(1) Foundries/ Castings	(2) Solid Metal Forming	(3) Sheet Metal Forming	(4) Metal Cutting	(5) Heat Treatment	(6) Surface Treatment	(7) Joining Technique	(8) Packaging	(9) Plastic Processing	(10) Tool Making
.21	Hagemeyer Industries (M) Sdn. Bhd.									●	
23	Hume Plastics (M) Sdn. Bhd.									●	
37	Hup Lee Coach Builders Sdn. Bhd.			●			▲	▲			
.25	Hup Soon Plastic Industrial (M) Sdn. Bhd									●	
27	Innovative Poly Sdn. Bhd.									●	
9	International Diecasting Sdn. Bhd.	●			▲		▲				▲
29	Itami Plastic Corporation (M) Sdn. Bhd.									●	
35	Kai Peng Engineering Works (M) Sdn. Bhd.				●			▲			
47	Kejuruteraan Faun Yee Sdn. Bhd.				●						
31	Kim Chan Plastic Industries									●	▲
21	Kitz (M) Sdn. Bhd.	●	▲								
23	Kohno Plastics (M) Sdn. Bhd.								▲	●	
41	Kotak Malaysia Sdn. Bhd.								●		
43	Kris Aluminium (M) Sdn. Bhd.			●				▲			
31	Kris Components Sdn. Bhd.			●	▲		▲	▲			▲
25	Kutex Sdn. Bhd.									●	
3	Kwan Cheong Engineering Sdn. Bhd.	◒			▲		▲	▲			
5	Kwong Lee Yoon Foundry Sdn. Bhd.	●			▲	▲					
3	Kwong Ming Engineering Co.			●	▲						
9	Lee Bing Hon Engineering Works			●				▲			
5	Lee Tai Metal Works			●							
7	Len Brothers Shoe Manufactory Sdn. Bhd.									●	
9	Ling Nam Rubber Works									●	
1	Loon Sunn Engineering Sdn. Bhd.				●						▲
7	Luen Mei Plastic Industries Sdn. Bhd.									●	
7	Maboco Metal Ind. Sdn. Bhd.	●			▲			▲			▲
3	Makmur Holdings Sdn. Bhd.								●		
13	Malasa (Sabah) Sdn. Bhd.								▲	●	
9	Malayan Cables Berhad		●			▲					
5	Malayan Fibre Containers Sdn. Bhd.								●		

● Main Production Process ▲ Secondary Production Process

List of supporting enterprises for machine tool manufacturing (cont'd)

	Name of Company	Production Process									
		(1) Foundries/ Castings	(2) Solid Metal Forming	(3) Sheet Metal Forming	(4) Metal Cutting	(5) Heat Treatment	(6) Surface Treatment	(7) Joining Technique	(8) Packaging	(9) Plastic Processing	(10) Tool Making
187	Malaysia Packaging Industries Sdn. Bhd.								●		
245	Malaysia Plastics Sdn. Bhd.									●	
107	Malaysia Radiators Sdn. Bhd.			●				▲			
247	Maplin Plastic Industries Sdn. Bhd.									●	
29	Melcom Industries Sdn. Bhd.	●									
31	Menglembu Wah Cheong Foundry Sdn. Bhd.	●			▲						
189	Meritex (Penang) Sdn. Bhd.								●		▲
109	Metropolitan Industries Sdn. Bhd.			●	▲		▲	▲			▲
249	Modern Engineering Plastic Sdn. Bhd.									●	
111	Nagasteel Equipment Sdn. Bhd.			●			▲	▲			
175	Nam Fatt Engineering (SEA) Sdn. Bhd.				▲			●			
33	Nam Hing Engineering Sdn. Bhd.	●			▲			▲			
35	Nam Yong Foundry Co.	●									
37	Nun Soon Metal Mfg. Sdn. Bhd.	●									
113	Nusa Teknik Sdn. Bhd.			●	▲			▲			
51	Nylex (Malaysia) Sdn. Bhd.									●	
53	Osaka Plastics Sdn. Bhd.									●	
55	Otomotif Malaysia Sdn. Bhd.									●	
57	Pai Len Manufacturing Sdn. Bhd.									●	
59	Pakai Industries Berhad.									●	
161	Paling Industries Sdn. Bhd.									●	
167	Pan Aluminium Services Sdn. Bhd.						●				
63	Pan-Malaysia Plastics Manufacturers									●	
39	Perusahaan Besi Sdn. Bhd.	●			▲			▲			
65	Perusahaan Jaya Plastik				▲					●	▲
115	Perusahaan Vinco Sdn. Bhd.			●	▲						▲
67	Plasticon (M) Sdn. Bhd.									●	
69	Polykim Sdn. Bhd.									●	
73	Polymold Tool & Engineering (M) Sdn. Bhd.				●						▲
71	Polyolefins Pipe Sdn. Bhd.									●	

● Main Production Process ▲ Secondary Production Process

List of supporting enterprises for machine tool manufacturing (cont'd)

	Name of Company	Production Process									
		(1) Foundries/ Castings	(2) Solid Metal Forming	(3) Sheet Metal Forming	(4) Metal Cutting	(5) Heat Treatment	(6) Surface Treatment	(7) Joining Technique	(8) Packaging	(9) Plastic Processing	(10) Tool Making
71	Pony Metal Works (M) Sdn. Bhd.		●		▲		▲				▲
73	Power Cables (M) Sdn. Bhd.		●								
273	Precico Sdn. Bhd.				▲					●	▲
41	Processed Castings & Manufacturers Sdn. Bhd.	●									
43	Progress Delta Sdn. Bhd.	●			▲						▲
275	Sama Plastic Industries Sdn. Bhd.									●	
191	San Yong Enterprise Sdn. Bhd.								●		
117	Seng Chong Metalworks Sdn. Bhd.			●				▲			
155	Seong Hin Engineering Works				●						
193	Shiu Fook (M) Sdn. Bhd.								●		
119	Sin Heng Bicycle Mfg. Sdn. Bhd.			●	▲		▲	▲			▲
157	Soon Heng Engineering Works				●			▲			
277	South East Asia Plastic Ind. Sdn. Bhd.									●	
195	South East Asia Plastic Packaging Sdn. Bhd.								●		
121	Special Metal Products Sdn. Bhd.			●							
279	Spirolite (M) Sdn. Bhd.									●	
123	Stainless Products Sdn. Bhd.			●	▲						▲
281	Star Polymer Sdn. Bhd.									●	
45	Sun Kong Luen Cheong Foundry Sdn. Bhd.	●			▲						
125	Sykt. Kejuruteraan Hup Huat			●	▲			▲			▲
127	Sykt. Lian Hak Industries Sdn. Bhd.			●			▲	▲			
129	Sykt. Rumpun Hijau Sdn. Bhd.			●			▲	▲			
75	Sykt. Wire (M) Sdn. Bhd.		●								
131	Tahansan Sdn. Bhd.			●				▲			
283	Tancho Corporation (M) Sdn. Bhd.									●	
47	Tasek Iron Steel Foundry Sdn. Bhd.	●				▲					
159	Tecknokraft Engineers				●			▲			▲
197	Tego Sdn. Bhd.								●		
161	Teknicon Sdn. Bhd.				●						
285	Thai Ah Plastic Manufacturing Sdn. Bhd.									●	

● Main Production Process ▲ Secondary Production Process

List of supporting enterprises for machine tool manufacturing (cont'd)

	Name of Company	Production Process									
		(1) Foundries/ Castings	(2) Solid Metal Forming	(3) Sheet Metal Forming	(4) Metal Cutting	(5) Heat Treatment	(6) Surface Treatment	(7) Joining Technique	(8) Packaging	(9) Plastic Processing	(10) Tool Making
287	Tiong Seng Plastic Ind. Sdn. Bhd.									●	▲
289	Toh's Plastic Mahjong Service									●	
49	Tong Fatt Engineering Works Sdn. Bhd.	●		▲	▲		▲	▲			
133	Tong Meng Co. (M) Sdn. Bhd.			●	▲		▲				▲
51	Toong Seng Foundry	●									
291	Toyo Plastic (M) Sdn. Bhd.									●	
293	T.U. Industries (M) Sdn. Bhd.									●	
295	Unic Plastic Industries Sdn. Bhd.									●	
135	Union Industries Sdn. Bhd.			●	▲						
77	United Bolt & Nut Sdn. Bhd.		●								
53	United Casting Sdn. Bhd.	●			▲						
137	United Industries Sdn. Bhd.			●				▲			
163	UMW Engineering Sdn. Bhd.				●			▲			▲
79	Universal Cable (M) Bhd.	▲	●								
297	Van Leer (M) Sdn. Bhd.			▲						●	
139	Vincent Industries (M) Sdn. Bhd.			●	▲						
55	Wah Hup Engineering Works Sdn. Bhd.	●			▲			▲			
299	Wah Ngai Industries Sdn. Bhd.									●	
57	Wahab Engineering Sdn. Bhd.	●			▲		▲	▲			
301	Wai Cheong Plastic Industries								▲	●	
303	Wesmalex Plastic Ind. Sdn. Bhd.									●	
59	Yau Fong Foundry Sdn. Bhd.	●			▲						
305	Yee Cheong Plastic Manufacturers (M) Sdn. Bhd.									●	
165	Yee Weng Engineering Works				●	▲					▲
61	Yodoshi Malleable (M) Sdn. Bhd.	●			▲	▲	▲				
169	Yong Liang Electroplating & Signcrafts						●				

● Main Production Process ▲ Secondary Production Process

Annex 4

Profile of machine tool manufacturers, Philippines

Profile 1

1.	Name/address	MARSTEEL CORPORATION 555 Tandang Sora Avenue, Baesa, Quezon City, Philippines
2.	Ownership	100 per cent Filipino
3.	Year of Establishment	1950
4.	Branch (ISIC Main Division)	3710, 3813, 3823 (Rolling mill, foundry, steel construction, machine building)
5.	Product range	Foundry: Spare parts, machine components (cast iron, steel, alloyed steels) Machine building: Small diesel engines, machine saws, machining of spare parts Rolling mill (capacity 50,000 tons/year): Reinforcing rods, hot-rolle nd cold-drawn sections Steel construction: Structural components, apparatus construction, erection work Forge: Flanges, grinding balls
6.	Main customers	Construction industry, mining, chemical industry, wood-working industry, cement industry, railways
7.	Turnover	60, max. 100 million pesos
8.	Number of employees	850
9.	Facilities	
	- Land	not stated
	- Buildings	not stated
	- Machinery	Foundry: 2 electric and 2 induction furnaces; total capacity 500 tons/month; output 200 tons/month Machine-building: cutting machines for up to about 1,200 mm diameter Total value of assets: 240 million Pesos With few exceptions, old equipment and machinery; close tolerances in machining scarcely possible.
10.	Status	Potential partner for production under license (with marketing support), for foundry products, small hydroelectric power station, valves, malleable iron castings.

Profile 2

1.	Name/adress	CREATIVE TRADE CENTER Calle Industria, Bagumbayan, Quezon City, P.O. Box 432, Greenhills Post Office, Rizal, Philippines
2.	Ownership	100 per cent Filipino
3.	Year of establishment	1970
4.	Branch (ISIC Main Division)	3823, 3819 (machine building; stamping plant with toolmaking)
5.	Product range	Stampings (for household appliances and motor vehicles), toolmaking, repair and reconditioning of machine tools, structural steel components.
6.	Main customers	Manufacturers of household appliances (La Germania gas stoves), motorcycle industry, car manufacturers, small and medium-sized metal-working enterprises.
7.	Turnover	not stated
8.	Number of employees	Production 85 (press shop: 25; machine tools: 50; repair department: 10)
9.	Facilities	
	- Land	5,300 sq m
	- Buildings	Approx. 3,600 sq m
	- Machinery	Approx. 20 presses, 500 - 600 tons Approx. 30 cutting machines (mostly overhauled older models)
10.	Status	The press and machine shops are only working to about one-third capacity (the number of staff has decreased by about 50 per cent since 1977) Italian manager, quality conscious. Potential subcontracting enterprise.

Profile 3

1.	Name/Address	ISB METAL WORKS CORPORATION 24 Oliveros Drive, Balintawak Quezon City, Philippines
2.	Ownership	100 per cent Filipino (family corporation)
3.	Year of establishment	1968
4.	Branch (ISIC Main Division)	3919, 3943 (steel contruction, car manufacturing)
5.	Product range	Body components for passenger and utility vehicles Sheet metal-working for the construction industry, special sections, smaller vessels for food processors.
6.	Main customers	"Progressive Car Manufacturing Programme", companies, building industry
7.	Turnover	Not stated
8.	No. of employees	120, including 20 supervisors
9.	Facilities	
	- Land	12,000 sq m
	- Buildings	3,000 sq m
	- Machinery	Approximately 30 machine tools, and sheet metal-working machines for up to max. 6,000 mm length, 15 mm thickness Condition: old; no close tolerance possible.
10.	Status	Sales to the automotive industry are decreasing. Capacity utilization rate in the building materials sector about 80 per cent.

Profile 4

1.	Name/Address	MASCHINENWERK PHILIPPINES INCORPORATED 1453 Casostome Street, Sampaloc Manila, Philippines
2.	Ownership	Corporation (Filipino)
3.	Year of establishment	1983
4.	Branch (ISIC Main Division)	3823
5.	Product range	Rebuilding of metal-working and wood-working machinery; pneumatic and hydraulic design work.
6.	Main customers	Metal-working and wood-working establishments
7.	Turnover	Not stated
8.	No. of employees	14
9.	Facilities	
	- Land	Not stated
	- Buildings	Not stated
	- Machinery	Not stated
10.	Status	Lacks basic machinery for rebuilding but subcontracts jobs to other firms with facilities Capitalization: Philippine peso 100,000.

Profile 5

1.	Name/Address	MASPE MACHINERY COMPANY INCORPORATED 226-W 9th Avenue, Grace Pank Caloocan City, Philippines
2.	Ownership	Corporation (Filipino)
3.	Year of establishment	1975
4.	Branch (ISIC Main Division)	3823, 3819
5.	Product range	Industrial machinery and parts; power-presses, speed reducers, etc., fabricated steel products and sheet metal works.
6.	Main customers	Refrigeration and airconditioning industry. Metal-working and wood-working companies.
7.	Turnover	Not stated
8.	No. of employees	Not stated
9.	Facilities	
	- Land	Not stated
	- Buildings	Not stated
	- Machinery	General machining; welding (gas and electric); pressworking.
10.	Status	Available for general subcontracting jobs and/or contract manufacturing.

Annex 5

List of selected machine tool manufacturers in Singapore

Name of company and address	Principal product(s) lines
1. LeBlond Makino Asia Pte Ltd 2 Gul Avenue Jurong Singapore 2262	Lathe machines, CNC machining centre
2. Chartered Metal Industries Pte Ltd (CMI) 249 Jalan Boon Lay Singapore 2261	CNC lathes, machining centres, grinders, radial drills
3. Fong Lee Machinery & Engineering Co Pte Ltd No. 4 Gul Lane Jurong Road Singapore 2262	CNC milling machines, CNC machining centre
4. Okamoto (Singapore) Pte Ltd 10 Riverside Road Singapore 2573	Precision surface grinding machine tools, universal cylindrical grinding machine
5. Chan Ho Engineering Pte Ltd 19 Benoi Crescent Singapore 2262	Industrial machinery for production process, hydraulic guilliotine shear, hydraulic press brake, mechanical power press
6. Hydrabend (SEA) Pte Ltd 4001 Ang Mo Kio Industrial Park 1, No. 01-21 Singapore 2056	Presses
7. Tata Precision Industries Pte Ltd 1 Liu Fang Road Jurong Singapore 2262	Press tools, dies, injection moulds
8. Bridgeport Machines Singapore (Pte) Ltd 59 Gul Drive Singapore 2262	Milling machines

Annex 6

1. List of selected machine tool manufacturers in Thailand

	Name and address	Main product
1.	Kaungton Industry 62/4Soi Lentpattanatai Daokanong-Chomtong Telephone: 468 1374	Mechanical press
2.	K-Thai Manufacturing 550 Teparak Road Samrong Nua Telephone: 394 4286	Shearing machine
3.	J Taworn Karnchang 407 Mu 2 Suksawat Soi 26 Telephone: 468 0410	Shearing machine
4.	Pongpaisarn Industry 313 Suksawat Soi 33 Telephone: 462 7054	Shaping machine
5.	Tarskin Steel & Equipment 32/1 Tarskin Road Telephone: 468 1521; 468 0285	Mechanical press
6.	Thonburi Loha 339 Suksawat Soi 30 Telephone: 468 1471	Mechanical press
7.	Chong Thai Rung Ruang Ltd 128/71 Mu 5 Soi Tamchareon T Bangduan A Muang C Samutprakarn	Hydraulic shearing machine
8.	Pol Electric 538 Suksawat 29 Telephone: 462 7293	Mechanical press
9.	Vichien Sanp 658 Wongsawang Road Telephone: 585 2772; 585 0897	Hydraulic press
10.	Sekkee Works 213 Mu 4 Suksawat Road Telephone: 468 1283; 468 1579	Lathe machine, shaping machine

	Name and address	Main product
11.	Piemchao Industry 1213/4-5 Tarskin Road Telephone: 468 5425	Hydraulic press
12.	Ching Chai Foundry 116-118 Sukkhumvit Soi 39 Telephone: 391 0449	Mechanical press
13.	Thavorn Foundry 108-114 Sukkhumvit Soi 39 Telephone: 391 0545; 392 8717	Mechanical press

The following are some of the leading importers/distributors of machine tools in Thailand:

		1981 turnover (in 1,000 $US)
A.	Companies	
1.	Wongawit Co., Ltd.	1,014
2.	Min Sen Machinery Co., Ltd.	22,610
3.	United Machinery Co., Ltd.	9,013 (1979)
4.	Siam Machine Tool Co., Ltd.	n.a.
5.	Richermann (Thailand) Co., Ltd.	482
6.	Lindeteves (Thailand) Co., Ltd.	3,062
7.	Louis T. Leonowens Co., Ltd.	40,139 (1979)
8.	F.E. Zuelling Co., Ltd	34,255
9.	Pan Supplies Co., Ltd.	817
10.	Borneo Engineering Co., Ltd.	17,707
B.	Limited partnerships	
1.	Bangkok Machinery LP	n.a.
2.	Burapha Machinery LP	n.a.

It should be noted that most of the companies, especially the multinationals, carry also some other product lines and not only machine tools.

2. Profile of two Thai machine tool manufacturers

Sekkee Works Ltd, Part and Pongpaisan Ltd. Part have been involved in machine tool manufacturing for nearly two decades. Although these companies employ old technology and traditional management, they adapt to local needs at low prices. They utilize the good subcontractor's service especially for casting and heat treatment. The profile described below for the two Thai manufacturers provides a general feel on this sector regarding technology level. Table A.1 presents the outline of the two machine tool manufacturers.

Sekkee Works Ltd., Part.

Sekkee Works Ltd., Part. was founded in 1958. They are manufacturers of lathes and shapers and also provide repairing and machining services for the needs of local industry.

The total number of employees were 50, of which 35 were directly productive, 7 indirectly productive and 3 others performing administrative functions.

The average service of workers is 5 years for direct productive skilled workers and 2-3 years for others. The workers were trained on a job rotation basis.

The building of a workshop located in Bangkok occupies an area of 1,600 m^2 of the total area of 2,000 m^2. Although the space is limited, they have good sub-contractors, 3 in castings, 2 for heat treatment and 2 in plating.

The production amount per annum of lathes are 30-40 units and less than 10 units of shaper per year which is worth 2.5 million.

- Hardened lathe bed
- Low price, low quality
- Old and simple design structure
- Weak sales network
- Imports of key precision parts.

Pongpaisan Ltd., Part.

Pongapaisan Ltd., Part, was founded in 1960. It is a manufacturer of shapers and construction machinery parts on a job-order basis.

The total number of employees are 26, of which 10 are directly productive skilled workers with 12 years working experience for shapers.

The present production amount of shapers is approximately 10 units a.n., and the share to the total sales is only 10 per cent.

However, at the peak of production in 1977, they produced approximately 150 units.

Table A.2 shows the specifications of Ponpaisan's shapers, Model PS-24 and PS-32.

Table A.1. The outline of machine tool manufacturers in Thailand, January 1983

Details	Sekkee Works Ltd., Part.	Pongpaisan Ltd., Part.
Registered capital	1,000,000 ฿	200,000 ฿
Established/legal status	1958 Limited Partnership	1960 Limited Partnership
Location	Bangkok, Thailand	Bangkok, Thailand
Type of production		
Lathes	Model SK165: 70,000 ฿ Model SK265: 80,000 ฿	
Drilling machines	-	-
Shapers	Model S226: 85,000 ฿	Model PS24: 62,000 ฿ Model AS32: 85,000 ฿
Sales (total)/year	2,500,000 ฿	8,000,000 ฿
Sales/man	50,000 ฿	300,000 ฿
Sales for machine tools	Lathe Shaper	
Quantities	30-40 10	10-12 (peak production
Sales amount	2,500,000 ฿	800,000 ฿ 150 units, 1977)
Customers percentage of direct sales	100 per cent	99 per cent
Number of subcontractors	(casting: 3) 8 (heat treatment: 3) (plating:2)	4 (casting: 3) (plating: 1)
Employees		
Total	50	26
Skilled	22	21
Un/semi-skilled	28	5
Factory		
Estate(m^2)	2,000	800
Building (m^2)	1,600	700
Production facilities		
Lathes machines	9	14
Drilling machines	7	6
Boring machines	3	1
Milling machines	5	3
Planing machines	3	3
Grinding machines	3	2
Gear cutting, hobbing finishing machine	9	1
Gear shaping machine	1	-
Shaping machine	7	-

Table A.1. The outline of machine tool manufacturers in Thailand, January 1983 (cont'd)

Details	Sumber Bahagia	PT PIMSF Pulogadung
Production facilities (cont'd)		
Key cutting machine	2	-
Slotting machine	3	-
Honing machine	1	-
Metal sawing machine	1	2
Comments	- 6 high school graduates - On the job training for workers by rotation of sections - Weak sales net work - Well arranged factory	- Stopped to produce drilling machine since 1979 - Major products, dam machines and other jobs - Skilled workers (90 per cent) for machine tools

Table A.2. Specification of Pongpaisan's shaping machine, Model PS24, PS32

Model	PS. 32			PS.24	
Max. stroke of ram	32"	812.80	24"	609.60 mm	
Max. planing width	25"	635.00 mm	20"	508.00 mm	
Range of ram in column	40"	1016.00 mm	28"	711.20 mm	
Width of ram	11"	279.40 mm	10"	254.00 mm	
Cross slide Width of cross slide	15"	281.00 mm	14"	355.60 mm	
Cross slide Length of cross slide	42"	1066.80 mm	30"	762.00 mm	
Size of tool holder	3/4" x 1-3/8"		3/4" x 1-3/8"		
Range of tool slide	8"	203.20 mm	6"	152.40 mm	
Dimension of swivel vise	14" x 25" x 9"	355.60 x 635.00 x 228.60 mm	10" x 23" x 7"	254.00 x 584.20 x 177.80 mm	
Max. opening of swivel vise	15"	381.00 mm	15"	381.00 mm	
Dimension of table	15" x 26" x 17"	381.00 x 660.40 x 431.00 mm	13" x 23" x 14"	330.00 x 584.20 x 355.60 mm	
T-slot Dimension of T-slot	5/8" x 1-3/16" x 1/8	15.87 x 30.16 x 3.17mm	5/8" x 1-3/16" x 1/8"	15.87 x 30.16 x 3.17 mm	
Vertical travel of table	14"	355.60 mm	14"	355.60 mm	
Max. distance table to ram	18"	475.20 mm	15"	381.00 mm	
Range of stroke per min.	10-60 DS/min			14-60 DS/min	
Range of table feed	0.1 - 1.0		0.1 - 1.0		
Motor	5 HP. 3 Phase 220 V.50 Cycle		3 HP. 3 Phase. 220 V. 50 Cycle		
Weight approx.	2700 kg.		1400 kg.		
Base area	28" x 73"	711.20 x 1854.20 mm	21" x 54"	553.40 x 1371.60 mm	

SOMMAIRE

Cette étude de l'industrie des machines-outils dans l'ASEAN région donne une évaluation générale du secteur avec l'intention de déterminer quelques stratégies possibles pour son dévéloppement. L'étude donne une analyse détaillée de l'industrie des machines-outils des pays suivants: l'Indonésie, la Malaysie, les Philippines, Singapour et Thailand.

Les résultats de l'étude démonstrent que la plupart des établissements pour la production des machines-outils existants dans les pays de l'ASEAN sont relativement petits. La plupart d'entre eux produit des machines-outils simples et ce production est, en générale, intermittante et très diversifiée. Ce situation donne lieu à une productivitée basse, mauvaise utilisation de la capacité installée, faible qualité des produits et des délais de livraison trop longs.

Les conclusions et les recommendations qui découlent de ces analyses sont présentées dans le volume I de ce document de travail sectoriel.

EXTRACTO

Este estudio sobre la industria de máquinas herramientas en la región ASEAN tiene como finalidad presentar una evaluación global del sector a fin de definir algunas posibles estrategias para su desarrollo. El estudio presenta un análisis detallado de la industria de máquinas herramientas de los siguientes países: Indonesia, Malasia, Filipinas, Singapur y Tailandia.

Los resultados arrojados por la investigación indican que gran parte de las empresas productoras de máquinas herramientas de la región ASEAN son relativamente pequeñas. La mayoría de estas empresas manufacturan máquinas herramientas simples, cuya producción no se hace sobre una base continua sino generalmente intermitente y con una alta diversificación de las líneas producción. El resultado inmediato indica que las empresas se caracterizan por su baja productividad, baja utilización de la capacidad instalada, baja cualidad y demoras en el despacho de pedidos.

En el volumen I de los documentos de trabajo sectoriales se presentan las conclusiones y recomendaciones derivadas del análisis por países.

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The machine tool industry in the ASEAN region: options and strategies. Analysis by country

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