Q50-1 Have you ever got claims of industrial pollution? (S) and What kinds of claims are they? (M)

1. Yes
2. No

Kind of industrial pollution (M)

1. Noise pollution
2. Vibration pollution
3. Air pollution (bad small)
4. Air pollution (smoke)
5. Water pollution
6. Others (specify)

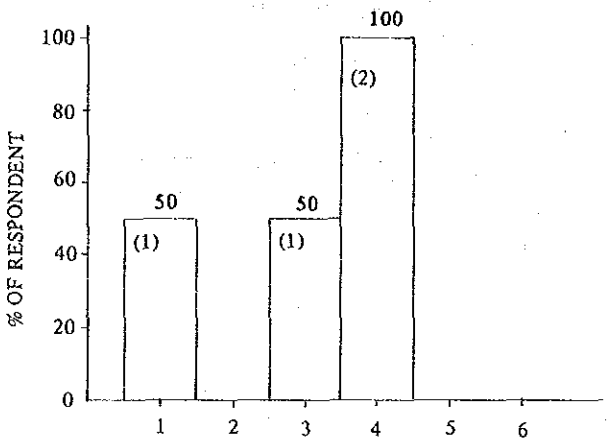


Fig. 4.4.2-48 Various kinds of environmental pollutions

(10) Suggestions to Pump/Valve Product Promotion Policy

1) The actual condition of pump/valve manufacture (mainly on the manufacture of product) is as mentioned above. On the other hand, as problems against the subcontracting seen from the parent enterprise, with regard to the quality, delivery time and cost the following are turned to problem in the PART 1. For Subcontractors Themselves Q1032,

① As to the quality 64 enterprises take it as problem.

② As to the delivery time, also 28 enterprises take it as problem.

③ As to the cost 27 enterprises take it as problem.

Seeing from industrial sectors,

a. 62.5% on quality of casting product

b. 57.1% on delivery time of casting product

c. 48.1% on price of casting product

All of them occupy the first place.

2) Inspection (Q46-1)

Concerning the inspection of casting products, ① the inspection system, ② inspectors, ③ inspection items and ④ feedback of inspection result, etc. are shown in Fig. 4.4.2-43.

As for ① that to perform samples is 50%, and the total inspection is 30%.

As for ② the inspection by the worker himself is 70%, and the inspection by the manager or owner is 50%.

As for the check methods and items in connection with ③ , they are the dimensional check and the visual observation check.

As feed back method for ④ the inspection record or notes shall be circulated to the worker or manager. With regard to the inspection method it is necessary to advance in the tackling with the product.

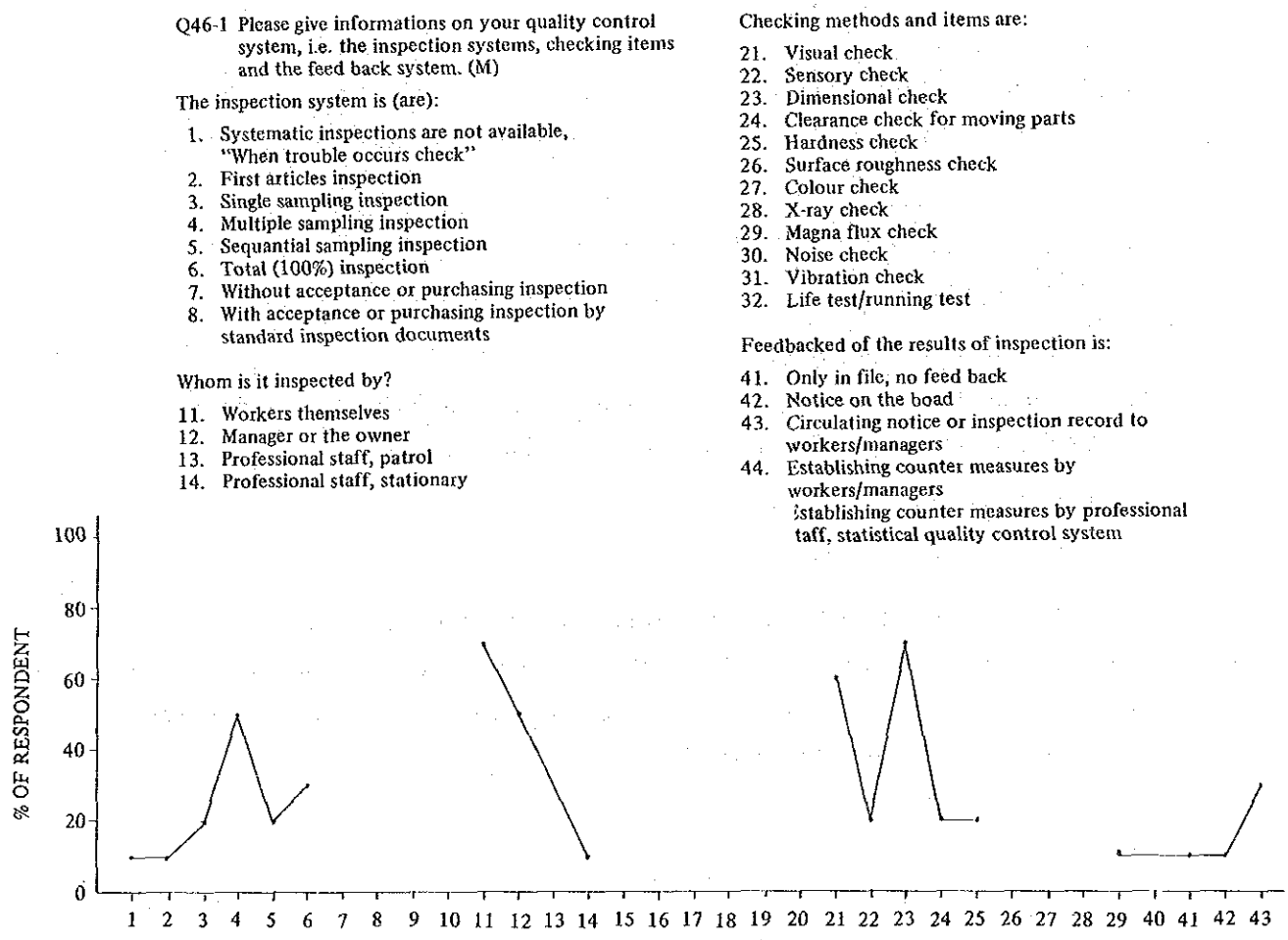


Fig. 4.4.2-43 Inspection System (Q46-1)

Considering that materials constituting pumps/valves are mainly casting products, by tackling the quality, delivery time and cost of casting products manufactured under subcontracting it can to supply stabilized materials to the parent enterprise, can enhance also the relation with the subcontracting, as well to connect with the fostering of subcontracting enterprises.

2) Production Techniques

① Fundamental technique including casting design on molding in the manufacture of casting products

② Fundamental technique on foundry sand

③ Fundamental technique in the melting work

④ Fundamental technique on inspection work

3) Control Techniques

① Level up on quality control

② Recognition and level up on production control (delivery time)

4) Education Trainings

① Training in the enterprise (Training adequate to the enterprise)

② Training in the training institute (Basic, middle and superior class trainings)

5) Modernization of Installation Machines

① Preferential treatments to promote the modernization of installation machines

② Preferential treatments for environmental pollution measures

6) Drive to the Standardization

To drive the standardization on raw materials, products, etc.

7) Diffusion and Official Approval of Testing and Inspection Machines

In the production activity various kinds of tests and inspections are necessary, and as to machines the official approval becomes necessary, too. With regard to these realizations perform them by the training institutes.

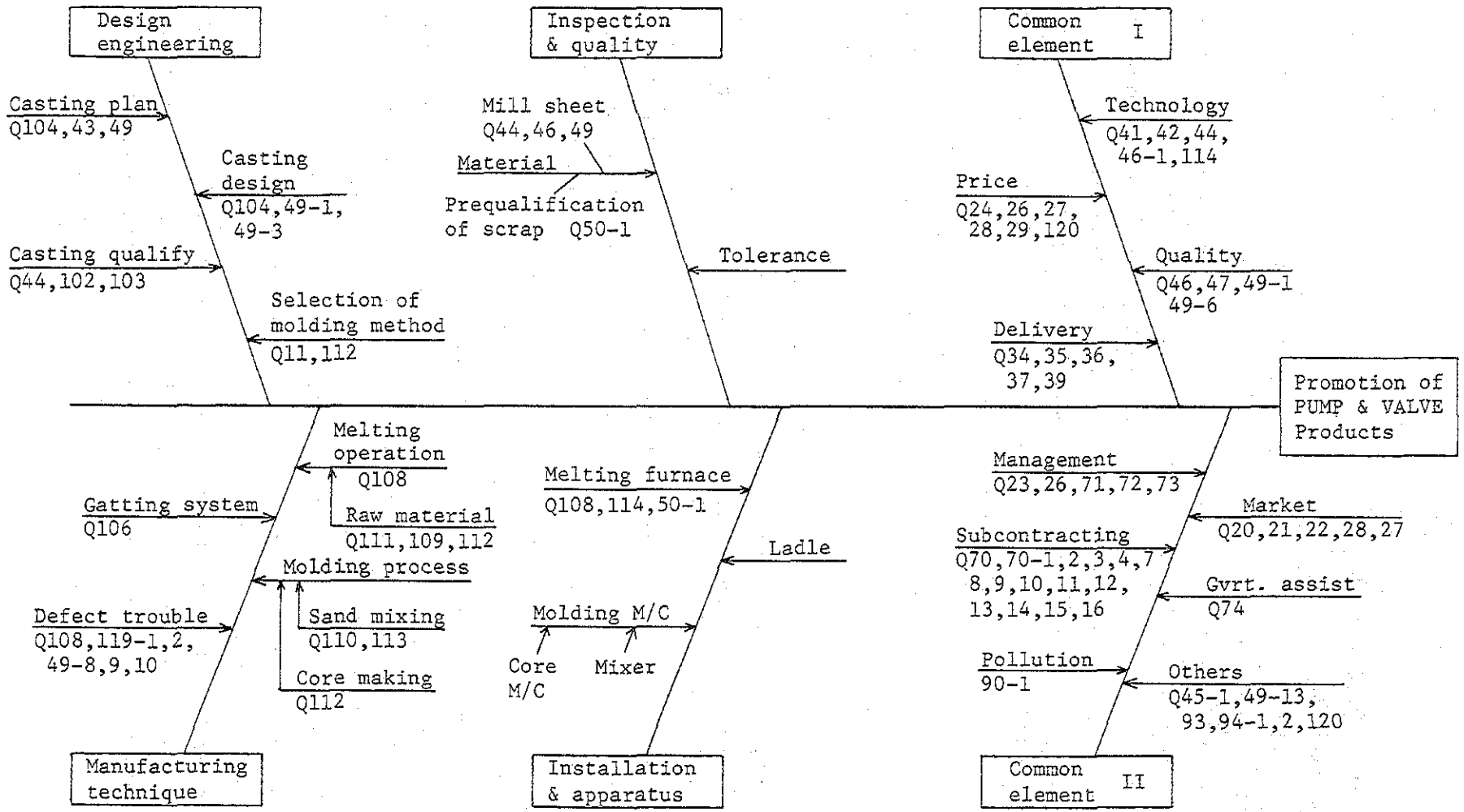


Fig. 4.4.2-49 Characteristic Factor Diagram for Promotion of Pump/Valve Products

4.4.3 Precise Machined Components

(1) Introduction

It is difficult to define "Precise Machined Component" exactly, since it covers a very broad spectrum of things.

Therefore, with a limited research period, mould and gear were selected as the subject for this research project. The reason behind the selection is explained hereafter.

The demand for tool and die has been rapidly expanding year after year along with the progress of industrialization in the country. In particular, the demands for automobile and plastic industries has been remarkable. Furthermore, it could be said that the demand would rapidly increase in the near future in the field of industries such as electrical machinery and appliance, household articles, stationaries and toys.

However, it is the present status that tools and dies produced domestically are lacking in quality, accuracy, quantity and size. Large, precise and complicated tools and dies are mostly imported from abroad.

On the other hand, it could be estimated that the demand for gears is not so great at present in terms of quality and quantity to that of tools and dies.

However, in line with the progress of the localization of automobile and machine tool industries and with the improvement of agricultural machineries, the demand for comparatively small size gears would gradually be expanded.

Comparative large and precise gears would also be needed in the near future, when the time comes to repair and replace machineries such as chemical plants, cement plants and transportation and loading/unloading system which are mostly imported at present.

Therefore, it could be considered reasonable to choose tool/die and gear as the subject for the study coping with the given situation.

Concerning the tool and die industry in Thailand, a comprehensive study was undertaken in 1983 by the Industrial Service Institute under the Department of Industrial Promotion (ISI/DIP). The study was carried out in cooperation with the co-research project titled 'Research on Technology Sharing and Transfer among Asean Countries' by JICA and TECHNONET ASIA, focusing on the comparative study of technology level of the small and medium scale industry in the participating three countries, Indonesia the Philippines and Thailand.

In Thailand, some 60 firms of tool and die industry were intensively surveyed. Two reports on this research have been issued. One is by ISI/DIP and the other is by TECHNONET ASIA, though it is still a draft report. Therefore, in our project we did not conduct a

field survey using questionnaires.

The finding of the present situation of Thai tool and die industry was quoted from those two reports and emphasis will be placed on the analysis of issues and resolutions thereof in this report.

On the other hand, any specific study focusing on the gear industry in Thailand was not carried out in the past. Against our expectation, only one firm was surveyed by the questionnaire in this survey.

Given the circumstances, some aspects of gear manufacturers will be presented, which were observed at some shops of agricultural machinery, machine tools and repair.

(2) Aspects of Tool and Die Industry

As aforementioned, the present status of Thai tool and die industry will be mostly quoted from the two following reports.

1) Report on Mold Industry in Thailand issued in 1983 by the Industrial Service Institute, Department of Industrial Promotion, Ministry of Industry, Thailand (hereinafter refered to as the 'ISI/DIP Report')

2) Draft Report on Research for Technology Sharing and Transfer among Asean Countries.
Book Three: Tool and Die Industry, 1984 by Rangsam Prisamavanich, Senior Program Officer Technonet Asia (hereinafter refered to as the 'SOT Report')

The raw data of these two reports are almost the same. While the ISI/DIP Report deals with the tool and die industry only in Thailand, the SOT Report deals with the comparative study among three countries focusing on technology sharing and transfer.

The survey in Thailand was undertaken by the ISI officials, who contacted tool and die producers directly using a questionnaire. At the beginning of the survey, the working group collected names and addresses of mold manufacturers registered with the Industrial Department, Ministry of Industry and through other sources including interviews of other manufacturers. The list of all the factories collected covered 129 factories in Bangkok and the nearby Changwad areas, however, only 60 from among 129 factories could be contacted in the period of June to July 1983.

The reasons that almost half of the listed firms could not be contacted are as follows:

① some factories ceased to operate or changed their business,
② some factories moved to other places and could not be found,
③ some factories did not produce tools and dies, and

4 some factories did not co-operate to the survey.

(2-1) General Aspects

A. Age of firms surveyed (refer to Table 4.4.3-1)

From among 60 factories surveyed, some 63% or 38 firms are less than 10 years from date established, and 40% are less than 5 years. There are certain reasons to support this fact. First, the plastic industry has rapidly expanded in this period. As an example, in 1969 there were only 36 plastic product factories and some 10 plastic mold factories. However, in 1977, some 800 plastic product factories were existent. Second, the metal mold industry was also in the same position. During that period, the government set up regulations to import less vehicles and spare parts and to use more locally produced spare parts and components. Coping with this policy, the Board of Investment (BOI) also promoted investment for this industry. So a great number of metal mold factories were established in this period.

B. Type of molds produced

In Thailand, there are two characteristics of mold producers, i.e.

One is in house mold producers who own the metal product or plastic product factory thus make molds mostly for their own use.

Another is commercial mold producers who do not have any metal and plastic production shops but simply make molds for their customers. They also accept job orders for machining other products as well as tool and die.

On the other hand, it is estimated that there are some 800 metalwork service industries operating small shops in Bangkok and its surrounding areas. They take job orders for various metalworks, out of which 80–120 shops accept mold making job orders.

Some 63% or 38 firms of 60 firms surveyed produce metal molds for sheetmetal works. Most of them produce simple blanking/forming dies, 37% produce compound dies and 27% produce progressive dies. However, no factory produces transfer dies which need complicate and highly advanced technology. Refer to Table 4.4.3-2.

Twenty seven firms out of the firms surveyed produce plastic molds, and all of them produce injection molds. Ten firms produce blow molds and six firms, compressive molds. From among 27 firms, 16 firms use unhardened steel for their molds. Refer to Table 4.4.3-3.

These molds are used in the various fields of industry in Thailand as shown in Table

4.4.3-4 and 5. Molds for vehicle components are considerably large, 53.3%, and molds for electrical equipment and household articles are also comparatively large.

C. Category of business operations

Almost half of the firms surveyed are single propriatorships and the rest are limited partnership/company and foreign invested firms, 45% and 10% respectively.

D. No. of employees and its change

Number of the employees in the 60 firms surveyed is shown in Table 4.4.3-6. The survey indicates that 30% of the firms are family-scale with only one to four employees, and 43% are small scale with 5 to 10 employees. Table 4.4.3-7 shows the comparison of the number of employees of the establishment, before 3 years and at present. When the factories were established, most of them, 65% started their business with 1–4 persons, and the number of employees does not differ remakably in comparison with the present and that of 3 years ago. This would be due to the fact that the economic situation of the world was depressed by various crisis during 1979–1982, and interest rates were high. This hindered the growth of the whole industry as well as the mold industry.

E. Workers' situation and labour wage

Approximately 83% or 49 firms of the surveyed firms work one shift with over time. Average wage of employees is between 3000–4000 Baht a month in 38% of the factories surveyed, and between 2000–3000 Baht in 33% of the firms. Concerning the educational level on the average, mold making workmen are educated in primary schools for 52% of the firms, and in junior high schools for 40% of the firms.

The average working period of mold making workers is less than 2 years in 42% or 25 firms of the total firms surveyed.

Judging from the above mentioned workers' situations, it could be assumed that the technology level of mold making workers is too low to enable them to understand technical drawings. Therefore, in most of the firms, job instructions are given to workers verbally with simple schetches or samples. It would be difficult to correctly transfer details of technical drawings through simple schetches and samples, in the case of complicated and precise products like tools and dies. This might be one of the reasons why most of the factories have to work one shift overtime, because it is difficult to continue or take over jobs from other workers.

F. Marketting

A mold is a different product from such industrial products as vehicles, electrical appliances, household articles and office supplies. It is not produced for sale in the general market, but limited to customers such as plastic product, rubber product and pressworking industries. Therefore, most of the molds are produced due to job orders except for standard components.

Eighteen firms or 30% of the 60 firms surveyed produce molds for their own use, and need not go into the market. However, some 40 firms have to find their way in the competitive market. The methods of finding customers are shown in Table 4.4.3-8. In most cases, it is likely that customers contact mold factories directly or new customers are introduced through old customers.

On the other hand, some firms export part of their products to ASEAN countries, particularly 3 firms of them export more than 50% of their products.

G. Import of molds

Almost all large, complicated and precise molds are imported. Although these imported molds are considerably expensive, the import amounts have been increasing every year. For example, according to the statistics of the Custom Department and the Department of Economic Trade, molds for non-metal products were imported to a total of 63.7 million Baht and it increased rapidly to a total of 173 million Baht in 1980. Molds for metal products were imported to a total of 3.4 million Baht in 1977, and increased to 12.8 million Baht in 1982. Refer to Table 4.4.3-9 and -10.

As aforementioned, in the case of tool and die industry, most of the products are produced in accordance with job orders and special specifications are sometimes demanded by owners who consider them as trade secrets. Due to such characteristics, it takes much cost and time to contact foreign mold manufacturers. For this reason, some customers are inclined to own expensive equipment and to make molds for inhouse use.

It could be assumed that many customers would be anxious for highly sophisticated and reliable subcontractors.

Table 4.4.3-1 Age of Firms

Catagory	Frequency	Percentage
1. Unknown	0	0
2. More than 20 years	4	6.7
3. Between 16-20 years	6	10.0
4. Between 11-15 years	12	20.0
5. Between 6-10 years	14	23.3
6. Between 2-5 years	24	40.0
7. Less than 2 years	0	0
TOTAL	60	100.0

Table 4.4.3-2 Types of Metal Sheet Molds

Types of metal sheet mold	No. of factories	Percentage (compared to the number of all factories under survey)
1. Not producing metal sheet mold	22	36.7
2. Simple blanking/forming	35	58.3
3. Compound dies	22	36.7
4. Progressive dies	16	26.7
5. Transfer dies	-	-
6. Others	2	3.3

Table 4.4.3-3 Table of Plastic Molds

Type of mold	Number of factories	Percentage (compared with the total number of factories in the survey)
1. Do not produce plastic mold	33	55
2. Injection mold	27	45
3. Blow mold	10	16.7
4. Compressive mold	6	10

Table 4.4.3-4 Industrial Fields of Products

Type	Frequency	Percentage*
1. Vehicle parts	32	53.3
2. Machine parts	8	13.3
3. Electrical equipment parts	16	26.7
4. Electrical equipment	18	30.0
5. Dining Tableware	8	13.3
6. Kitchen equipment	7	11.7
7. Household equipment	14	23.2
8. Office equipment	6	10.0
9. Household parts	6	10.0
10. Toys	9	15.0
11. Packing materials	9	15.0
12. Footwear	4	6.7
13. Dressing & Ornaments	6	10.0
14. Stationery	4	6.7
15. Others	13	21.7

Table 4.4.3-5 Industrial Fields of Main Products

Type	Frequency	Percentage
1. Vehicle parts	23	38.3
2. Machine parts	1	1.7
3. Electrical equipment part	4	6.7
4. Electrical equipment	4	6.7
5. Dining Tableware	0	0
6. Kitchen equipment	3	5
7. Household equipment	0	0
8. Office equipment	1	1.7
9. Household parts	2	3.3
10. Toys	3	5
11. Packing material	7	11.7
12. Footwear	0	0
13. Dressing & Ornaments	4	6.7
14. Stationery	0	0
15. Others	8	13.3
TOTAL	60	100

Table 4.4.3-6 Number of Employees

Category	Frequency	Percentage
1. 1-4 workmen	18	30
2. 5-10 "	26	43.3
3. 11-20 "	8	13.3
4. 21-50 "	7	11.7
5. 51-100 "	1	1.7
TOTAL	60	100

Table 4.4.3-7 Change of No. of Employees

Category	First Established		Presently		3 years ago	
	Frequency	%	Frequency	%	Frequency	%
1. 1-4 workmen	39	65	18	30	19	31.9
2. 5-10 "	11	18.3	26	43.3	22	36.6
3. 11-20 "	6	10	8	13.3	9	15
4. 51-100 "	0	0	1	1.7	1	1.7
5. Unknown	1	1.7	0	2	2	3.3
TOTAL	60	100	60	100	60	100

Table 4.4.3-8 Methods of Finding New Customers

Methods used to find customers	No. of factories
1. No customer	18
2. Through mass communication such as newspapers, yellow pages	-
3. Through Industrial Associations	-
4. Through Government Agencies	-
5. The factories contact customers directly	11
6. Through old customers	27
7. Customers contact the factories directly	31

Table 4.4.3-9 Statistics of Imported Molds

TYPES OF MOLDS	1977		1978		1979		1980		1981		1982		1983	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume	Value
Mold for non-metal products (Plastic/rubber) (BTN 846003)	684	63,737	999	144,403	905	122,935	1,439	173,152	912	157,307	1,162	150,930	288	44,257
PVC Injection Molding Machine (BTN 845903)	352	127,502	589	175,657	601	200,111	283	91,607	236	126,367	293	126,640	87	31,816
Dies for pressing Sheet Perforating cutting Dies Tools (BTN 820521)	9	3,427	12	4,587	17	8,160	10	7,215	46	24,320	42	12,843	16	3,110
Wire Drawing Extrusion Dies (BTN 820528)	12	2,209	9	4,664	10	4,531	10	3,714	4	3,256	7	3,514	2	1,108

Table 4.4.3-10 Statistics of Imports and Exports, 1981 - March 1983

TYPES OF MOLDS	CODES	1981				1982				1983			
		IMPORT		EXPORT		IMPORT		EXPORT		IMPORT		EXPORT	
		Volume (KG)	Value 1000 ¥	Volume (KG)	Value 1000 ¥	Volume (KG)	Value 1000 ¥	Volume (KG)	Value 1000 ¥	Volume (KG)	Value 1000 ¥	Volume (KG)	Value 1000 ¥
Molds for plastic and rubber products	BTN 846003	911,628	157,307	169,640	11,883	1,162,000	150,930	86,140	25,997	288 UNITS	44,257	51,309	4,697
PVC Injecting Machine	BTN 845903	236,000	126,367	-	-	293,000	126,640	62	2,773	87 UNITS	31,816	27	344
Molds for metal products	BTN 820521	46,000	24,320	-	-	42,000	12,843	-	-	16,000	3,110	-	-
Molds for injecting metal wire	BTN 820528	4,000	3,256	-	-	7,000	3,514	-	-	2,000	1,108	140	51

(2-2) Technology and Facility

A. Choice of raw materials

As a result of the survey, most of the mold producers are well acquainted with raw materials for molds, however, in reality they can not necessarily choose the best materials because these are expensive and sometimes are not available.

When they choose materials, the following conditions are taken into account;

1) machinability of materials depending on machine tools used in the factories,
2) strength and hardness of materials,
3) hardenability, if required heat treatment
4) durability against wear and tear, etc.

However, some small manufacturers and some customers lack the knowledge to choose materials.

Table 4.4.3-11 shows how the firms surveyed choose raw materials for molds. 65% of them choose according to previous experiences, 30% do as stipulated by customers. In some 29% of them, engineers or designers of the factories choose materials.

High carbon steel and alloy steel are popularly used in 80% of the firms, carbon steel are used in 72%, and carbon tool steel in 48%. Some mold producers use stainless steel and non-ferrous metal.

All raw materials are imported mainly from Sweden, Japan and West Germany.

Most of the firms purchase materials on a one-month credit term from seven local representatives. Before the survey, material portion of total production cost had been assumed to be remarkably high, however, as a result of the survey it has been proven that it is lower than expected, between 11% to 30% in average. Refer to Table 4.4.3-13.

B. Design and drawings.

Table 4.4.3-14 shows who designs molds in the firm. In about half of the firms surveyed, molds are designed by firm's owners themselves, and in 47% they are designed by engineers or controllers of the firms. In 37 firms, they have no full-time draftsmen. Refer to Table 4.4.3-15.

C. Machinery and its accessories

As a result of the survey, it proven that all the firms surveyed have ordinary machine tools such as cutting machine, lathe, shaper and drilling machine. Seven to nine firms own electric discharge machines, EDM, and 21 firms who do not own EDM, use

outside service for EDM work.

Only one firm owns a jig boring machine, using it to produce molds for plastic and metalwork products.

Regarding the number of machines equipped within the surveyed firms, 24 firms or 40% of them have seven to ten machines, 18 firms or 30% four to six and 28 firms or 28% more than ten. Refer to Table 4.4.3-16.

About half of the firms surveyed use second-hand machines. Most of the machines are made in Korea and Taiwan. However, some quality machines that comes from Japan, West Europe and the USA are also used for precise machining.

The average ages of these machines are between 2 to 5 years for 45% of the firms, 6 to 10 years for 38% and more than 10 years for 13%. The age of the machines is correlated to the age of the firms which were previously mentioned. Refer to Table 4.4.3-17.

It is interesting to note that comparatively high quality machines such as plane grinder, EDH and wire-cut EDM are owned by small scale manufacturers with 5 to 10 workers who started the business within ten years. These machines are also used to service outside job orders. As for lathes, most of the firms surveyed use ordinary lathes made in Taiwan. Korea and China. Only 8 firms use locally produced lathes.

On the other hand, some 40% or 24 firms of the 60 use locally made shapers.

Vertical and horizontal type milling machines are popularly used by 45% of the firms, and also universal and turret milling machines are used by 35% of the firms. However, copy milling machines are owned by only 8 firms while NC and CNC machines are not available in any of the firms.

Cylindrical grinders are utilized only in some firms. EDM and Wire Cut EDM are utilized by 50% and 15% of the total firms, respectively including outside services. Although entrepreneurs are widely acknowledged with the virtues of these quality machines, they can hardly purchase or utilize these machines because of high prices and high outside service fees. This could be proven by answers given to questions on future plan. Refer to Table 4.4.3-18. About 45% or 27 firms of the surveyed firms have plans to purchase EDM or Wire-cut EDM for the future. The desire is much stronger than that for other machines such as lathe, milling machine and surface grinder.

nologies such as knowledge, experienced know-how and skill of workers are still lacking within the present situations in Thailand.

D. Accuracy and measuring instrument.

Generally in the field of mold industry, accuracy, complicacy and precision of molds are more appreciated than quantative production capacity. The more complicated, precise and accurate products are, the more highly commercial values are appreciated.

As a result of the survey, the highest accuracy of the products is lower than 0.02 mm in almost half of the firms. It does not mean that the products are very precise. Therefore in most of the firms, verniers and calipers are popularly used for measuring their products. Micromdeters and dial gauges are also used in 62% of the firms and inside-micrometers and depth gauges are used in 38% of the firms. Vernier calipers are sufficient for measuring the accuracy of 0.02 mm or less if micrometers and/or dial gauges are applied on important parts of the products.

However, it is an important point that these measuring tools are used correctly. These precision measuring instruments should be periodically calibrated by reference tools or precise gauge blocks, and should be carefully controlled when in use or when storing them.

Table 4.4.3-11 Methods of Choosing Raw Materials

How to choose the materials?	No. of factories	%
1. As stipulated by customers	18	30
2. Advised by seller or factory	9	15
3. According to the catalogues of the companies selling steel or other books.	16	26.7
4. Choice made according to previous experience	39	65
5. As stipulated by the engineer or the mold designer of the factory	17	28.5
6. From advice received from various educational institutes	2	3.3

Table 4.4.3-12 Types of Raw Materials

Type of metals for molds	No. of factories	% (In comparison with all factories surveyed)
1. Scrap Iron	-	-
2. Ordinary Steel	43	71.7
3. High carbonated steel or steel alloy	48	80.0
4. Steel for tools	24	48.3
5. Stainless steel or rust-less steel	9	15
6. Metal mixed with aluminium copper or zinc	4	6.7

Table 4.4.3-13 Rate of Material Cost

Type	No. of Factories
1. No sale of molds	21
2. Less than 11%	3
3. 11 - 30%	26
4. 31 - 50%	9
5. More than 50%	1

Table 4.4.3-14 Designers In-Charge

Designers of molds	No. of factories	%(In comparison to all factories surveyed)
1. Owner	28	46.7
2. Designer of molds	21	35
3. Controller	7	11.7
4. Maker of molds	9	15
5. Clients' designs	10	26.7

Table 4.4.3-15 Number of Full-Time Draftsmen

Number of full time draftsmen	No. of factories	%
None (0)	37	61.7
1 - 2 draftsmen	16	26.7
3 - 5 draftsmen	5	8.3
More than 6 draftsmen	2	3.3

Table 4.4.3-16 Number of Machines

No. of machines (by machine)	No. of factories	%	No. of 2nd hand M-C		No. of machines made from developed countries	
			No. of M-C	%	No. of factories	%
0 - 3	1	1.7	47	78.3	39	65
4 - 6	18	30	6	10	8	13.3
7 - 10	24	40	3	5	6	10
More than 11 and over	17	28.3	4	6	7	11.7

Table 4.4.3-17 Age of Production Machines

Age of the machine	No. of factory	%
1. Unknown	1	1.7
2. More than 20 years	1	1.7
3. 16 - 20 years	2	3.3
4. 11 - 15 years	5	8.3
5. 6 - 10 years	23	38.3
6. 2 - 5 years	27	45
7. More than 2 years	1	1.7

Table 4.4.3-18 Future Plan of Investment

Type of machine	No. of machines installed	%
1. Lathe/Shaper/Drill	11	18.3
2. Copy lathe/copy shaper	1	1.7
3. Milling M/C	7	11.7
4. Copy milling M/C	8	13.3
5. Surface grinder/ Cylindrical grinder	3	5
6. EDM/Wire cut EDM	27	45
7. Others	2	3.3
8. No plan	28	46.7

Table 4.4.3-19 Highest Accuracy of Mold Produced

Accuracy	No. of factories	%
1. By estimating with the eye	3	5
2. 0.1mm or more	14	23.3
3. 0.02 - 0.05 mm	14	23.3
4. 0.01 mm	20	33.3
5. Less than 0.01 mm	7	11.7
6. Unable to answer	2	3.3

Table 4.4.3-20 Measuring Instruments Used

Type of Instrument	No. of factories	% (in comparison with all factories surveyed)
1. Ruler	33	55
2. Vernier Caliper	59	98.3
3. Outside micrometer or Dial Gauge	37	61.7
4. Inside micrometer or Depth micrometer	23	38.3
5. Gauge block	9	15
6. Digital Readouts	6	10
7. Others	5	8.3

E. Skill of workmen.

Although it is very difficult to quantatively evaluate the technology level of workmen merely through the results of the questionnaire, the technology level of workers was studied indirectly in this survey, by means of educational level and working period in factory.

As aforementioned in Article 2-1, E, the average working period is between 2 to 5 years and the average educational level is mostly primary school-educated or junior high school-educated at most.

Judging from such a fact, it would be pressumed that the workmen's technology level is still low. Because, it is generally said in Japan that it takes ten years at least to develop new-comers to skilled mold workmen, even graduates from technical high schools or vocational training schools.

F. Technology level evaluation on Thai mold industry.

It would be very difficult to define the development level of the industry, however it may be possible if some assumptions are to be accepted. The categorization of the technology levels in the developing process of the tool and die industry is stated in the aforementioned 'SOT Report' by the author, Rangsam Presanavanich senior program officer of Technonet Asia.

In the Report, he trys to classify the technology level into five stages from the five points of view; 'Type of machinery used', 'Quality and source of machinery', 'Measuring tool and Acurracy control', 'Education and Training' and 'Engineering and design'. Refer to Table 4.4.3-21.

In accordance with this classification, the technology level of the mold producers surveyed are evaluated as follows:

1) 'Type of machinery used'

Level 1: 13%
Level 2: 50%
Level 3: 30%
Level 4: 7%
Level 5: 0%

2) 'Quality and source of machinery'

Level 1 to 2: 60 to 70%
Level 3 : 20 to 30%
Level 4 : 10%

Level 5 : 0%

3) 'Measuring tool and accuracy control'

Level 1 to 2: 40 to 80%

Level 3 : 10 to 20%

Level 4 : less than 10%

Level 5 : 0%

4) 'Education and training'

Level 1 to 2: 80%

Level 3 : 20%

Level 4, 5 : 0%

5) 'Engineering and design'

Level 1 to 2: 70 to 80%

Level 3 : 20%

Level 4 : less than 5%

As for 'Type of machinery', most of the firms are classified in Level 2 to 3, however, in the other points they are mostly in Level 1 to 2.

G. Output and sales.

About 35% of the firms produce annually less than 20 sets of tool and dies, 23% produce 20 to 50 sets and 12% produce 51 to 100 sets.

As for annual sales, the top group firms sell their products by about 200,000 Baht to 300,000 Baht per year, and the second level between 0.5 million to one million Baht per year.

Table 4.4.3-21 Classificaiton of Technology Levels by Type of Technological Areas

Technology Level	Type of Machinery	Quality of Machinery and Source	Measuring Tools and Accuracy Control	Training and Quality of Tool Makers	Level of Design Engineering and Selection of Materials
1	Lathe, Shaper and Drilling Machine	- Local made - General Purpose Machine - Old Second hand Machine	- Steel Ruler, Caliper, Divider - Less Steel divider extensively for precision machining - Drawing is not used - Tolerance ± 0.05 and above	-Education - Primary School or less -Training - By experience -Without ability to read drawing	- Based on experience on make tools without drawing - Simple moulds and dies - Use steel scrap or carbon steel as materials
2	Above + Milling Machine	- Imported Machine from developing countries like Taiwan, China, Korea, Eastern European countries, India, etc. - General purpose machine	- Above + Micrometer - Use veier caliper and micrometer for precision machining - Drawing is used from time to time - Tolerance ± 0.02	-Education - Secondary or High School -Training - By experience with ability to read technical drawing	- Based on experience and rough sketch drawing is used fairly often for work instruction - Alloy steels are used for certain components - Simple moulds & dies with dimensions & tolerance control
3	Above + Surface and/or Cylindrical Grinder and/or Tool & Cutter Grinder +/or Copy Milling +/or basic EDM Machine	Above + some tool room machines	+ Tolerance ± 0.01 for certain components	-Foreman and above have technical training while most tool makers are trained by experience -Technical drawings are used extensively -Tool makers are sent outside for training	- Ability to design simple progressive dies or fairly complicated plastic moulds - Use of standard components for certain parts - Choice of steel and its heat treatment for each part are selected based on its function
4	Above EDM wire cut and/or NC milling and/or Jig boring/ grinding and/or optical profile grinder	- Machine from Developed countries - Mostly tool room machine are used - One or two NC machine	- Above + gauge block + master height gauge + optical profile projector + other precision measuring devices - Can maintain a tolerance of + 0.01 or less for most parts and most parts are interchangeable	-Tool makers graduated from the Polytechnic or technical institution -Systematic training program for the tool makers	- Ability to design sophisticated progressive dies and complicated plastic mould - Standard is used extensively in designing
5	Mostly NC machines with tape input from CAD	- Mostly NC machine from developed countries	- Above + coordinating machine + metrology lab - Computer aided testing (CAT)		CAD

(2-3) Issues and Problems

Most of the firms surveyed face various issues and problems which are classified and enumerated as follows:

Issues on Marketing	Frequency	Percentage
1) keen competition	16	26.7%
2) shortage of current funds	16	26.7
3) difficulty in forecast of order quantity	11	18.3
4) inability of keeping-up with delivery time	9	15.0
5) search for new customers	7	11.7
Technical Issues		
1) lack of funds for new facilities	27	45.0
2) inaccuracy of machines used	16	26.7
3) shortage of machines' capacity	15	25.0
4) lack of reliable outside service for heat treatment	10	16.7
5) difficulty in finding outside service for special works, jig boring, EDM, grinding, etc.	9	15.0
Finance and Employment		
1) difficulty in maintaining skilled workers	24	40.0
2) high interest rates	22	36.7
3) difficulty in seeking funds	20	33.3
4) high labour turnover	18	30
5) low labour productivity	16	26.7
6) lack of workers' experience and ability	15	25

The above mentioned are summarized as follows:

- o lacking or shortage of funds
- o low skill of workers
- o keen competition
- o lacking or shortage of reliable subcontractors

(3) Aspects of Gear Manufacturing Industry

In this survey, only one firm responded to the Questionnaire for Gear manufacturers, which is a foreign-affiliated firm whose factory is modernized and sophisticated. Therefore, the results of the questionnaire do not imply the general aspects or situations of the Thai gear manufacturing industry.

Consequently, the following aspects are some actual examples of gear shops which were observed through other field surveys on agricultural machinery, hand tool and machine tool industries in Thailand.

The firms visited are classified as follows:

agricultural machinery factory	2
machine tool factory	1
gear repair shop	1
construction and civil engineering machinery repair shop	1

A. Briefing.

It seems that specific study on the gear manufacturing industry in Thailand has not been undertaken in the past.

There are very few firms which specialize on gear production. It is likely that there are other local specialized gear producers aside from the above mentioned foreign-affiliated firm. Agricultural machinery and machine tool manufacturers use gear produced by themselves or supplied by outside service. For the vehicle and construction/civil engineering machine industries, gears used in their products are mostly imported through their parent companies abroad.

In the case of transportation and loading/unloading equipment, chemical and cement plants and other industrial machinery, gears or gear boxes used in their plants or equipment are also imported. In any case, the gear industry in Thailand is not yet so large. Table 4.4.3-22 shows the import aspects of gears, gear boxes and other power transmission components.

B. Facilities.

Gear cutting machines in the shops visited are old-fashioned and difficult to determine when they were produced. All of them are hobbing machines, not gear shapers. In the machine tool firm, gear grinder and gear shaving machines are used for finishing gear teeth, while gears for farm machinery are only hobbed and roughed on tooth flanks. Most of the hobbing machines are small with 200 to 300 mm work table, except for two hobbing machines in the repair shop with some 1,000 mm work tables.

Hobs, which are all imported, are ground with ordinary tool grinder. No factory owns a hob sharpener.

As for gear measuring instruments, only a tooth micrometer is used in the machine tool factory, and in other factories, vernier calipers are used for measuring tooth thickness. Tooth pitch-meters and profile checking machines are not used in any factories.

C. Raw material and heat treatment.

For machine tools, through-hardened (quenched and tempered) and surface-hardened gears are used. Raw materials are mostly Cr-Mo steel. For farm machinery Cr-Mo steel is also used for gears and shafts, but not hardened. These alloy steels are mostly imported from Japan, price thereof is considerably high, particularly heat-treatment cost is nearly three times of that in Japan. All ball and roller bearings are also imported mainly from Japan. Gears of low carbon steel and cast iron are sometimes produced although its usage was not proven.

D. Assembling and testing.

At the machine tool factory, gearboxes for machine tools are assembled on the assembling bases, and components thereof are well prepared before assembling. However, it was pointed out that problems on vibration and noise from gear boxes had been sometimes experienced.

From actual observations, vibration was probably caused by mal-alignment of shafting which was due to the inaccuracy of the boring gear housing or due to undesirable assembly of bearings. Noise was caused by mal-alignment or by edge contact with mating gears. Edges of tooth flanks should be removed off by mini-grinder.

Concerning assembling gearboxes of farm machinery, there exist important problems in both factories visited. First, before assembling gearboxes, mechanical components are not cleaned sufficiently, so rust and fine dust remain on them. These precise machinery components are left carelessly on the dusty and gloomy floors without any covers. Second, after assembling these components, gear housing covers are welded. It may cause deformation of housing by thermal stress and results in undesirable forces on the bearing and mal-contact of mating gears. Tooth contact is not checked after assembling and after one to five minute engine test. Oil leakage from gear boxes is checked at the moment. Gear endurance test was observed by chance in one farm machinery shop, which was being carried out because the gear material had been replaced.

E. Industrial standards and regulations.

There is no national industrial standards and regulations for gears, so they produce gears in various ways. English and metric systems are used in the same shop.

In order to upgrade gear production technology and quality in the country, it is essential to establish the national standards or regulations regarding quality, accuracy and methods how these should be measured and judged.

Table 4.4.3-22

Imports of Power Transmission Components, 1981

Bearings, Gears, Couplings and Shafts, etc.

	Quantity (ton)	CIF Value (million Baht)	%
Ball bearing	4645.7	612.56	100
Japan	2512.0	337.01	55.02
China Peoples Rep.	833.6	55.72	9.10
U.S.A.	167.4	48.41	7.90
West Germany	217.8	42.39	6.92
France	48.7	22.14	3.61
Romania	221.2	20.27	3.31
Other 26 countries	645.0	86.62	14.14
Roller and Needle Brg.	505.03	92.17	100
Japan	252.37	35.45	38.46
U.S.A.	112.43	32.52	35.28
West Germany	36.73	8.20	8.90
United Kingdom	13.12	3.52	3.82
Sweden	19.44	3.26	3.54
Others 22 countries	70.94	9.22	10.00
Parts of Ball, Roller, Needle Brg.	82.58	6.113	100
Japan	55.33	3.946	64.55
India	10.24	0.438	7.17
West Germany	0.32	0.376	6.15
Taiwan	6.64	0.353	5.77
Other 9 countries	10.05	1.00	16.36

Gears and Gearing	1094.13	221.06	100
Japan	601.53	121.82	55.11
U.S.A.	110.23	29.92	13.53
West Germany	28.76	16.04	7.26
United Kingdom	62.12	15.28	6.91
China Peoples Rep.	121.32	6.56	2.97
Hong Kong	55.45	6.10	2.76
France	13.26	5.30	2.40
Other 19 countries	101.46	20.04	9.06
Shaft Couplings	1545.70	261.16	100
Japan	753.34	114.98	44.03
U.S.A.	99.92	35.93	13.76
West Germany	70.78	27.18	10.41
United Kingdom	219.99	24.37	9.33
Italy	121.20	11.34	4.34
France	22.93	7.31	2.80
Taiwan	87.84	6.19	2.37
Other 27 countries	169.70	33.86	12.97
Clutches	26.32	8.165	100
Japan	6.39	2.062	25.25
U.S.A.	4.00	1.449	17.75
Italy	4.96	1.358	16.63
West Germany	1.19	0.766	9.50
United Kingdom	1.22	0.667	8.17
Other 12 countries	8.56	1.863	22.82

Crank Shafts	384.51	64.613	100
Japan	164.49	25.631	39.67
West Germany	28.88	9.753	15.09
U.S.A.	17.61	5.859	9.07
France	8.38	5.677	8.79
United Kingdom	15.47	4.296	6.65
India	82.30	3.340	5.17
Taiwan	24.03	2.269	3.51
Other 18 countries	43.35	7.788	12.05
Bearing Housing	375.78	34.329	100
Japan	211.14	19.002	55.35
Taiwan	95.02	5.121	14.92
United Kingdom	52.79	5.101	14.86
U.S.A.	5.07	2.089	6.09
Other 11 countries	11.76	3.016	8.78
Plain Shaft Bearing	201.35	52.229	100
Japan	50.19	12.803	24.51
United Kingdom	37.17	9.296	17.80
U.S.A.	22.86	7.626	14.60
West Germany	9.01	6.123	11.72
South Korea	19.89	5.076	9.72
Other 19 countries	62.23	11.305	21.65
Flywheel & Pulley	172.02	20.758	100
Japan	95.10	10.079	48.55
U.S.A.	17.43	3.640	17.54
United Kingdom	8.01	2.097	10.10
West Germany	4.63	1.579	7.61
Taiwan	40.95	1.182	5.69
Other 17 countries	5.90	2.181	10.51

Parts of transmission shaft, crank, bearing, etc.	3312.2	45.643	100
Japan	96.0	18.855	41.31
West Germany	3115.1	9.871	21.63
U.S.A.	10.7	3.372	7.39
United Kingdom	6.9	2.713	5.94
Taiwan	24.2	1.941	4.25
India	25.9	1.125	2.46
Other 18 countries	33.4	7.766	17.01

(4) Issues and Countermeasures

(4-1) Tool and Die Industry 64

One of the different characteristics of the mold industry from other general industries is that most of the products are produced singly in accordance with customers' diverse specifications. Therefore, it is essential to organize well a combination of abilities of mold designers and draftsmen and skills of mold workmen, in order to produce high quality molds.

However, the actual situations are quite different from the above as mentioned previously. It is still in the primitive level from every point of view.

Furthermore, with the advancement of industrialization in the country, the demands for more complicated and sophisticated molds would rapidly increase in the near future.

Therefore, it would be an urgent issue to be solved, to educate and train mold production engineers and workmen in quality and quantity. It will take a long time to develop human resources, whereas equipment and machinery are comparatively easy to introduce if financial conditions are satisfied.

For this reason, strong and effective policies should be established and implimented as soon as possible.

Therefore, the issues on the human resources will be highlighted hereinafter from among the various potential problems of the mold industry in Thailand.

A. Education and training of apprentices.

'A Mold Industry Course' should be more increased or established in the existing technical high schools and vocational training schools. In technical high schools, designers and draftsmen relating to mold production should be intensively educated and trained with emphasis on basic subjects such as mathematics, physics, strength of materials, heat treatment, and production engineering. In vocational training schools, basic skills and technologies of machining, grinding, finishing and reading production drawings should be emphasized in relation to operation and maintenance techniques. For advanced courses, operation techniques of quality machines such as EDM, jig borers and NC machines and measuring techniques should be taught.

B. Re-education or re-training of leading engineers and controllers in firms.

In general, there are few opportunities for leading engineers, controllers and technicians of firms to be re-educated or re-trained after joining the firms, particularly for those in the small and medium scale industries. However, for rapidly progressing and developing industries as the chemical, electronics and mold production, it is

essential that they upgrade their technologies at all times to survive in a highly competitive market. For this purpose, it is recommended that organizations like institutes should be established with such functions and activities as mentioned above. In these organizations managerial technologies such as quality control, production control and marketing research as well as technical matters should be covered. Furthermore, information regarding domestic and foreign technologies should be gathered and served to the private sector.

C. Supporting services for small and medium scale industries.

As observed through the survey, most of the mold producting firms are small in scale, and they have strong desires to use high quality machines. However, they can not afford to purchase them for shortage of investment funds, skilled workers and experienced engineers. To resolve the situation, something like a 'Service Center' for small and medium scale industries should be established.

The service centers should be furnished with such equipment which can not be easily purchased by the firms as special machine tools, measuring instruments and testing equipment. The center should also serve the firms' special machining jobs and inspection at reasonable fees.

Furthermore, training services on these facilities should be available if required by the firms. Roving extention services should also be undertaken.

(4-2) Gear Manufacturing Industry

Except for the foreign and few domestic gear manufacturers, most of the gear shops are still in the primitive stage of technology level. However they may not be aware of their situations and technology level. It is also a fact that they are anxious for new quality and high production machines, but cannot acquire due to financial limitations.

Considering the situation, the following recommendations are proposed.

A. Supporting services for small and medium firms.

A service center should be established under a suitable government organization. Functions and activities thereof are as follows:

1) Job service of special machining and inspection to small and medium scale industry.

The center should be equipped with special gear making facilities and measuring instruments and serve production and inspection at reasonable fees. Furthermore, training on these facilities should be available, if required.

Examples of the facilities to be prepared are: hobbing machine with crowning device, gear shaper, gear grinder, gear shaving machine, straight and spiral bevel gear generator, lapping machine, profile and lead tester, pitch tester, hob tester, surface roughness tester, tooth contact bench test equipment etc.

2) Roving extention service and compiling manufacturer lists.

The center should undertake roving extention services mainly to small/medium scale firms with portable measuring instruments. Technical advices and consultations should also be offered.

Through this extention services, information of the surveyed manufacturers should be collected and compiled in the list. Production capacity, kinds of gears, maximum accuracy, facilities, number of employees and usage of gears etc. should be listed.

3) Drafts of gear quality standards.

Gear quality standards should be prepared in accordance with international standards such as ISO, AGMA and JIS, and proposed to the relevant government authority in charge of industrial standards.

Manufacturers should be classified in accordance with the quality standards. This list can be distributed to foreign and local large firms and it may be useful to increase subcontracting jobs from large firms.

4) Seminars and training courses on practical gear design and production technology.

The center should conduct seminars and training courses on gear design and production technology. An example of a course curriculum is shown in Table 4.4.3-23.

Table 4.4.3-23 Curriculum of Gear Engineering Course

Course	Contents
Practical Gear Design and Engineering	General • Power transmission system • Types and application • Kinds and feature of gears • Kinds of tooth form • Bearings • Coupling, brake and clutch Fundamental Gear Design • Design process, flow chart • Design conditions • Decision of gear specification • Shafting, bearing, key, seal and coupling, etc. • Gear housing • Lubrication system • Drawings Advanced Gear Design • Forced lubrication system system design, loss power, supply oil quantity, etc. • Vibration; torsional, lateral and axial • Oil film on tooth surface • Tooth form modification • Profile shifted gear • Shaft alignment • Differential gears Applied Gear Design • Marine use gears • Industrial use gears • Gear for farm machinery, construction machinery and machine tools, etc.

Table 4.4.3-23 (Continued)

Course	Contents
Practical Gear Design and Engineering (continued)	Seminar for Users • Selection of gears, coupling and clutches • Maintenance • Gear troubles • Purchase order sheet Special Seminars • Standardization of gears • Planning of gear shop construction • Development and Lab. test • Tooth profile theory, etc. Production • Process and procedure • Production facilities • Production technology • Assembly and check items • Tool regrinding and maintenance • Machine maintenance and repair Inspection • Gear inspection by process • Inspection instruments and technique • Inspection record and application to quality control

4.4.4 Hand Tool

(1) Introduction

Hand tools have been indispensable for human life since the primitive ages. The type and number of hand tools are countlessly numerous. From among them, hand tool for industrial use was specifically chosen as one of the target items for the study.

Although some 350 firms were surveyed in order to study the present situation of the metalworking industries forcusing on the small and medium scale industries, only a few firms produce hand tools, and only one questionnaire for hand tools was collected. Two possible reasons could be given why more firms were not surveyed. First, hand tool manufacturers are limited in number in the actual surveyed areas. Second, manufacturers are existent, but they were not selected by chance as samples for the survey.

The former reason would be probable, because other studies on the tool industry in Thailand were undertaken before our survey, though they were not so many. According to the reports of the these previous studies, it was proven that the number of tool manufacturers are at most several.

The latest study on Thai tool industry is a co-research titled 'Research on Technology Sharing and Transfer among ASEAN Countries', which was undertaken in the period of July 1982 to September 1984 by the Japan International Cooperation Agency, JICA and the Technonet Asia. In this project, hand tools were selected as one of the target items, and Thai hand tool industry was studied. However, only five manufacturers were surveyed.

As aforementioned, only one questionnaire was collected through the survey, therefore the abovementioned JICA-TECHNONET ASIA Co-research report (hereinafter referred to the 'SOT Report') will be quoted for the fact finding on the situation of the Thai hand tool industry.

(2) Present Situation of Thai Hand Tool Industry

1) General Aspects

Several manufacturers which produce hand tools for industrial use such as hammer, hacksaw, vice plier, wrench, spanner and file are existent in Thailand. They are mostly located in the capital city, Bangkok and its surrounding areas.

Spanners and files are still in the test production stage and are not yet sold in the market. Production amounts of vice pliers and wrenches are very limited, whereas hammers and hacksaw blades are produced in commercial quantity.

These hand tools could be manufactured by small-scale facilities, which do not require

large investment for the equipment and advanced technology for production. Therefore, it could be said that these hand tools are appropriate to be produced by small and medium scale enterprises in developing countries.

Furthermore, there exist some developing technologies such as die forging, heat treatment and tool and die, which means that the fundamental technologies for hand tool industry have already been available, and also means that it would be rather easy to start up more advanced tool industries such as spanner, wrench, drill and tool bits.

However, some issues are observed in the tool market of the country. A great deal of imported products are abundantly flowing into the market from China, Taiwan, India, Japan and West Germany, etc., and consumers do not feel inconvenienced without domestically produced products. Therefore, it would be difficult for new local entrepreneurs to penetrate the highly competitive market. Moreover, there are no supporting organizations in the government and public sectors, which give technical, financial and political assistances to the industry.

Imports of hand tools have been increasing gradually through the years. The import amount was estimated at some five million Baht in 1981, and it was approximately doubled in 1975. Imports would inevitably increase with the industrialization of the country, if the situation is left as it is.

Table 4.4.4-1 and Fig. 4.4.4-1 show the import aspects of hand tool and cutting tool for seven years since 1975. Table 4.4.4-2 shows detailed aspects in the latest year 1981. For comparing other Asean countries' situation, Fig. 4.4.4-2 will be available.

Table 4.4.4-1 Thailand - Export/Import of Tools

COUNTRY NAME : Thailand

TARGET PRODUCT
Hand Tools and Cutting Tools

		UNIT	1970	1975	1976	1977	1978	1979	1980	1981	REMARKS
saw, wrench spanner, file, plier hammer, etc	Domestic	Baht $x10^6$		203.7							SOURCE : 1. Foreign Trade Statistics 2. Industrial Census, National Statistics Office
BTN No. 8202 8203 8204	Import	$x10^3$ PCS		1934.0	2509.7	2901.0	1897.3	2381.4	2006.1	tons (2599.1)	
		CIF $x10^6$ Baht		141.9	182.0	236.5	127.3	170.5	182.5	294.0	
	Export	$x10^3$ PCS					0.71				
		$x10^3$ FOB Baht					145.6	157.5	530.1		
lathe, tools drill, tap bit, etc	Domestic										
	Import	$x10^3$ PCS	92.1	87.0	86.27	113.4	124.3	95.46	60.91	tons (81.61)	
		$x10^6$ CIF Bht	90.0	15.87	15.46	22.87	24.78	27.59	22.39	30.94	
BTN No. 8205 22 24 26	Export	PCS			30	20	70	4168	377	5	
		$x10^3$ FOB Bht			1.50	1.20	19.1	73.0	18.36	1 08	
tool tips plate, stick	Domestic										
BTN No. 8207	Import	Weight Tons	2.93	2.395	5.07	6.96	9.22	13.87	15.96	12.00	
		$x10^6$ CIF Bht	0.973	2.492	3.112	4.664	9.569	16.22	13.92	15.98	
	Export										

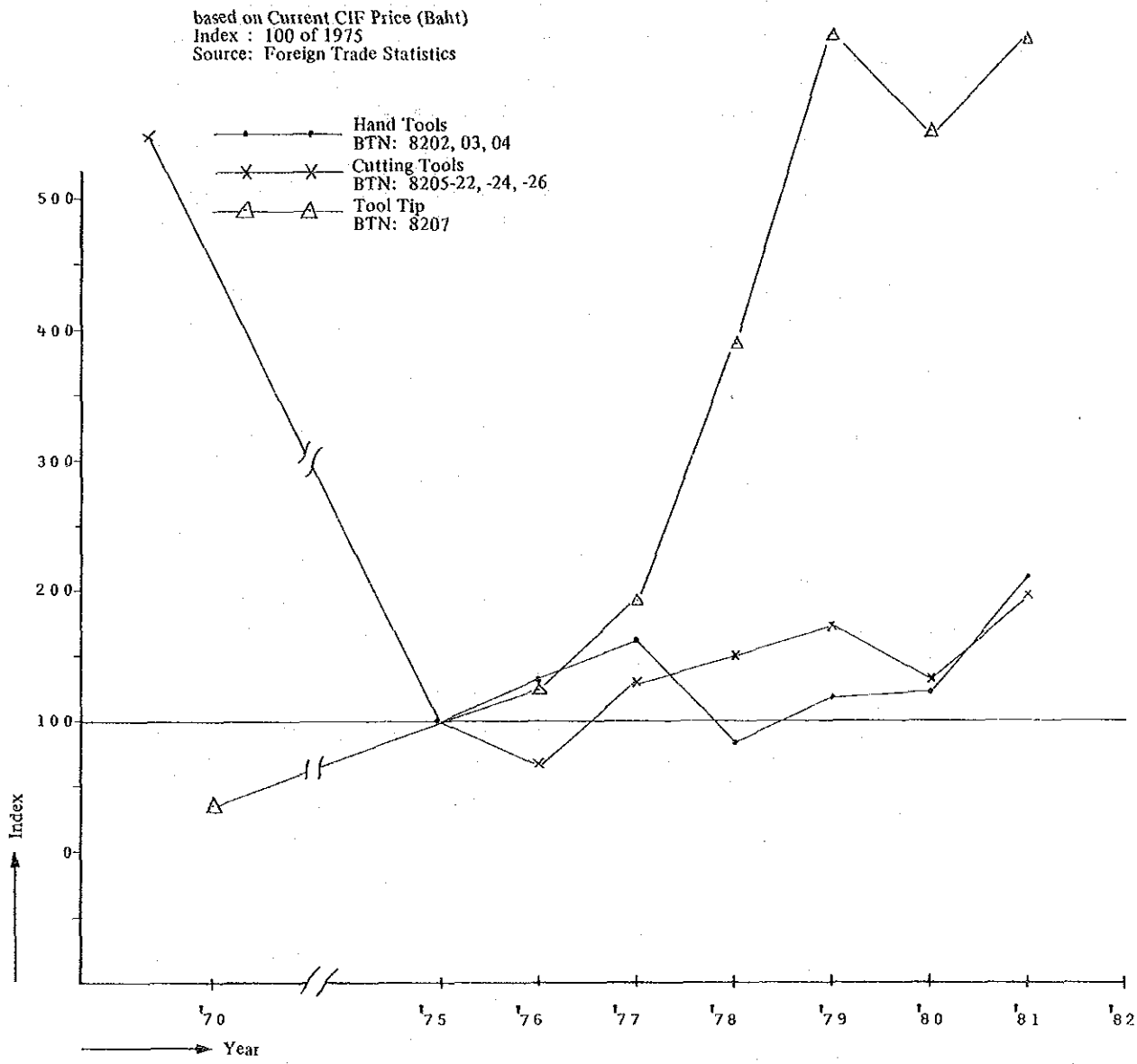


Fig. 4.4.4-1 Thailand - Import Index by Target Item

Table 4.4.4-2 Thailand, 1981

(Value in Baht thousand CIF)

	BTN No.	Item	Quantity	Value	Main Origin Countries e/s)
	8202 00			103,866.1	
*	11	hacksaws	24,761	1,210.6	CHN(33.2) ITLY(20.0) WG(17.8)
*	15	other handsaws	509,800	9,696.7	WG(42.0) JPN(16.6) SWD(16.5)
*	16	hacksaw blades	1,361,250	8,956.8	UK(47.2) CHN(19.7) JPN(11.1)
	17	toothless handsaw blds	70,292	3,772.0	ITLY(95.5)
*	19	other handsaw blades	16,634,702	27,114.1	JPN(27.1) WG(23.1) SWD(17.9)
	21	circular saw blades	12,030	15,347.5	SWD(48.3) ITLY(18.1) WG(13.5)
	22	toothless machine saw blades	(21,110kg)	1,150.1	WG(76.4) ITLY(11.2) JPN(8.3)
	29	other machine saw blds	1,067,690	32,383.7	WG(30.1) ITLY(22.0) JPN(13.9)
	30	parts of handsaws	(80,626kg)	4,234.6	WG(39.3) CHN(32.0) CND(14.2)
	8203 00			241,427.5	
*	01	pliers, pincers	(415,577kg)	48,218.1	USA(35.9) CHN(17.6) WG(16.2)
	02	Tinmen snip, cutters	(104,979kg)	9,012.8	JPN(43.7) CHN(29.2) UK(13.9)
*	03	spanners & wrenchers	(1,102,077kg)	89,822.5	JPN(26.7) CHN(23.8) IND(18.3)
*	04	files & rasps	(287,927kg)	74,966.8	CND(64.9) PHLP(7.5) CHN(6.7)
	8204 00			155,826.5	
*	11	hammers	(675,228kg)	27,695.6	CHN(54.5) WG(14.0) MXC(9.2)
*	16	drilling, threading, tapping	(118,430kg)	6,430.3	CHN(42.2) PLD(19.9) TWN(15.2)
	21	vices & clamps	(528,175kg)	12,521.4	CHN(48.7) JPN(17.3) IND(15.9)
	8205 00			343,231.3	
	10	interchangeable tools for hand tools	(90,934kg)	38,929.0	JPN(61.2) UK(13.8) USA(10.0)
*	22	drilling, boring, etc	(42,081kg)	12,051.5	JPN(45.3) UK(14.6) CZSL(13.9)
*	24	threading & tapping tools	(32,953kg)	16,578.9	UK(46.5) JPN(44.8)
*	26	lathe tools	(6,578kg)	2,310.2	JPN(39.6) WG(17.0) USA(16.9)
	8206 00	knives & cutting blades	(220,748kg)	78,504.5	JPN(53.7) WG(12.2) USA(9.4)
*	8207 00	tool tips, plates, sticks	(12,000kg)	15,976.7	LXBG(32.8) PLND(10.9) JPN(10.5)

* target item of the project

SHORTENINGS OF COUNTRY NAME

AST	:	Australia	FR	:	France	SNG	: Singapore
A'RIA	:	Austria	HK	:	Hong Kong	SPN	: Spain
BLG	:	Belgium	IND	:	India	SWD	: Sweden
BRZ	:	Brazil	ITLY	:	Italy	SWZ	: Switzerland
CHN	:	People's Republic of China	JPN	:	Japan	TWN	: Taiwan
CND	:	Canada	MXC	:	Mexico	USA	: United States of America
CZSL	:	Czechoslovakia	NZL	:	New Zealand	UK	: United Kingdom
DNK	:	Denmark	PHLP	:	Philippines	WG	: German Federal Republic
			PLND	:	Poland		

Source : Foreign Trade Statistics of Latest Year

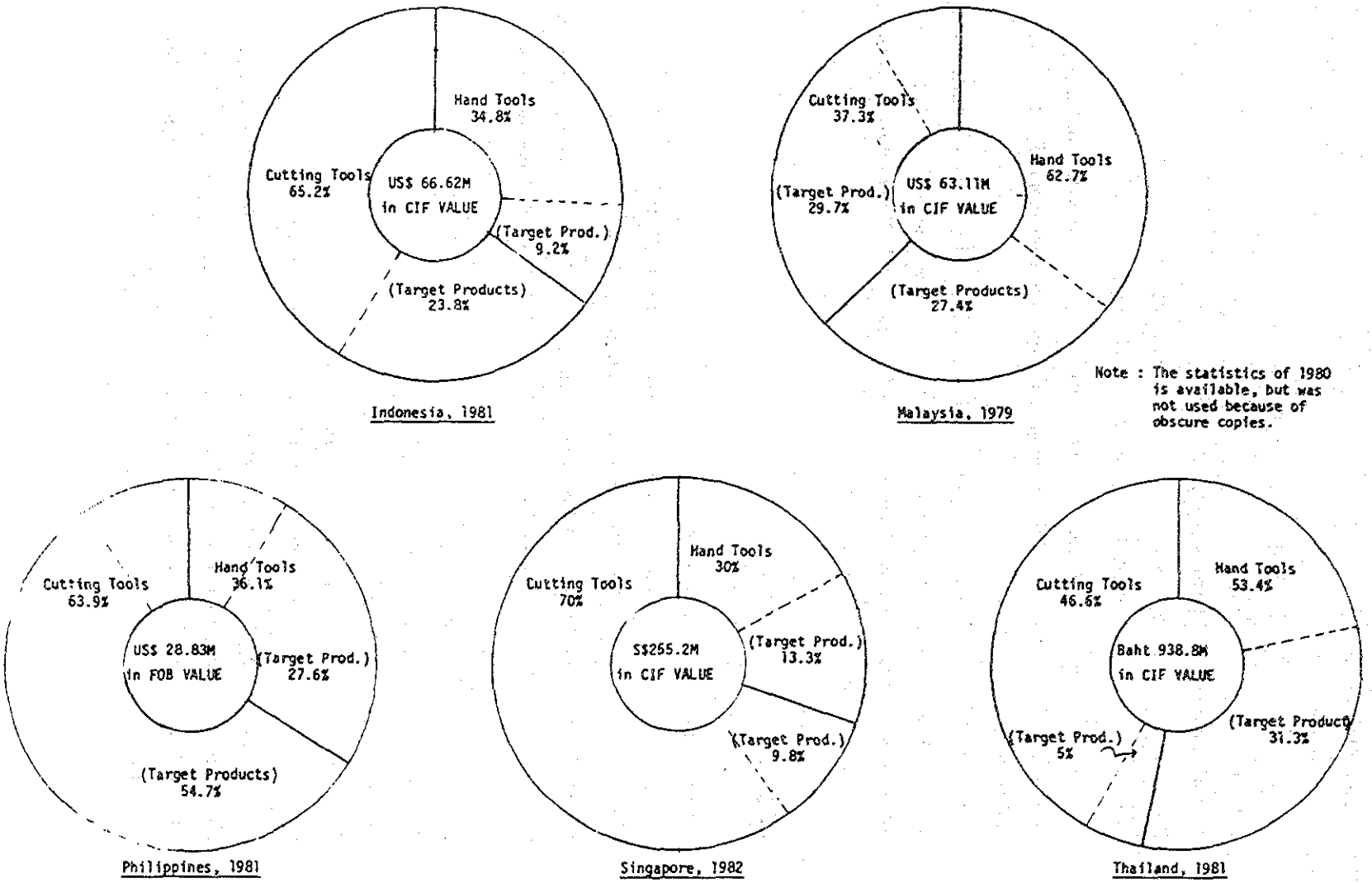


Figure 4.4.4-2 Import Aspects of Hand Tools and Cutting Tools in Aseans

2) Background Information

Firm A

Location	:	Bangkok
Establishment	:	1962
No. of employees	:	approximately 90 persons
Products	:	hammer, wrench, chiesel, bolt and nut
Process	:	forging, heat treatment, machining

Some 12,000 hammers and 4,000 wrenches were produced in 1982, and they were mostly sold in the country. Raw materials are imported from Japan, West Germany and Sweden.

The shop is equipped with broaching machine, copy milling machine, pneumatic hammer and batch-type furnace as well as ordinary machine tools such as lathe, shaper and drilling machine. They had abundant jobs and the employees worked for some 70 hours a week with overtime.

Firm B

Location	:	Bangkok
Establishment	:	1965
No. of employees	:	approx. 50
Products	:	hammer, door hinge, steel angle for shelf, etc.
Process	:	sheetmetal working, machining

Some 100,000 hammers of cast iron were produced in 1982. The major process of the shop is sheetmetal works although they are equipped with some machine tools.

Firm C

Location	:	Bangkok
Establishment	:	1975
No. of employees	:	approx. 50
Products	:	vice plier, woodworking saw
Process	:	machining, presswork, heat treatment by salt bath, plating

In 1982, some 12,000 vice pliers and 10,000 saws for woodworking were produced. The annual production capacity for vice plier is 60,000 pieces. Raw material cost is estimated at 44% of total cost. Raw materials are imported from Japan and West Germany.

Firm D

Location	:	Bangkok
Establishment	:	1970
No. of employees	:	approx. 40
Products	:	hacksaw blade, hand hoe, file (test production)
Process	:	machining, heat treatment, induction hardening, presswork

About 30 of 40 employees are engaged in the production of hacksaw blades, who are mostly women. Besides producing hacksaw blades and hand hoes for agriculture, job orders for high-frequency induction hardening of ball joint components and gears from Taiwan were undertaken. Furthermore, they were carrying out test production of files on machines developed by them. In spite of a 1.2 million blade production capacity, the output in 1981 was 600,000 pieces only. Most of the products are distributed through wholesalers throughout the country and sometimes to other Asean countries. Cost of raw materials, Cr-Mo steel from Japan is estimated to be approximately 60% of total production cost.

Another hacksaw blade manufacturer is in existence in Bangkok. These two firms produce almost 100% of the hacksaw blades in the country.

Firm E

Location	:	Samatprakarn, a suburb of Bangkok
Establishment	:	not specified
No. of employees	:	approx. 50
Products	:	more than 300 of forgings
Process	:	free and die forging, machining, heat treatment

This is one of the largest forging factories in Thailand. Spanners and wrenches are still in the test production stage. Tool and die requirements are also made in their machine shop.

However, should they have the intention of producing spanners and wrenches and to be able to penetrate the tool market in the country, it is recommended that they use more specialized and sophisticated equipment and to prepare the production line according to cost reduction and mass-production principles. Job order or intermittent production system is not advisable for the hand tool industry.

Firm F: Wholesale retailer of tools

Location	:	Bangkok
Establishment	:	1976

No. of employees : approx. 45

The firm deals with many sorts of hand tools, cutting tools, industrial materials and electrical machinery, etc., most of which are imported except for domestically made hammers and hacksaw blades.

These goods are distributed in the whole country, 30% of which are to retailers and 70% are directly to consumers.

The main countries of origin of imported products are adviced as follows:

Tool bits	:	Sweden and Japan
Drills	:	Britain, Japan and China
Metalsaws and blades	:	Britain, USA, Japan and China
Files and rasps	:	USA, Japan and India
Wrenches and spanners	:	Japan and India
Pliers	:	Japan and China
Hammers	:	West Germany, USA, Japan, Taiwan and China

Furthermore, the distribution channel of hand tools is, in general as follows:

for domestic products

Channel 1. manufacturers–agents–retailers–consumers

Channel 2. manufacturers–wholesalers–retailers–consumers

for imported products

foreign manufacturers–importers–retailers–consumers

Taxes on hand tools are usually levied as shown below:

Custom duty	30%	depending on sort of tools
Trading tax	11%	
Local tax	7%	

The abovementioned aspects of five tool manufacturers and one wholesale-retailer were mostly quoted from the previous 'SOT Report'. In addition to these firms, one manufacturer is added which is the only firm serveyed by this project, as shown hereunder.

Firm G

Location	:	Samatprakarn, suburb of Bangkok
Establishment	:	not specified
No. of employees	:	approx. 50

Products : carpenter and home use hand tools

The output in 1983 was some 12000 pieces of carpentry and home use hand tools, which were sold mostly in the region.

Raw materials are high carbon steel and alloy steel and are die-forged to make the products.

Their shop is equipped with pressmachines, milling machines and surface grinders besides ordinary machine tools.

They also have an electric heating furnace but have no heat-treatment furnace.

3) General Opinions about the Tool Industry

In the previous SOT Project, research was carried out to ascertain the reason why tool industries have not been successful in the ASEAN countries. For this purpose, questionnaires were distributed to persons who were interested in these industries including manufacturers.

Collected data from samples are so limited that their characteristics by occupation cannot be analysed and concluded. Their opinions are briefly shown as follows:

① Market Situations

a. Market size is very limited because of the slow development of the metal-working industries, and minimal distribution of the products domestically.
b. Many foreign competitors flow into the domestic markets.
c. Consumers prefer foreign goods and have prejudice against domestic ones, because they are more durable, relatively cheap and easily available for various uses.

② Manufacturers Situations

a. Domestic ones are more expensive because of high cost of raw material, low productivity and difficulty of mass production which is caused by poor equipment and small size market.
b. Poor quality of domestic products, which is caused by poor inspection tool and technique, lack of quality control concept, shortage of engineers and skilled workers, poor quality of raw materials and heat treatment.
c. Shortage of sales network and advertisement.
d. None or few entrepreneurs have the intention of setting up a tool making enterprise, because of the large investment requirements, difficulty of getting raw materials, difficulty of getting immediate profits and small market size, etc.

Also, most answers point out the lack of government supports like taxes, financial aid and the preferencial treatment given by foreign competitors.

(3) Major Issues and Recommendations Thereof

The vital issue in the development of the tool industry in Thailand is the indifference of the consumers to locally produced tools and also their unawareness of the importance thereof. Presently, most of the tool consumers do not feel inconvinienced and are satisfied with the statusquo because they can easily get various types of imported tools at comparatively cheaper prices. Furthermore, the government and public sector also do not

have any interest in this field, because tool industry is a small venture compared to other major industries such as energy and power industry, automobile and shipbuilding industries and chemical industries. Moreover, the import of tools is much smaller in amount than the imports of the major industries.

On the other hand, the government of Thailand has been making an effort to modernize and industrialize its country and acknowledged the importance and necessity of small and medium scale industries, above all, labour intensive industries, because their labour forces have gradually increased year by year and unemployed, jobless potential workers are one of the serious problems of the country. In line with this, the development and promotion of the tool industry should be re-considered.

However, should the situation be left as it is, it would never improve. To improve the situation, strong and effective governmental or public assistances should be expected closely related to the long-term and short-term national development plan of the country. They should be implemented as suitably and consistently as possible.

The following recommendations are being proposed to improve and develop the tool industry in Thailand.

1) Organize a Government Authority in Charge of the Tool Industry

This should be organized under the most appropriate administrative authority of the government, for example, under the Department of Industrial Promotion or under the Department in charge of small scale industry promotion. Should it be difficult to set up a new organization, then appoint local officers to take charge on a concurrent basis.

The functions and activities of the organization are recommended as follows:

a) Research and Analysis of the Whole Aspect of Tool Industries in the Country

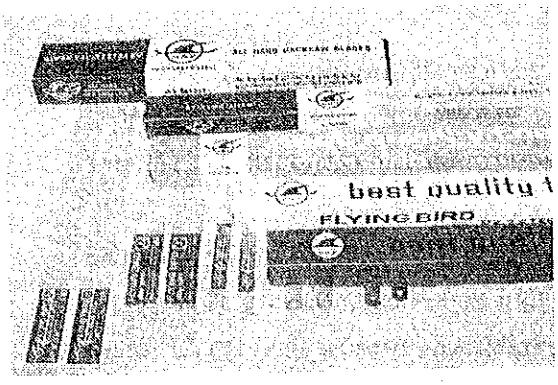
All kinds of tools made in the whole country are researched and analyzed.

- Domestic Production by Region

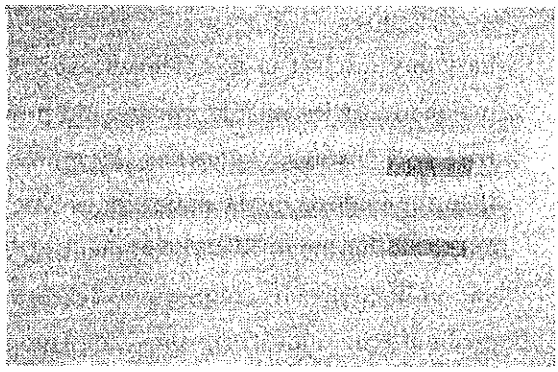
  No. of manufacturers, kinds of products, output, No. of employees, facilities, market areas, distribution routes, kinds and consumption of raw materials, cost, market prices, etc.
- Export and Import Aspects

  Quantity of export and import by commodity and by country, No. of exporters and importers, amount of trading, etc.
- Wholesaler and Retailers

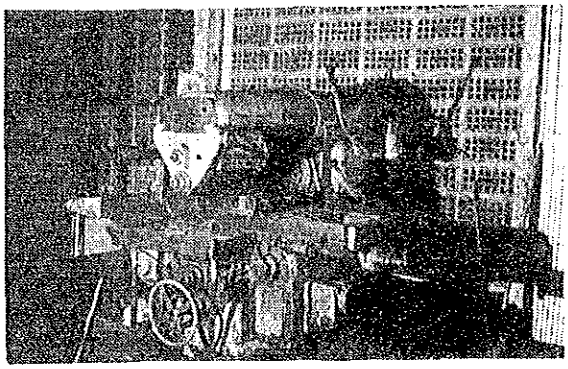
  Amount of sales by commodity, distribution route and area, No. of firms,



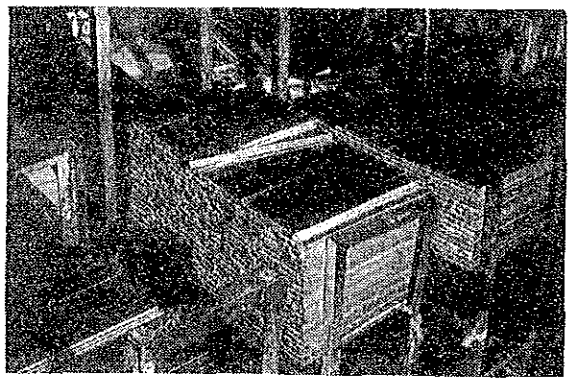
Their products



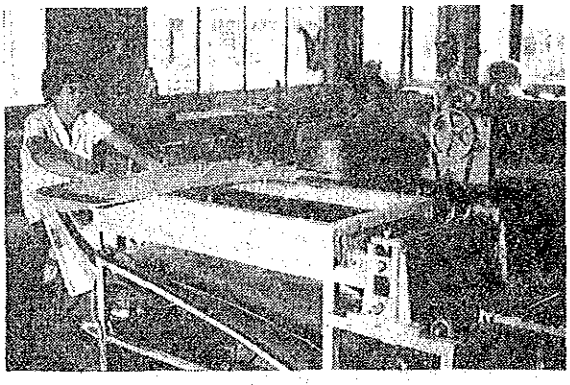
Blades



Milling of Blades



Blade Blanks in Process



Annealing Process

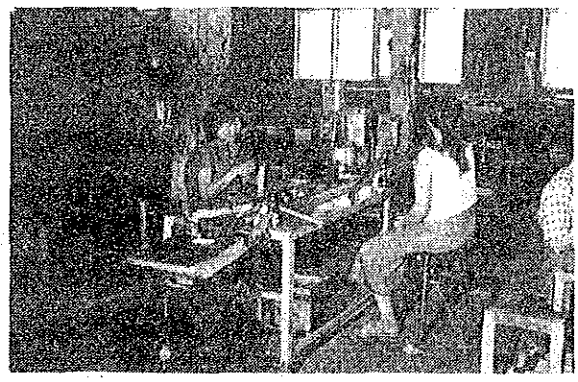


Photo 4.4.4-1 Hacksaw Blades in a Thai Firm

example:

domestic consumption by commodity, demand forecast, finding problems on technology, financial, management and marketing etc.

b) To make policy and development plan

On the basis of the above research and analysis, concrete development plan and policy should be made related to the national development of the country, for example:

- which products should be produced by domestic firms,
- which products are dependent on import,
- which products should be localized,
- which products should be produced by government leading,
- re-study on import taxes, trading taxes, financial support,
- what to do for technology improvement or development
- statistics data should be gathered regularly,
- promotion to set up industrial and commercial associations

2) Organize a Tool Industry Association in the Private Sector

The functions and activities thereof are shown as follows:

- Promotion and distribution of domestic products
  - o distribution of general catalogs of domestic products
  - o publish association bulletins
  - o exhibitions
- Cooperation to improve technology level
  - o technical information
  - o seminars, symposium, study tours
- Statistics of outputs, employees, material consumption
- Recommendation and requirement to the Government
- Joint Procurement of raw materials
  - o standardization and limitation of kinds
  - o measures for prompt purchase
- Financial mutual aid
- Promote cooperation among members, etc.

3) Support the Tool Industry by Technical Institutes

- Conduct technical seminars and training courses on material, forging, heattreatment, tool and die design, production technology and facilities, etc.,

- Provide roving extention services for small and medium scale industries through mobil rounding tours.
- Research and experiment on the basic technology for tool manufacture, and offer the data to the private sector,
- Prepare and offer domestic and foreign technical informations such as technical papers, technical magazines and other publications,
- Issue technical bulletins and newsletters
- Draft industrial standards and proposals to the relevant organizations.

4.4.5 MACHINE TOOLS

(1) INTRODUCTION

1) Background :

In 1977, ISI of the Ministry of Industry, Thailand issued a survey report on the machine tool industry of Thailand. According to the report, 18 companies were engaged in the manufacture of machine tools for metals at that time. Of these makers, 9 makers were engaged in the manufacture of cutting machines (which are classified as tip-removing type machines, such as lathes, shaping machines, drilling machines, etc.) and the remainder in the manufacture of forming machines (which do not produce tip such as pressing machines, shearing machines, etc.). The estimated production in both sectors was amounting to approx. 990 to 1,280 pieces (no production statistics available, ISI's estimated value) and this fact suggested that the way to the substitution of domestic products for imported ones be paved by the mass production of simple lathes, drilling machines and components thereof as well as repair parts for imported machinery to be undertaken by local emterprises in Thailand in the future.

During the period of 1979 to 1980, Entwicklungs Beratung EB GMBH, West Germany, conducted a comprehensive survey on the machine tool industry in Thailand with the co-operation of IFCT, BOI. The EB report issued in 1980 gave several recommendations, on the ground that no competitive machine tool industry capable of haveing a good command of up-to-date techniques could be brought up unless the governmental intensive guidance and promotion measures are implemented, as a result of the survey on the status, demand tendency, technical level of the machine tool industry in Thailand. In particular, metal cutting machine tool industry is one of the most difficult sectors in developing countries as being called for a high grade of design and engineering, production technique and technological developing ability to meet the requirements for complicacy and high-precision such as in the mechanism of power transmission, since rotating speed, feeding speed vary by the materials, size, hardness and roughness of machined surfaces. On the other hand, forming machine tools are less difficult in such technicalities as construction, precision than metal cutting machine tools. The report suggested that no particular governmental assistance was needed for forming machine tools.

In 1979, the second oil crisis threatended Thailand economy to reduce capital investment drastically, so that machine tool makers underwent heavy damage and were obliged to change or close their business one after another.

During the period of 1982 to 1983, Japan International Co-operation Agency (JICA) crried out the joint research project "SHARING & TRANSFERRING OF TECHNOLOGY AMONG ASEAN COUNTERIES (SOT PROJECT)" In this project, factories and governmental organizations related to machine tool industry were surveyed (particularly for metal cutting machine tools) in an attempt to grope for sharing the seed technology existing in ASEAN region. These surveys clarified that the nine (9) makers reported in 1977 reduced to as small as 2 in 1983. Of these 2 makers, one was manufacturing lathes and shapers and the other shapers. In particular, the former is the only one specialized in this field within ASEAN countries except for Singapore. Total production by both makers amounts to 50 to 80 pieces, the share of which in the total amount of import of 21,200 pieces (metal cutting machine tools in 1980)is neglisible. Production statistics for machine tools is not yet available.

Table 4.4.5 (1) Domestic Production of Cutting Machine Tools in Thailand

	1977 *1			1982 *2		
	No. of Firms	Production		No. of Firms	Production	
		Pieces	Value M.฿		Pieces	Value M.฿
Lathe (160-380mm centre height)	6	200-300	12-15	1	30-50	2.4-4.0
Shaper (500-800mm stroke)	7	160-200	4.5-5.5	2	20-30	1.6-2.4
Drilling Mach. (12-13mm dia.)	2	70-100	0.9-1.3	-	-	-
Total	15	430-600	17.4-21.8	3	50-80	4-6.4

*1. Industrial Service Institute, Status Report of Machine Tool Industry in Thailand, 1977.

*2. Field Survey of SOT Project, from Janauary to May 1983.

Since machine tools are capital goods that are effected by the fluctuation in business activity, particularly by the trend in equipment investment, and they are also high-technology products necesitating a great amount of investment, sophisticated engineers and skilled labor, they are the most difficult field as for a deep-rooted business to be undertaken in developming countries. Investors, entrepreneurs and foreign capitals are hesitating to launch into this field under such severe conditions as weak support industries, limited markets, strong overseas products, low-priced second-hand machines and low-priced imported machines from NICs. As the survey under SOT project was conducted for tip-removing type machine tools for metalworking, the actual state of metal forming machine tools such as pressing machines, shearing machines, and woodworking machine tools is indistinct as being excluded from the survey. Furthermore, no production statistics are available. Since, however, the degree of difficulty in construction and precision in the latter sector is no as high as in the sector of metal cutting machines as suggested by EB, several makers are engaged in production activities.

2) Firms involved in this survey :

Firms dealt with in this section are 13 manufacturers that gave an answer of "yes" to the items concerning the metalworking and woodworking machine tools in the questionnaire Q05-02-01 to medium and small scale firms in PART-III, out of about 350 firms subjected to the present survey. The composition of firms was; 5 : lathes, 6 : drilling machines, 5 : shapers, one ; pressing machines, 2 : shearing machines, one : punching machines, for metalworking and one : lathes, 3 : drilling machines, one : planers, and 2 : others, for woodworking. The reason that the total number is more than 13 is attributed to some makers concurrently engaged in making other kind of machines (Refer to Table 4.4.5 (6)-Q04-02-01). These enterprises are not always making a complete set of machine unit, but are mainly engaged in the production of machine components on a subcontract basis. The two (2) manufacturers which are producing metal cutting machine tools surveyed under SOT project as referred to previously are dealt with as parent companies in PART-I.

(2) RESULTS OF SURVEY ON CURRENT FIELD SITUATION

1) Outline of Enterprises under Survey

i. Firm Age, Capital and Legal Status :

Outline of enterprises dealt with in this section is summerized on the basis of factory survey by questionnaire in terms of age of the firm, registered capital, legal status of business, factory site, building, total number of employees as follows :

Table 4.4.5 (2)
Age of Firms
(Q01-00-01)

	Freq	%
1. Less than 2 years	0	0
2. 2 - 5 years	0	0
3. 6-10 years	2	15.4
4. 11-20 years	5	38.5
5. 21-30 years	3	23.0
6. More than 30 yrs	3	23.0
Total	13	100.0

Table 4.4.5 (3)
Registered Capital
(Q01-01-01)

Registered Capital (฿)	Freq	%
1. Less than 250,000	7	53.8
2. 250,001-1,000,000	4	30.8
3. 1,000,001-4,000,000	1	7.7
4. 4,000,001-16,000,000	1	7.7
Total	13	100.0

The age of firms falls under a relatively long one, such as 38.5% for 11 - 20 years, 46% for more than 20 years and 15.4% for 6 - 10 years. (Table 4.4.5(2), Q01-00-01)

Registered capital of 13 makers is classified into less than ฿250,000 for 7 makers (53.5%), ฿250,001-1-1,000,000 for 4 makers (30.8%), ฿1,000,0001-4,000,000 and ฿4,000,001-16,000,000 for one maker each (7.7% each). (Table 4.4.5 (3) Q01-01-01).

Legal status fo business of 13 makers in total is classified into family business/single proprietorship for 5 makers (38.5%), partnership and company for 4 makers each (30.8% each). (Table 4.4.5 (4), Q07)

Table 4.4.5 (4) Legal Status
(Q07-01)

	Freq	%
1. Family business/single proprietorship	5	38.5
2. Partnership	4	30.8
3. Company	4	30.7
4. Cooperative	-	-
5. Joint venture with foreign firms	-	-
6. Government company	-	-
7. Foreign-owned	-	-
Total	13	100.0

Each of factory estate, building structure and floor area mainly falls under a small-scale one of less than 2,500 m2.

Table 4.4.5 (5) Factory (ies)
(Q01-03)

(a) Factory estate
(Q01-03-01)

03-01 Estate (m^2)	Freq	%
1. Less than 2,500	7	53.8
2. 2,501-6,300	4	30.8
3. 6,301-16,000	1	7.7
4. 16,001-40,000	1	7.7
Total	13	100.0

(b) Factory Building
(Q03-04-01)

04-01 Factory building floor area (m^2)	Freq	%
1. Less than 2,500	11	84.6
2. 2,501-6,300	1	7.7
3. 6,301-16,000	1	7.7
Total	13	100.0

The number of both male and female employees is classified into: less than 6: one makers (7.7%), 7-16: 4 makers (30.8%), 17-40: 5 makers (38.5%), 41-100: 2 makers (15.4%) and 101-250: one maker (7.6%). The share of family business and small enterprises (less than 40 employees) is 77% (Refer to Table 4.4.5 (13), Q10-00).

ii. Main Products

Table 4.4.5 (6) is a summary of the results of answers to Q05-02-01 on main products. Besides machine tools (for metalworking and woodworking), these makers are mainly engaged in processing basic metals and articles and component parts such as for industrial machinery, agricultural machinery and automobiles.

Tablel 4.4.5 (6) Commodities by Kind
(Q05-02-01)

Name of products	Freq	%
Basic metals & articles thereof		
2. Cast iron products	6	46.2
4. Steel iron	1	7.7
11. Founded	1	7.7
15. Punched/pressed	2	15.4
16. Bent or otherwise machined	3	23.1
Hand tools, cutlery		
29. Pipe cutter	1	7.7
Industrial machinery		
43. Pump, centrifugal	2	15.4
46. Pump, hand/foot operated	1	7.7
47. Pump, other	1	7.7
53. Civil, structural construction machinery	1	7.7
Agricultural machinery		
61. Farm tractor	1	7.7
Machine tools for metal working		
71. Lathe	5	38.5
72. Drilling machine	6	46.2
73. Shaper	5	38.5
74. Power press m/c	1	7.7
75. Shearing m/c	2	15.4
76. Punching/notching m/c	1	7.7
Machine tools for woodworking		
77. Lathe	1	7.7
78. Drilling m/c	3	23.1
79. Planer	1	7.7
80. Others	2	15.4
Vehicles		
81. Motor cars, jeep & vans	1	7.7
82. Truck, bus	2	15.4
Miscellaneous		
92. Pipe work	1	7.7
94. Electrical machinery	1	7.7
Total	13	400.4

The share of each products by category is classified into '41-60%' for 4 makers (30.8%) and '61-80%' for one maker (7.7%) in the sector of capital good (i.e. machine tools and industrial machinery) and 'less than 20%' for others in the sector of components for consumer goods (i.e. automobiles, pumps, etc.) and these figures therefore clarify that many factories are engaged in processing various products concurrently.

Table 4.4.5 (7) Main Products and Processings
(Q05-01)

Category of products \ Share to sales	(1) 0-20%		(2) 21-40%		(3) 41-60%		(4) 61-80%		(5) 81-100%		Total	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Machines and parts thereof												
01-01. Complete machines for Capital goods	8	61.5	-	-	4	30.8	1	7.7	-	-	13	100
01-02. Complete machines for Consumer goods	11	84.6	1	7.7	-	-	-	-	1	7.7	13	100
01-03. Parts, component for Capital goods	10	76.9	2	15.4	-	-	1	7.7	-	-	13	100
01-04. Parts, component for Consumer goods	12	92.3	1	7.7	-	-	-	-	-	-	13	100
01-05. Gears	13	100	-	-	-	-	-	-	-	-	13	100
Repairing and rebuilding services												
01-11. For own products only	12	92.3	-	-	-	-	-	-	1	7.7	13	100
01-12. For domestic products	13	100	-	-	-	-	-	-	-	-	13	100
01-13. For import products	13	100	-	-	-	-	-	-	-	-	13	100
Processing and/or subcontracting services												
01-21. Machining	8	61.5	4	30.8	-	-	1	7.7	-	-	13	100
01-22. Casting	10	76.9	1	7.7	-	-	1	7.7	1	7.7	13	100
01-23. Forging	13	100	-	-	-	-	-	-	-	-	-	-
01-24. Heat treatment	13	100	-	-	-	-	-	-	-	-	-	-
01-25. Plating	13	100	-	-	-	-	-	-	-	-	-	-
01-26 Welding	13	100	-	-	-	-	-	-	-	-	-	-
01-27. Painting	13	100	-	-	-	-	-	-	-	-	-	-
01-28. Sheetwork/pressing	13	100	-	-	-	-	-	-	-	-	-	-
01-29. Precision machining for gears, die-mold, etc.	13	100	-	-	-	-	-	-	-	-	-	-
01-30. Others	13	100	-	-	-	-	-	-	-	-	-	-

The share in machining is '21-40%' and '61-80%' for 4 makers each, while the share in casting is '21-40%', '61-80%' and '81-100%' for one maker each and these figures therefore clarify that specialization in these sectors is in progress.

iii. Sales

a) Sales Amount and Production Orders in Hand

Annual sales amount is classified into less than ฿250,000 for 4 makers (30,8%), ฿250,001-1,000,000 for 2 makers (15.4%), ฿1,000,001-4,000,000 for 5 makers (38.5%), ฿4,000,0001-16,000,000 and more than ฿16,000,001 for one maker each (7.6% each).

It is necessary to take precautions that small enterprises may often give an answer of a purposely reduced sales amount to outsiders.

Table 4.4.5 (8) Annual Sales Amount (฿)
(Q01-02-01)

Sales Amount (฿/year)	Freq	%
1. Less than 250,000	4	30.8
2. 250,001-1,000,000	2	15.4
3. 1,000,001-4,000,000	5	38.5
4. 4,000,001-16,000,000	1	7.7
5. 16,000,001-100,000,000	1	7.6
Total	13	100.0

Production orders in hand is clasified into "none" and "one week or less" 23.1% each for 3 makers each, "8-15 days" 15.4% for 2 makers, "16-30 days" 7.7% for one maker, showing that the majority falls under a short period group as against "1-5 months" 30.7% for 4 makers and "more than 5 months" for none. (Table 4.4.5 (9), Q22-01-01)

Table 4.4.5 (9) Production Orders in Hand
(Q22-01-01)

	Freq	%
1. None	3	23.1
2. One week or less	3	23.1
3. 8 - 15 days	2	15.4
4. 16 - 30 days	1	7.7
5. 1 - 5 months	4	30.7
6. More than 5 months	-	-
Total	13	100

b) Markets, Competitors and Completitiveness

Markets of products are classified into 76.9% region/district around the location of enterprises, 46.2% province/state and 61.6% whole country of Thailand. Attention may be given to 2 makers (15.4%) engaged in export to developing countries. (Table 4.4.5 (10), Q20-01-01)

Competitors are limited to local manufacturers because of 100% domestic products, so that there is no competition with imported products. (Table 4.4.5 (11), Q21-01-01)

Table 4.4.5 (10) territory of Market (Q20-01-01)

	Freq	%
1. Region/Dirstrict	10	76.9
2. Province/State	6	46.2
3. Country	8	61.5
4. Developing countries	2	15.4
5. Newly industrialized countries (NICS)	-	-
6. Developed countries	-	-
Total	13	200

Table 4.4.5 (11) Main Competitors (Q21-01-01)

	Freq	%
1. Local	13	100
2. Foreign	-	-
Total	13	100

Reasonable self-evaluation is given to the competitiveness in the market as classified into 69.2% "moderate" and 15.4% each "strong" and "weak". (Table 4.4.5 (12), Q28-01-01)

Table 4.4.5 (12) Self Evaluation of present position in market (Q28-01-01)

	Freq	%
1. Very strong	-	-
2. Strong	2	15.4
3. Moderate	9	69.2
4. Weak	2	15.4
5. Very weak	-	-
Total	13	100.0

iv. Employees

Table 4.4.5 (13) shows the total number of employees and those in production division (directly productive staff, indirectly productive staff) and administration division classified by skilled, unskilled, male, female and number of persons (Q10-00), while Table 4.4.5 (14) shows the survey results of average age, service years and wage of employees. According to these figures, the directly productive skilled staff in production idvision mainly consists of age of 26-35 years (84.6%) with service years of 6-10 (61.5%) and monthly wage of ฿2,50-4,000 (53.8%).

Table 4.4.5 (13) Employees (Q-10-00)
(a) Number of Employees by Category

Classified Employee \ Number of Employee		(1) 1-6	(2) 7-16	(3) 17-40	(4) 41-100	(5) 101-250	(6) 251-630	(7) 631-1600	Total
Directly Productive Staff									
00-01 Skilled, male	Freq.	3	4	6	-	-	-	-	13
	%	23.1	30.8	46.1	-	-	-	-	100.0
00-02 Skilled, female	Freq.	13	-	-	-	-	-	-	13
	%	100.0	-	-	-	-	-	-	100.0
00-11 Unskilled, male	Freq.	9	1	2	1	-	-	-	13
	%	69.2	7.7	15.4	7.7	-	-	-	100.0
00-12 Unskilled, female	Freq.	12	1	-	-	-	-	-	13
	%	92.3	7.7	-	-		-	-	100.0
Indirectly Productive Staff									
00-21 Skilled, male	Freq.	11	2	-	-	-	-	-	13
	%	84.6	15.4	-	-	-	-	-	100.0
00-22 Skilled, female	Freq.	13	-	-	-	-	-	-	13
	%	100.0	-	-	-	-	-	-	100.0
00-31 Unskilled, male	Freq.	12	-	1	-	-	-	-	13
	%	92.3	-	7.7	-	-	-	-	100.0
00-32 Unskilled, female	Freq.	12	1	-	-	-	-	-	13
	%	92.3	7.7	-	-	-	-	-	100.0
Administration Staff									
00-41 Male	Freq.	12	1	-	-	-	-	-	13
	%	92.3	7.7	-	-	-	-	-	100.0
00-42 Female	Freq.	13	-	-	-	-	-	-	13
	%	100.0	-	-	-	-	-	-	100.0
Sub-Total									
00-51 Male, total	Freq.	1	4	5	2	1	-	-	13
	%	7.7	30.8	38.5	15.4	7.6	-	-	100.0
00-52 Female, total	Freq.	11	1	1	-	-	-	-	13
	%	84.6	7.7	7.7	-	-	-	-	100.0
Total									
00-61 Total, male + female	Freq.	1	4	5	2	1	-	-	13
	%	7.7	30.8	38.5	15.4	7.6	-	-	100.0

(b) Average Age, Service Years and Wage of Employees

	Directly Productive Staff				Indirectly Productive Staff				Admin Staff		Total	
	Skilled		Un/Semi-Skilled		Skilled		Un/Semi-Skilled					
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Average Age	00-03		00-13		00-23		00-33		00-43		00-53	
1. Less than 15 years.	-	-	3	23.1	10	76.9	11	84.6	2	15.4	10	76.9
2. 16-25	-	-	9	69.2	-	-	1	7.7	1	7.7	-	-
3. 26-35	11	84.6	1	7.7	2	15.4	1	7.7	3	23.1	3	23.1
4. 36-45	2	15.4	-	-	1	7.7	-	-	6	46.2	-	-
5. Higher than 46	-	-	-	-	-	-	-	-	1	7.6	-	-
Sub total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0
Average Service Yr.	00-04		00-14		00-24		00-34		00-44		00-54	
1. Less than 2 years.	-	-	9	69.2	10	76.9	12	92.3	2	15.4	10	76.9
2. 3-5	3	23.1	3	23.1	-	-	-	-	1	7.7	1	7.7
3. 6-10	8	61.5	1	7.7	3	23.1	1	7.7	3	23.1	2	15.4
4. 11-15	1	7.7	-	-	-	-	-	-	2	15.4	-	-
5. Longer than 16	1	7.7	-	-	-	-	-	-	5	38.4	-	-
Sub total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0
Avg Wage Per Mth	00-05		00-15		00-25		00-35		00-45		00-55	
1. Less than 1,000 ¥	-	-	1	23.1	10	76.9	11	84.6	7	53.8	10	76.9
2. 1,001-1,600 ¥	-	-	-	-	-	-	-	-	-	-	-	-
3. 1,601-2,500 ¥	3	23.1	9	69.2	-	-	2	15.4	-	-	2	15.4
4. 2,501-4,000 ¥	7	53.8	1	7.7	2	15.4	-	-	2	15.4	-	-
5. 4,001-6,300 ¥	3	23.1	-	-	1	7.7	-	-	1	7.7	1	7.7
6. Higher than 6,300 ¥	-	-	-	-	-	-	-	-	3	23.1	-	-
Sub total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

The directly productive unskilled staff consist of age of 16-25 years (69.2%) with service years of less than 5 years (92.5%) and monthly wage of ฿1,601-2,500 (69.2%) On the other hand, the indirectly productive skilled staff consists of age of less than 15 years (76.9%) with service years of less than 2 years (76.9%) and monthly wage of less than ฿1,000 (76.9%). Nearly the same tendency applies to the indirectly productive unskilled staff. Administration division shows a high level such as age of 36-45 years (46.2%) with service years of 11-15 years and monthly wage of more than ฿6,300 (23.1%).

As a whole, there is a high percentage young laborors of less than 15 years old (76.9%) with service years of less than 2 years and monthly wage of less than ฿1,000 (76.9%) but these figures seem to be lower than the actual ones. Allocation of personnel to principal departments such as marketing/selling, cost estimation, design/engineering and inspection is as shown in table 4.4.5 (15), Q10-01.

Table 4.4.5 (15) Employee's Number by Key Department (Q10-01)

	1.01-01 Marketing/ Selling		2.01-02 Cost Estimation		3.01-03 Inspection/ QC		4.01-04 Design/ Engineering	
	Freq	%	Freq	%	Freq	%	Freq	%
1. None	6	46.2	3	25.0	3	23.1	5	55.6
2. One person	5	38.5	7	58.3	8	61.5	2	22.2
3. 2 - 3 persons	1	7.7	2	16.7	1	7.7	1	11.1
4. 4 - 5 persons	1	7.7	-	-	1	7.7	-	-
5. More than 6 persons	-	-	-	-	-	-	1	11.1
Total	13	100	12	100	13	100	9	100

Attention is given to each department where persons in charge are not specifically alloted. Especially marketing/selling and design/engineering are weak.

Moral of Employees :

Self-evaluation is given to the moral of employees, which is relatively low in 2 firms but is moderate or high in other firms. Table 4.4.5 (16), Q15-01-01.

Table 4.4.5 (16) Moral of Employees

	Freq	%
1. Very low	-	-
2. Relatively low	2	15.4
3. Moderate	5	38.5
4. Relatively high	4	30.8
5. High	2	15.3
6. Very high	-	-
Total	13	100

Education level of employees :

Education level of employees mainly consits fo graduates of primary school, secondary school and higher grade school. There are only 3 makers and 2 makers that recuited the graduates of vocational/trade/higher technical schools and polytechnic/semi-academic schools repectively. There are no makers that recruited university graduates. Table 4.4.5 (17), Q11-00.

Table 4.4.5 (17) Education Level of Employees
(Q11-00)

Level / Number	00-01 Primary school or less		00-02 Up to 3 years secondary school		00-03 4-6 yrs higher grade school		00-04 Vocational/Trade/ Higher Technical		00-05 Polytechnic/ Semi-academi		00-06 University	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
1. 0	3	23.1	6	46.2	4	30.8	10	76.9	11	84.6	13	100.0
2. 1-3	3	23.1	1	7.7	6	46.2	2	15.4	2	15.4	-	-
3. 4-6	3	23.1	-	-	2	15.4	1	7.7	-	-	-	-
4. 7-10	2	15.4	2	15.4	1	7.6	-	-	-	-	-	-
5. 11-20	1	7.7	1	7.7	-	-	-	-	-	-	-	-
6. More than 21	1	7.6	6	23.0	-	-	-	-	-	-	-	-
Total	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0	13	100.0

v. SUBCONTRACT

a) Subcontracting Job In/Out :

Table 4.4.5 (18), Q70-00

Makers reciving subcontract orders are classified into 38.4% "constantly", 15.4% "sometimes" and 7.7% "often", but there are no makers placing subcontract orders. (This answer conflicts with Table 4.4.5 (19) where subcontracting out for casting and heat treatment is seen).

Table 4.4.5 (18) Subcontracting Job

	00-01 In		00-02 Out	
	Freq	%	Freq	%
1. No	4	30.8	1	100
2. Rarely	1	7.7	-	-
3. Sometimes	2	15.4	-	-
4. Often	1	7.7	-	-
5. Very often	-	-	-	-
6. Constantly	5	38.4	-	-
Total	13	100.0	1	100

Subcontracted in processes are classified into 100% machining, 50% each casting and sheetwork/welding, and 40% machine assembly. Table 4.4.5 (19), Q02-01

Table 4.4.5 (19) Category of subcontracting in/out (Q02-01)

	01-01 Own		01-02 In		01-03 Out	
	Freq	%	Freq	%	Freq	%
1. Casting	1	14.3	5	50.0	1	33.3
2. Forging	-	-	-	-	-	-
3. Sheetwork & Welding	6	85.7	5	50.0	-	-
4. Plating	-	-	-	-	-	-
5. Machine Assembly	3	42.9	4	40.0	-	-
6. Machining	4	57.1	10	100.0	-	-
7. Presswork	1	14.3	-	-	-	-
8. Precision Machining (Mold & Die, Gear, etc)	-	-	-	-	-	-
9. Heat Treatment	-	-	-	-	3	100
Total	7	214.3	10	240.0	3	133.3

Table 4.4.5 (20) Own use/ subcontracting job in/out (Q04-01)

	01-01 Own		01-02 In		01-03 Out	
	Freq	%	Freq	%	Freq	%
1. Service & Repair only	4	66.7	6	54.5	-	-
2. Auxiliary materials	2	33.3	-	-	-	-
3. Basic materials	-	-	-	-	-	-
4. Standard component/ parts	-	-	4	36.4	-	-
5. Fabricated goods	-	-	2	18.2	-	-
6. Assembled goods	2	33.3	5	45.5	-	-
7. Integrated goods (Fabricated & Assembled goods)	2	33.3	5	45.5	-	-
8. Others (Specify)	-	-	-	-	-	-
Total	6	166.6	11	200.1	-	-

On the other hand, makers placing subcontract orders (subcontracting out) with outside makers are as small as one for casting and 3 for heat treatment. In Table 4.4.5 (20), Q41-01 where questions are raised as to the job description of subcontracting-out goods and the number of subcontractors, only one maker raised casting as subcontracting-out goods. These results show the fact that makers themselves are concentrating on subcontracting business and that they have no room of placing subcontract orders with outside makers. There are servive/repair, standard component/parts, assembled goods that can be raised as subcontract job description.

b) Subcontracting In/Out by Product

Makers are mostly engaged in subcontracting-in of automobile - related components and industrial machinery parts as well as components of agricultural machinery, electrical equipment, railway equipment, etc. They place no subcontract orders with outside firms. Table 4.4.5 (21), Q05-00

Table 4.4.5 (21) Kind of Products
(Q05-00)

	00-01 Own		00-02 In		00-03 Out	
	Freq	%	Freq	%	Freq	%
1. Motor vehicles or parts	-	-	9	100	-	-
2. Industrial machinery or parts	2	40.0	9	100	-	-
3. Civil, structural & construction machinery or parts	1	20.0	1	11.1	-	-
4. Agricultural machinery or parts	2	40.0	4	44.4	-	-
5. Electrical & telecommunication machinery or parts	-	-	2	22.2	-	-
6. Transport & harbour equipment not classified elsewhere but including shipbuilding & repairing	-	-	1	11.1	-	-
7. Pipework or parts (except item 16)	-	-	1	11.1	-	-
8. Architectural/ carpentry & bldg works or parts	-	-	-	-	-	-
9. Railway equipment & carriage parts	-	-	2	22.2	-	-
10. Working tools or parts	1	20.0	-	-	-	-
11. Metalworking machinery or parts (except item 17)	-	-	-	-	-	-
12. Moulds & dies or parts	1	20.0	-	-	-	-
13. Tableware/utensils or parts	-	-	-	-	-	-
14. Kitchen equipment	-	-	-	-	-	-
15. Engines & turbines	-	-	-	-	-	-
16. Pumps & valves	-	-	-	-	-	-
17. Machine tools	-	-	-	-	-	-
18. Gears	-	-	-	-	-	-
19. Other machineries & equipment or parts	-	-	-	-	-	-
20. Others, specify ___	-	-	-	-	-	-
Total	5	140	9	322.1	0	0

c) Number of Subcontractors

In Q31-01, Table 4.4.5 (22) where a question is raised as to the number of subcontractors only 2 makers raised subcontractors for casting and others gave answers that they have no subcontractors. From this example, it is clear that they are not in subcontracting-out position, but in subcontracting-in position.

Table 4.4.5 (22) Number of Subcontractors by Process
(Q31-01)

Products \ Number of sub-contractors	(1) 0		(2) 1-3		(3) 4-6		(4) 7-10		(5) 11-20	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
01-01 Complete products	13	100.0	-	-	-	-	-	-	-	-
Parts, component & processing										
01-02 Machining	13	100.0	-	-	-	-	-	-	-	-
01-03 Casting	11	84.6	-	-	-	-	1	7.7	1	7.7
01-04 Forging	13	100.0	-	-	-	-	-	-	-	-
01-05 Heat Treatment	13	100.0	-	-	-	-	-	-	-	-
01-06 Plating	13	100.0	-	-	-	-	-	-	-	-
01-07 Painting	13	100.0	-	-	-	-	-	-	-	-
01-08 Welding	13	100.0	-	-	-	-	-	-	-	-
01-09 Sheet Work/Pressing	13	100.0	-	-	-	-	-	-	-	-
01-10 TOTAL:	13	100.0	-	-	-	-	-	-	-	-

2) Technological Aspect

i. Design & Engineering

Tabel 4.4.5 (23), Q49-03 shows the results of survey on the source of design and engineering on stage-by-stage basis. Design and engineeering on the upstream side such as conceptual design, decision of specification structural design, etc. are mainly provided by client and detail design, production engineering, procurement of materials are likely to be performed by their own technology. Copying of preceding products seems to play an important role in the stages of conceptual design and structural design.

Although makers own industrial standards, answers to a question whether "owned but not in use" or "owned and actually in use" are as shown in Table 4.4.5 (25), Q44-01-01. Irrespective of such international standards as ANSI, ASTM, BS, JIS, etc. given in the table, customer's standards which subcontractors usually adhere to are most frequently used (92.3%). Company standards (38.5%) follow customer's standards.

Table 4.4.5 (23) Source of Design and Engineering (Q49-03)

Engineering Source / Items	(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

Machine Tools

Table 4.4.5 (24)
Industrial Standrds
(Q44-01-01)

Name of Std.	Owned, not in use		Actually in use	
	Freq	%	Freq	%
ANSI	-	-	1	7.7
ASTM	-	-	2	15.4
BS	-	-	1	7.7
JIS	1	7.7	4	30.8
ISO	-	-	1	7.7
DIN	-	-	1	7.7
TIS (Thai Ind. Std.)	-	-	3	23.2
Customer's Std.	-	-	12	92.3
Company Std.	-	-	5	38.5
Total	Freq: 13, %: 238.6			

Table 4.4.5 (25) Instruction of Quality Specification from Contractor to Subcontractor
(Q49-06)

	06-01 From		06-02 To	
	Freq	%	Freq	%
1. None	3	23.1	-	-
2. Yes, verbal instruction only	1	7.7	-	-
3. Yes, by order specification	7	53.8	-	-
4. Yes, by special document/drawing	2	15.4	-	-
5. Yes, 4.4 dispatched instructor(s)/ supervisor(s)	2	15.4	-	-
6. Others (Specify)	-	-	-	-
Total	13	115.4	-	-

Instruction of quality specification from contractor to subcontractor is classified into 23.1% "none", 7.7% "yes, verbal instruction only" and 53.8% "yes, by order specification". (table 4.4.5 (25), Q49-06).
Besides the above, there were 15.4% each "yes, by special document/drawing" and "yes, dispatched instructor/supervisor" by 2 makers each.

ii. Production

Monthly production is classified into less than 10 pieces and 11-150 pieces by 4 makers each (30.8% each) and 151-300 pieces by 2 makers (15.4%), namaely, on a small-scale production basis.

Table 4.4.5 (26) Monthly Production
(Q30-01-01)

	Freq	%
1. Less than 10 pieces/month	4	30.8
2. 11 - 150 pieces	4	30.8
3. 151 - 300 pieces	2	15.4
4. 301 - 600 pieces	1	7.7
5. 601 - 1,500 pieces	1	7.7
6. More than 1,500 pieces	1	7.6
Total	13	100.0

There are some makers utilizing used or second-hand parts such as gears, motors, steel plates, etc. as a part and components for their products. Table 4.4.5 (27), Q50-01-01

Table 4.4.5 (27) Used/Second-hand Parts and Raw Materials (Q50-01-01)

	Freq	%
1. None	6	50.0
2. Gears	2	16.7
3. Bearings	-	-
4. Bushes	-	-
5. Motors	1	8.3
6. Steel plates	1	8.3
7. Raw materials	5	41.7
8. Others (Specify):	-	-
Total	12	125.0

Table 4.4.5 (28) shows answers to a question on the number of employees who can understand the technical drawings. The answer "none" at 30.8% includes no anser.

Table 4.4.5 (28) Number of Employees who can Understand Technical Drawings (Q41-01-01)

	Freq	%
1. None	4	30.8
2. One person	2	15.4
3. 2 - 4 persons	4	30.8
4. 5 - 10 persons	1	7.7
5. More than 10 persons	2	15.3
Total	13	100.0

Efforts are made in reducing defect rate (Table 4.4.5 (29), Q49-10-01) and most of the makers (61.5%) gave answers of defect rate after shipping being less than 1%. One of them gave such a high defect rate as 11-20%. (Table 4.4.5 (39), Q-09-01)

Table 4.4.5 (29)
Defect Management
(Q49-10-01)

	Freq	%
1. Not applicable	2	15.4
2. Emprically	5	38.5
3. Analysis of causes as a whole	4	30.8
4. 3. + their monetary terms conversion	-	-
5. 4. either for each kind of product or process	2	15.3
6. 4. both for each kind of product & process	-	-
7. Others (Specify)	-	-
Total	13	100.0

Table 4.4.5 (30)
Defect Rate after Shipping
(Q4.4.5 (30)

	Freq	%
1. More than 30%	-	-
2. 21 - 30%	-	-
3. 11 - 20%	1	7.7
4. 6 - 10%	2	15.4
5. 2 - 5%	2	15.4
6. Below 1%	8	61.5
Total	13	100.0

Dimensional tolerance for main products is classified into 76.9% "less than 1/10mm" and 7.7% (only one maker) "less than 1/100mm". (Table 4.4.5 (31), Q43-01-01). It is hardly imaginable that these figures were given by enterprises engaged in the production of machine tools (mainly components).

Table 4.4.5 (31) Tolerance of Main Products
(Q43-01-01)

	Freq	%
1. 100 mm or rough estimate	-	-
2. 10 mm	1	7.7
3. 1 mm	5	38.5
4. 1/10 mm	10	76.9
5. 1/100 mm	7	53.8
6. Less than 1/100 mm	1	7.7
Total	13	184.6

It is considered from these figures that makers are mostly engaged in the production of low-precision components and repair parts applied on a field-adjustment basis. Instructions given to workers are mostly by means of "sample/rough sketch/verbal instruction" (69.2%), followed by "technical drawing" (30.8%). Table 4.4.5 (32), Q47-01-01

Table 4.4.5 (32) Instruction to the Workers
(Q47-01-01)

	Freq	%
1. Sample/rough sketch/verbal instruction	9	69.2
2. Technical drawing	4	30.8
3. Own design technical drawing	-	-
4. Others, specify _____	-	-
Total	13	100.0

Interviewer's Assessment of Technical Level :

Interviewer's assessment after visiting makers is classified into 30.8% "normal/average" and 38.5% "relatively low", that are not much lower than expected. The assessment shows that these figures may be considered to repesent the actual state of mini- and small-scale metalworking industry in thailand. (table 4.4.5 (33), Q49-13-01)

Table 4.4.5 (33) Evaluation of Technical Level by the Interviewer (Q49-13-01)

	Freq	%
1. Very low (Primitive level)	2	15.4
2. Relatively low (Traditional level)	5	38.5
3. Normal/Average (Local level)	4	30.8
4. Relatively high (National level)	-	-
5. High (International level)	2	15.3
6. Extremely high (Exportable level)	-	-
Total	13	100.0

3) Production Facilities and Measuring Instrument

The cost and quality of product greatly depend upon the efficiency and accuracy of production facilities. Since checks on dimensions, angles, profile, surface roughness and hardness druing or after processing are also an important factor to improve the accuracy of machining, investigation was made into the measuring instrument.

i. Production Facilities

Due to faulty output processing of computor, correction will be made to produce output again.
Re-examination of data is required.

ii. Measuring Instrument

The measuring tools owned in each maker are shown in Table 4.4.5 (34), Q42-01-01.

Table 4.4.5 (34) Mesuring Instrument
(Q42-01-01)

	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 protoractor	1	7.7
23. Universal benel protoractor	-	-
24. Square	3	23.1
25. Straight edge	-	-
26. Combination square set	2	15.4
27. Micro protoractor	-	-
28. Optical protoractor	-	-
29. Iron level	-	-
30. Precision level	-	-
31. Box precision level	-	-
Profile		
32. 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. Harnester	-	-
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

Length and Flatness :

Though most of the makers keep tape measures, straight edges, calipers, etc., there are not many makers who keep micrometers (38.5%), depth meters (7.7%), dial gauges (15.4%) and cylinder gauges (15.4%). There are no makers who keep such high precision instruments as microscopes, thickness calipers, precision levels, surface plates and jigs.

Angle, Squareness and Parallelism :

Makers keep very simple measruing tools such as angle plates, squares, and combination square sets, etc.

Profile :

Not many makers keep radius gauges, screw pitch gauges, taper gauges, geartooth gauges, etc.

Temperature :

Reply was made by 2 makers only and this fact clarifies that temperature is hardly included in the object of measurement.

Surface Hardness ;

One maker each keeps Brinell, Rockwell and vickers testers respectively and, therefore, surface hardness is not checked just the same as the following surface roughness.

Surface Roughness (Machined surface) :

Only one maker keeps a surface roughness tester.

Electric Performance Testing :

One maker keeps a wattmeter, while 4 makers each keep a voltmeter and an ammeter respectively. This fact means that those which require dynamic test, running test are not included in the line of maker's product.

Testing and Inspection :

Only one maker keeps a chemical analyser.

Others :

Surface plates and V-blocks are kept by about 1/3 of all makers.

From the above results, no measurements can be made for those which require accuracy. Checks on surface roughness and hardness, that are indispensable for precision products, are not conducted also. Furthermore, surface plates, working jigs and inspection jigs are not put to use. Current situation of quality control is relatively poor since the basis of quality control starts from the control based on the measured figures. As surface plates, working jigs and inspection jigs offer a relatively higher effect than the amount of investment, it is necessary to conduct guidance to their application positively.

4) Product Inspection and Quality Control

Table 4.4.5 (35) shows ansers to questions on quality control system including inspection systems, inspectors, checking items and feed back of the results, which were raised to grasp the situation of product inspection. (Q46-01-01)

Table 4.4.5 (35) Inspection System and Feed Back System (Q46-01-01)

	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. Sequantial 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

- to be continued -

Product Inspection System :

Product inspection system is classified into "total inspection" (46.2%), "when trouble occurs check" (38.5%), "multiple sampling inspection" (23.1%), etc.

Inspectors :

Inspectors are classified into "workers themselves" (53.8%, about a half of the makers), which follows "manager or the owner" (61.5%). There is only one maker who has full-tme inspectors.

Checking Items and Methods :

Checking items and methods are classified into "visual check" (84.6%), "dimensional check" (84.6%), "clearance check for moving parts" (23.1%) and "hardness check" (7.7%, only one maker). No checks for surface roughness, internal defects of material, etc. are conducted.

Feedback after Trouble-shooting :

Feedback of the results of inspection is classified into "only in file, no feedback" (30.8%), "circulating notice or inspection record to workers/managers" (23.1%), "notice on the board" (7.7%), etc. and there is no organized system for the prevention of recurrence of troubles.

Inspection Records : Table 4.4.5 (36), Q49-08-01

Inspection records are classified into "nothing" (38.5%), "vsual inspection records" (46.2%), "dimensional check record" (23.1%), etc. and there are some makers who keep material test records, dynamic/static test records.

Table 4.4.5 (36)
Inspection Record
(Q49-08-01)

	Freq	%
1. Nothing	5	38.5
2. Visual inspection records	6	46.2
3. Dimension check records	5	38.5
4. Colour check records	-	-
5. X-ray, ultrasonic, magna-flux test records	-	-
6. Material test records	3	23.1
7. Material analysis records	1	7.7
8. Heat treatment records	-	-
9. Statical operation test records	2	15.4
10. Dynamical operation test records	1	7.7
11. Others (Specify)	-	-
Total	13	177.1

Table 4.4.5 (37)
Shipping Inspection for
Subcontracted Products
(Q49-07-01)

	Freq	%
1. None	4	30.8
2. Permanent check by subcontractor's staff before delivery	6	46.2
3. Temporary check by subcontractor's staff before delivery	-	-
4. Visual check after delivery	2	15.4
5. Inspection records check after delivery	1	7.6
6. Self-management of subcontractee	-	-
7. Others (Specify)	-	-
Total	13	100.0

Shipping Inspection System : Table 4.4.5 (37), Q49-07-01

Shipping inspection system is classified into "permanent check by subcontractor's staff before delivery" (46.2%), "none" (30.8%), and others such as "visual check after delivery" and "Inspection record check after delivery".

5) Price and Delivery

i. Price :

As the price is decided "after comparing market price" (161.8%, Table 4.4.5 (38), Q27-01-01), the price level is equal to "market price" (61.5%) or "1%-10% higher "(30.8%, Table 4.4.5 (39), Q24-01-01).

Table 4.4.5 (38)
Decision Making of
Price (Q27-01-01)

	Freq	%
1. Same as quotation/estimation of subcontractee	-	-
2. After comparing with self-estimation (target price)	3	23.1
3. After comparing market price	8	61.5
4. Short term agreement of price (Less than 6 months)	2	15.4
5. Long term agreement of price (More than 6 months)	-	-
6. Others (Specify)	-	-
Total	13	100.0

Table 4.4.5 (39) Assessment
of Price (Q24-01-01)

	Freq	%
1. 31% and above higher	-	-
2. 21% ~ 30% higher	-	-
3. 11% ~ 20% higher	-	-
4. 1% ~ 10% higher	4	30.8
5. Market price	8	61.5
6. Less than market price	1	7.7
Total	13	100.0

ii. Delivery :

Instruction of delivery time from the contractor is classified into "by purchase order specification" (46.2%), "verbal instruction only" (23.1%), "none" (23.1%), etc. table 4.4.5 (40), Q34-01-01

Table 4.4.5 (40) Instruction of Delivery Time from the Contractor (Q34-01-01)

	Freq	%
1. None	3	23.1
2. Yes, verbal instruction only	3	23.1
3. Yes, by purchase order specification	6	46.2
4. Yes, by short term agreement	1	7.6
5. Yes, by long term agreement	-	-
6. Others (Specify)	-	-
Total	13	100.0

Frequency of delayed delivery is classified into "sometimes" (38.5%), "very rare" (23.1%) and "rarely" (15.4%) (Table 4.4.5 (41), Q36-01-01), while average term of delayed delivery is less than one week (majority) and "1 month to 2 months" (one maker only). (Table 4.4.5 (42), Q37-01-01)

Table 4.4.5 (41) Delayed Delivery (Q36-01-01)

	Freq	%
1. Very often	1	7.7
2. Sometimes	5	38.5
3. Rarely	2	15.4
4. Very rare	3	23.1
5. Not at all	2	15.3
6. Others (Specify)	-	-
Total	13	100.0

Table 4.4.5 (42) Average Term of Delayed Delivery (Q37-01-01)

	Freq	%
1. Less than 3 days	4	33.3
2. 4 days to one week	5	41.7
3. 2 to 4 weeks	2	16.7
4. 1 month to 2 months	1	8.3
5. 3 months to 4 months	-	-
6. More than 5 months	-	-
Total	12	100.0

Cause of delayed delivery is classified into "poor process schedule", "shortage of manpower", "shortage of delivery time", "delay of raw materials". (Table 4.4.5 (44), Q35-01-01)

Table 4.4.5 (43) Causes of Delayed Delivery (Q39-01-010

	Freq	%
1. Poor process schedule	4	33.3
2. Delay of raw materials	2	16.7
3. Shortage of delivery time	3	25.0
4. Shortage of manpower	4	33.3
5. Delay of design engineering	-	-
6. Defect/Reject of delivery goods	1	8.3
7. Others (Specify)	1	8.3
Total	12	100.0

Table 4.4.5 (44) Preventive Measures for Delayed Delivery (Q35-01-01)

	Freq	%
1. No action	6	46.2
2. Occasional check of deference between planned & actual schedule	2	15.4
3. Weekly check of deference between planned & actual schedule	-	-
4. Daily check of deference between planned & actual schedule	3	23.1
5. Permanent follow up of necessary action by special staff	2	15.3
6. Others (Specify)	-	-
Total	13	100.0

Preventive measures for delayed delivery are classified into "no action" (46.2%), "daily check of difference between planned and actual schedules" (23.1%), and others such as "occasioanl check of difference between planned and actual schedules", "permanent follow up of necessary action by full-time staff", etc. (Table 4.4.5 (44), Q35-01-01)

6) Managerial Aspect

i. Management :

Profit management system is classified into "check as a whole business "(61.5%), "profit & loss calculation/account" (46.2%), "every business for each product" (30.8%), etc. (Table 4.4.5 (45), Q71-01-01)

Table 4.4.5 (45) Profit Management (Q71-01-01)

	Freq	%
1. Check as a whole business	8	61.5
2. Every business for main products	1	7.7
3. Every business for each products	4	30.8
4. Deference between standard cost & actual cost	1	7.7
5. Break even point	1	7.7
6. Profit & loss calculation/ account	6	46.2
7. Others (Specify)	-	-
Total	13	161.6

Table 4.4.5 (46) Term of Profit Management (Q72-01-01)

	Freq	%
1. Annually	11	91.7
2. Every six months	-	-
3. Monthly	1	8.3
4. Weekly	-	-
5. Daily	-	-
6. Others (Specify)	-	-
Total	12	100.0

Profit managemednt is carried out overwhelmingly "anually" (91.7%) and monthly (8.3%, only one maker). (Table 4.4.5 (46), Q72-01-01)
One-year interval is excessively less frequent.
Attaching great importance to direct cost such as material cost, labor cost, etc. in cost accounting, such answers as fix cost, sales charge, overhead are given by a few makers., (Table 4.4.5 (47), Q23-01-01)

Table 4.4.5 (47) Break down of Accounting System

	Freq	%
1. None	1	7.7
2. Every kinds of products	3	23.1
3. Every kinds of parts & compartments	4	30.8
4. Material cost	7	53.8
5. Labour cost	7	53.8
6. Direct cost/Indirect cost	4	30.8
7. Overhead	2	15.4
8. Sales charge	2	15.4
9. Profit	4	30.8
10. Depreciation	3	23.1
11. Fixed cost	-	-
12. Variable cost	3	23.1
13. Others (Specify)	-	-
Total	33	307.8

Table 4.4.5 (48) Management Policy to be Developed (Q73-01-01)

	Freq	%
1. R & D of product	6	46.2
2. R & D of technology	8	61.5
3. Productivity	7	53.8
4. Expansion of market share	8	61.5
5. Upgrading qualification	4	30.8
6. Diversification of products	1	7.7
7. Own capital	3	23.1
8. Labour cost	2	15.4
9. Material cost	3	23.1
10. Capital cost	4	30.8
11. Overhead cost	3	23.1
12. Production control	3	23.1
13. Process control	2	15.4
14. Design engineering	-	-
15. Cost control	2	15.4
16. Quality control	4	30.8
17. Human resources	-	-
18. Training of workers	-	-
19. Others (Specify)	-	-
Total	13	461.7

Main management policy to be developed is classified into "increase of market share" (61.5%), "R & D of technology" (61.5%), "R & D of product" (46.2%), "improving productivity" (53.8%), etc., that are to be accomplished with effort, and also "ugpraded quality" and "quality control" (30.8% each) to which attention is to be given.
(Table 4.4.5 (48), Q73-01-01)

Answers to questions on an organization chart are such that "none" or "verbal function only" is given by most of the makers and "chart with line function and job classification" is given by 3 makers only (23.0%). (Table 4.4.5 (49), Q12-01-01)

Table 4.4.5 (49) Organization Chart (Q12-01-01)

	Freq	%
1. None	3	23.1
2. Verbal function only	5	38.5
3. Verbal job classification only	2	15.4
4. Chart with line function	-	-
5. Chart with job	-	-
6. Chart with line function and job classification	3	23.0
7. Others (Specify)	-	-
Total	13	100.0

Training system for employees is classified into "whenever necessary (inhouse) "(58.3%), "man to man (OJT)" (61.5%) and "periodically according to planned scheme", "attend to training course/seminar/workshop (outside)" (one company each). (Table 4.4.5 (50), Q14-01-01) It is the current situation in Thailand that the training system for employees, though its importance is recognized, is not put into practice sufficiently due to a high rate of occupational change.

Table 4.4.5 (50) Training System (Q14-01-01)

	Freq	%
1. None	2	15.4
2. Man to man (OJT)	8	61.5
3. Whenever necessary (Inhouse)	7	53.8
4. Attend to training course/ seminar/workshop (Outside)	1	7.7
5. Periodically according to planned scheme	1	7.7
6. Others (Specify)	-	-
Total	13	100.0

Table 4.4.5 (51) Market Survey (Q29-01-01)

	Freq	%
Market tendency		
1. Competitors	5	55.6
2. Selling prices	5	55.6
3. Purchasing prices, raw materials, key parts/component	3	33.3
4. Quality	4	44.4
5. Subcontractors	1	11.1
6. New technology	1	11.1
Demand situation		
7. Total demand	-	-
8. Domestic output/Export	-	-
9. Import	1	11.1
Total	9	222.2

Out of 13 makers, 9 makers gave the answer "yes" to the question "whether or not market survey has so far been made".
Breakdown of all answers is given in Table 4.4.5 (51), Q29-01-01, which is classified into "competitors" and "selling price" (55.6% each), "quality" (44.4%), "purchasing prices of raw materials" (33.3%) and others such as subcontractors", "new technology".

ii. Subcontractor/Contractor

a) Purposes of Getting Subcontract Job

Main purposes to get subcontracting job are classified into "stable business performance" (83.3%), "increase of market' (50.0%), "own conveniences" (25.0%), etc. Also, "technology transfer" is given by one maker. (Table 4.4.5 (52), Q70-10-01)

Table 4.4.5 (52) Main Purposes to Get Subcontracting Job (Q70-01-01)

	Freq	%
1. Stable business performance	10	83.3
2. Increase of market	6	50.0
3. Technology transfer	1	8.3
4. Training of employee	-	-
5. Promotion of specialization	-	-
6. Own conveniences	3	25.0
7. Stable supply of raw materials	1	8.3
8. Information sources	1	8.3
9. Coexistence and coprosperity	2	16.7
10. Others (Specify)	-	-
Total	12	199.9

b) Subcontracting Job from Contractor

Contractors are classified into "companies of the larger scale" (41.7%), "companies of same scale" (25.0%), "government organization" (25%), "parent company" (16.7%), etc. (Table 4.4.5 (53), Q70-01). Distance up to the contractor is relatively long, usch as "less than 10 km" (15.4%) and "more than 151 km" (38.4%). (Table 4.4.5 (54), Q70-11-01). Makers have no designated subcontractors.

Table 4.4.5 (53) Sub-contracting Job To /From (Q70-01-01)

	01-01 From		01-02 To	
	Freq	%	Freq	%
1. Not applicable	2	16.7	-	-
2. Parent company/Affiliated company	2	16.7	-	-
3. Companies of the same scale	3	25.0	-	-
4. Companies of the larger scale	5	41.7	-	-
5. Government organization	3	25.0	-	-
6. Companies with foreign equity	2	16.7	-	-
7. Others, specify _____	2	16.7	-	-
Total	12	158.5	-	-

Table 4.4.5 (54) Distance up to the Contractor(s) (Q70-11-01)

	Freq	%
1. Less than 10 km	2	15.4
2. 11 - 20 km	1	7.7
3. 21 - 40 km	1	7.7
4. 41 - 80 km	2	15.4
5. 81 - 150 km	2	15.4
6. More than 151 km	5	38.4
Total	13	100.0

c) Minimum order scale and payment terms Minimum order scale is mostly as small as "less than 10 pieces" (84.6%). (Table 4.4.5 (55), Q70-12-01). Payment terms are classified into "cash + credit" (53.8%) and "credit (2 to 3 months)" (38.5%), and there are no payment terms exceeding 3 months (Table 4.4.5 (56), Q26-01-01)

Table 4.4.5 (55) Minimum Order Scale (Q70-12-01)

	Freq	%
1. Less than 10 pieces	11	84.6
2. 10 ~ 50 pieces	1	7.7
3. 51 ~ 100 pieces	-	-
4. 101 ~ 1,000 pcs	1	7.7
5. 1,001 ~ 10,000 pcs	-	-
6. More than 10,001	-	-
Total	13	100.0

Table 4.4.5 (56) Payment TProducts (Q26-01-01)

	Freq	%
1. Cash on delivery	1	7.7
2. Cash + Credit	7	53.8
3. Credit (Less than 1 month)	-	-
4. Credit (2 to 3 months)	5	38.5
5. Credit (4 to 6 months)	-	-
6. Others (Specify)	-	-
Total	13	100.0

d) Motivation of Receiving Orders and Oorder Route of Subcontracting Job

Motivation of receiving orders for subcontacting job started mostly from "by own market cultivation" (54.5%) and "relationship with owners/managers" (36.4%) (Table 4.4.5 (57), Q70-15), Order route of subcontracting job is "directly through contractor" (91.7%). Middlemen and traders/dealers are not much involved in the order route. (Table 4.4.5 (58), Q70-13)

Table 4.4.5 (57) Motivation to the Initial Stage with the Contractor/Subcontractor (Q70-15)

	15-01 Contractor		15-02 Sub-contractor	
	Freq	%	Freq	%
1. Neighbour	1	9.1	1	50.0
2. Realtives	-	-	-	-
3. Relationship between owners/managers	4	36.4	-	-
4. Introduction by an influential man	1	9.1	1	50.0
5. By own market cultivation	6	54.5	-	-
6. Others (Specify)	-	-	-	-
Total	11	109.1	2	100.0

Table 4.4.5 (58) Order Route of Subcontracting Job (Q70-13)

	13-01 In		13-02 Out	
	Freq	%	Freq	%
1. Through middleman	2	16.7	-	-
2. Through trader/dealer	-	-	-	-
3. From market	1	8.3	-	-
4. Through subcontractor's introducer	1	8.3	-	-
5. Directly through sub-contractor	11	91.7	-	-
6. Others (Specify)	-	-	-	-
Total	12	125.0	-	-

e) Description of Asistance from Contractor to Subcontractor

Description of assistance received from contractor is classified into "engineering services", "sequential advice" (33.3% each) "start-up advice" (22.2%), and others such as "machines & equipment procurement/supply", "capital investment" and also "no advice" (22.2%). (Table 4.4.5 (59)-Q70-02) Answers to the questions as to whether these items of assistance have been valid are shown in Table 4.4.5 (60), Q70-03.

Among affirmative answers such as "good" (44.4%), "relatively good" (11.1%), and "normally effective" (22.2%), it is interesting to see "very poor" (22.2%). It is presumed that the answer "very poor" was given by the makers who gave the answer "no advice" to the preceding question in Table 4.4.5 (59)

Table 4.4.5 (59) Assistance, Get/Give for Subcontracting Job (Q70-02)

	02-01 Get		02-02 Give	
	Freq	%	Freq	%
1. Capital investment	1	11.1	-	-
2. Provision of loans	-	-	-	-
3. Machine & equipment procurement/supply	1	11.1	-	-
4. Expert dispatch	-	-	-	-
5. Engineering services	3	33.3	-	-
6. Supply of indigenous raw material	-	-	-	-
7. Supply of imported raw material	-	-	-	-
8. Training of workers	-	-	-	-
9. Costing	-	-	-	-
10. Trouble shooting	-	-	-	-
11. Follow up cell	-	-	-	-
12. Utilities, consumables	-	-	-	-
13. License	-	-	-	-
14. Start-up advice	2	22.2	1	50.0
15. Sequencial advice	3	33.3	-	-
16. No advice	2	22.2	1	50.0
17. Others (Specify): ____	-	-	-	-
Total	9	133.2	2	100.0

Table 4.4.5 (60) Assessment after Assistance Gotten/ Given (Q70-03)

	03-01 Gotten		03-02 Given	
	Freq	%	Freq	%
1. Very poor	2	22.2	-	-
2. Relatively poor	-	-	-	-
3. Normally effective	2	22.2	-	-
4. Relatively good	1	11.1	-	-
5. Good	4	44.5	-	-
6. Excellent	-	-	-	-
7. Others	-	-	-	-
Total	9	100.0	-	-

f) Guaranty of Subcontracted Products

Guaranty of subcontracted products is classified into "none" (53.8%, the highest figure), "replacement only at delivery time", "less than three months" and "one year" (15.4% ,i.e. 2 makers each). (Table 4.4.5 (61), Q70-07-01). Aftercare of claims is classified into "none" (75%), "by manager" (25%) and "by marketing staff "(8.3%). (Table 4.4.5 (62), Q70-08-01)

Table 4.4.5 (61) Guaranty of Subcontracted Products (Q70-07-01)

	Freq	%
1. None	7	53.8
2. Replacement/correction only at delivery time	2	15.4
3. Less than three months	2	15.4
4. Three to six months	-	-
5. One year	2	15.4
6. More than one year	-	-
Total	13	100.0

Table 4.4.5 (62) Aftercare of Claims (Q-70-08-01)

	Freq	%
1. None	9	75.0
2. Marketing staff	-	-
3. Marketing/Production staff	1	8.3
4. Manager	3	25.0
5. Owner	-	-
6. Others (Specify)	-	-
Total	12	108.3

g) Preferable Relationship with Contractor and Subcontractor

Preferable contractor from the viewpoint of subcontractor is classified into "companies of the larger scale" (45.5%), "parent company/affiliated company", "companies of the same scale", "government organization", etc. (Table 4.4.5 (63), Q70-16)

Table 4.4.5 (63) Preferable Subcontracting Job From/To (Q70-16)

	16-01 From		16-02 To	
	Freq	%	Freq	%
1. Not applicable	1	9.1	1	100.0
2. Parent company/ Affiliated company	3	27.3	-	-
3. Companies of the same scale	3	27.3	-	-
4. Companies of the larger scale	5	45.5	-	-
5. Government organisation	3	27.3	-	-
6. Companies with foreign equity	1	9.1	-	-
7. Others, specify _____	1	9.1	-	-
Total	11	154.7	1	100.0

For future policy for receiving subcontracting job order and future relationship with contractor, most of the answers are "as same as present level" and "as it is", but a high percentage is also given by "gradual increase" or "more close tie up". On the other hand, there are some makers giving such answers as "gradual decrease" or "decrease of order". These makers wish to uplift their abilities so as to quit subcontractor's business.

Table 4.4.5 (64) Future Plan for Subcontract In (Q70-09-01)

	Freq	%
1. Rapid decrease	-	-
2. Gradual decrease	2	15.4
3. As same as present level	5	38.5
4. Gradual increase	6	46.1
5. Rapid expansion	-	-
6. Others (Specify)	-	-
Total	13	100.0

Table 4.4.5 (65) Future Relationship with the Contractors/subcontractors (Q70-14)

	14-01 Sub-Contractor		14-02 Sub-contractor	
	Freq	%	Freq	%
1. Stop the new order	-	-	-	-
2. Decrease of order	1	9.1	-	-
3. Diversifying sub-contractor	1	9.1	-	-
4. As it is	5	45.5	2	100.0
5. More close tie up	4	36.4	-	-
6. Others (Specify)	-	-	-	-
Total	11	100.1	2	100.0

iii. Sources of Technical Informations :

For information sources, answers are classified in the order of those given at a higher percentage into "other firms" (61.5%), "human network" (53.8%), "Industrial Service Institute (ISI) of DIP", "magazine (foreign)" (38.5% each) and others such as "consultant", "workshop" and "seminar" (Table 4.4.5 (66), Q49-04-01)

Table 4.4.5 (66) Technical Information Sources (Q49-04-01)

	Freq	%
1. Newspaper	1	7.7
2. Magazine (Local)	3	23.1
3. Magazine (Foreign)	5	38.5
4. Seminar	4	30.8
5. Workshop	4	30.8
6. Exhibition	3	23.1
7. Consultant	4	30.8
8. Extension officer	1	7.7
9. Circular	1	7.7
10. Corporative	1	7.7
11. Industrial Service Institute (ISI) of DIP	5	38.5
12. Human network	7	53.8
13. Subcontractor	2	15.4
14. Other firms	8	61.5
15. University/college	1	7.7
16. Others (Specify)	-	-
Total	13	384.8

7) Financial Aspect

Stock period of raw materials is classified into "8-30 days" (46.2%), "2-3 months" (30.8%), "1-2 months" (15.4%), etc. (Table 4.4.5 (67), Q60-00-01) It should be noted that makers have never utilized the governmental credit assistance program. (Table 4.4.5 (68), Q60-01-01)

Table 4.4.5 (67) Stock of Raw Materials (Q60-00-01)

	Freq	%
1. Up to 7 days	-	-
2. 8 - 30 days	6	46.2
3. 1 - 2 months	2	15.4
4. 2 - 3 months	4	30.8
5. More than 3 months	1	7.6
Total	13	100.0

Table 4.4.5 (68) Experiance of the Government Fund (Q60-01-01)

	Freq	%
1. Yes	-	-
2. No	13	100
Total	13	100

Trend in Capital Investment :

Although several questions were raised as to production facilities, machinery, estate, building structure (acquirement or remodeling), most of the makers refrain from answering to these questions and it is difficult to grasp the trend. Judging from the status of makers at the field survey of them, no brisk investment takes place. (Q61-02)

Investment for Research and Development :

Investment in research and development to sales is classified into "less than 0.5%" and "1.1-2.0%" (4 makers each, i.e. about 1/3 each) (Table 4.4.5 (69), Q45-01-01)
On the other hand, about 1/3 of the makers gave the answer "none" to the question on investment in research and development.

Table 4.4.5 (69) Expence to the R & D Program to the Total Sales (Q45-01-01)

	Freq	%
1. None	5	38.5
2. Less than 0.5%	4	30.8
3. 0.6% - 1%	-	-
4. 1.1% - 2%	4	30.7
5. 2.1% - 3%	-	-
6. More than 3%	-	-
Total	13	100.0

8) Preferable Government Assistances and Assessment of Existing Ones (Table 4.4.5 (61), Q74)

Most of the answers centered on encouraging measures for investment such as tax exemption, market activation, low-interest credit assistance, etc. and also on technical information services such as testing services, information services, consultancy services, etc., where the assessment of these assistance measures and services was judged to be "useful" or "very useful". Since testing and inspection facilities which call for a great amount of investment for measuring instruments, building and specialists are a great burden to medium-and small scale enterprises, it is desired to provide them with technical services by public sectors.

Table 4.4.5 (70) Preferable Government Assistance and Assessment of Existing Ones (Q-74)

	1. Not useful		2. Useful		3. Very useful		Total	
	Freq	%	Freq	%	Freq	%	Freq	%
Development of infrastructure								
01-01. Access road	-	-	2	66.7	1	33.3	3	100.0
01-02. Telecommunication	-	-	2	50.0	2	50.0	4	100.0
01-03. Electric supply	-	-	2	100.0	-	-	2	100.0
01-04. Water supply	-	-	2	66.7	1	33.3	3	100.0
01-05. Central sewerage treating	-	-	1	100.0	-	-	1	100.0
01-06. Pollution control	-	-	1	33.3	2	66.7	3	100.0
Technical/information services by public organization								
01-11. Training services	-	-	1	33.3	2	66.7	3	100.0
01-12. Consultancy services	-	-	3	75.0	1	25.0	4	100.0
01-13. Information services	-	-	3	60.0	2	40.0	5	100.0
01-14. Testing services	-	-	3	50.0	3	50.0	6	100.0
01-15. Laboratory	-	-	1	50.0	1	50.0	2	100.0
01-16. Standardization	-	-	2	100.0	-	-	2	100.0
01-17. Quality control	-	-	2	66.7	1	33.3	3	100.0
01-18. Seminer/symposium	-	-	2	66.7	1	33.3	3	100.0
Financial/Marketing support Encouraging investment								
01-21. Tax rebate and tax exemption	-	-	4	44.4	5	55.6	9	100.0
01-22. Credit assistance	-	-	2	50.0	2	50.0	4	100.0
01-23. Subsidy	-	-	1	100.0	-	-	1	100.0
01-24. Marketing	-	-	3	42.9	4	57.1	7	100.0
Protection of domestic products								
01-31. Import surcharge	-	-	2	100.0	-	-	2	100.0
01-32. Import restriction	-	-	1	100.0	-	-	1	100.0
01-33. Export promotion	-	-	1	25.0	3	75.0	4	100.0

(3) CONCLUSION

1) Current Field Situations

Machine tools, the machinery for the manufacture of machinery and tools, is the nucleus for the development of the machinery as well as other heavy and chemical industries. It is, however, one of the least developed industries in developing countries, due to lack of technology, the slow development of raw materials and parts industries and limited domestic market.

As domestic demand began to increase, several companies entered this industry. But they met technical problems and also the import pressure by low price machines from Taiwan and R. China, and used machines from the developed countries.

Local productions' share of the demestic market is very negligible.

Enterpreneurs are reluctant to enter the machaine tool business, because of the high risk involved in this business environment.

Setting up a machine tool factory equipped with modern machines, equipment and personnel could not be possible to proceed unless the government will be nvolved in the project and provide substantial support for the industry.

Existing firms should be given more assitance and incentives to further motivate them. Constant dialogue between the government and the industrialist should be carried out on a regular basic to update existing technologies. The government as well as the industrialist should promote joint ventures inviting foreign investors to the country for the manufacture of new product lines and infusion of the much needed capital investments.

The support industries (casing and forging, heat treatment, gear cutting) which the machine tool industry requires possess limited capabilities too. They are not generally capable of meeting the machine tool industry's work specifications. These industries are essential for the operation of the machine tool industries and special attention should be given said industries for possible assistance and development. for purposes of technical update on process and material selection, interaction among the material suppliers, support

industries and the manufacturers is highly advisable. Each institution could be instrumental in disseminating and sharing of informations relevant to their operations. The government on the other hand can provide the necessary incentives (training programs, research and development program) needed by both the machine tool industry and the support industries.

2) Demand tendency

There is a big technology gap getween the developing countries and the developed countries. The current local market need in the participating countries features small, light, universal, and technically simple machines with a tendency towards more precise, heavy specialized efficient (e.g. milling rather than shaper) and refining machines.

Simple general purpose machines to satisfy the local need are no longer produced in the advanced countries such as simple engine lathes, drilling machines and shapers. For local manufactures, there are opportunities to enter this field.

On the contrary, with the development of industrialization of the national economy, the metal industries need high quality and high productivity machines at low prices. The requirement for the industry are largely met by importations, because the local production has not contributed any portion of the total market for the industry.

3) Major problems of Machine Tool Industries

i. Technical/Production Problems

The machine tool industry is a high technology-intensive one which requires engineers of high grades, especially for designers. For them, they must have a good knowledge in definite field and also possess actual working experiences. They should have received relatively long period of training and development. The shortage of these engineers is the most serious problem for the ASEAN countries.

Existing firms which manufacture machine tools are doing their business in a very small way adopting family tyle management. Due to lack of

techniques on personnel, finance, business and material management, and lack of engineering know-how and knowledge for precision products, the quality of products is unstable. The quality of products are suffered partly because of the poor quality of production facilities and measuring instruments.

Their sales is very small. To operate successfully a company, however, has to sell its products in large volme. to obtain volme business it must have a supply of satisfied customers who can be relied upon to continue buying its products out of confidence and dependence upon the company's reputation for producing quality products. Thus quality in the products is essential to volume sales. Volume sales mean a competitive price which means more satisfied customers and an even bigger volume.

The machine tool industry is closely supported by industries and suppliers which can meet the specifications for raw materials, parts and components and technical services such as casting, forging and heat treatment. The field current situations of the support industries are :

a) The parts for manufacturing machine tools in ASEAN countries are of low grade or are unstable. Special alloy steel is wholly imported in limited amount and high cost ; tool steel, carbon steel and alloy steel lack intensity and durability.

b) High forged components such as spindles, bearings, gears and pumps are also in short supply domestically. These and other precision parts are entirely purchased from foreign countries.

c) There are very limited number of firms which specialize in heat treatment technology which is necessary to manufacture durable precision parts.

d) Standardization of parts, bolts, nuts, etc. are insufficient and inadequate.

ii. Labour Problems

Existing labour force does not possess sufficient skill, knowledge for basic technology and engineering know-how, which will take long experience in production of precision products. In this field survey, the average service of workers were only 2-5 years. Therefore their procutivity and operating efficiency are rather low. High labour turnover causes the labour skill and training problems.

iii. Financial Problems

Due to limited finance, their production facilities and measuring instruments are old and poor. The interest rate and the unreasonable tariff for raw materials should be improved.

Table 4.4.5 (71) Major Problems Encountered in the Machine Tool Industry

Items	Thailand
Marketing	
o Demand situation for new machines	X
o Inability to find new customer	X
o Inability to meet delivery dates	X
o Terms of payment	
o Stiff competition	X
o Collection of receivable	-
o Brand consciousness	Δ
Management/Labour/Financial	
o Difficulty in getting finances from traditional markets	O
o Interest rate	X
- Prime rates	
- Commercial bank	17-18%
o Lack of skilled labour	Δ
o Excessive labour turnover	Δ
o Low productivity	Δ
o Existing labour force do not have sufficient skills	Δ
o Sales network	X
Technical/Production	
o Inability to buy new machine due to high price	X
o Existing machine available are not accurate enough	X
o Existing machine available are not capable of performing all required works	X
o Shortage of raw material/Difficult to get right size or proper kind of steel	Δ
o Difficult to get good quality heat treatment services	Δ
o Difficult to get special machining services from outside	Δ
o Difficult to get casting/forging services from outside	Δ
o High price of raw materials	
Government Activity	
o MIRDC, MIDC	-
o Institute of Technology	-
o University	-
o Government Company	-

O : Strong, Yes or Good

Δ : Weak or no good

X : Bad

- : No activity

(4) Recommendation

From the result of the field survey and subsequent discussions, upgrading activities for the machine tool industry in Thailand were suggested as follows :

For short term

1. To provide assistance to existing and possible firms,
2. To assist in upgrading the technology of sub-contractor,
3. And to establish the Promotion Centre for the machine tool industry.

For medium/long term

1. To support local firms for innovative products,
2. To establish joint venture companies or to draw foreign investment,
3. To train trainers from technology centre,
4. And to develop skill man power for industry.

(5) Promotion scheme for the machine tool industry

1) Promotion of Basic Technology :

The promotion scheme of the industry here refers to the recommendations of the SOT project, but note that situations are too sophisticated for a single proposal to cover all requirements. Table 4.4.5 (72) is the proposed promotion scheme of the machine tool industry in Thailand.

For Thailand, the government owned institutes (such as ISI) should be adviced to get wider powers in playing their role as a planner and an advisor for the promotion of the machine tool industry and other related industries which are still languishing from the lack of technology. Advisory services to overcome technical managerial problems and product development should be conducted by the agency.

Extension and trainng services for related indstries by public sectors should focus on the expansion of their technical know-how as well as the acquisition of modern methods for material procurement, production,

testing, inspection, design and engineering quality control in the following areas :

(1) Casting and forging
(2) Heat treatment
(3) precision machining/gears, die-mould
(4) Other basic metal works

Quality control system is one of the most effective means of maintaining good products, reducing cost of production by decreasing rework and scrap and reducing labour costs. However, for the developing countries, this normally is a weak point. They should learn modern techniques in quality control to ensure cost efficiency in their operations. If there is no improvement in the cost and quality of the products manufactured by the support industries, the whole industry will be faced with economic problems.

2) Technology Transfer from Developed Countries

To improve local conditions for Thailand, they should request the assistance of the NICs/developed countries for technical expertise in the machine tool industries as well as for the support industries. The assistance could be in the form of study grants or through the services of industry consultants.

Table 4.4.5 (72) Promoting Scheme of the Machine Tool Industry

Period	Recommendations	
	Figures	Effective means for Promotion
Short/ Medium Term	1. Assistance of existing and possible manufacturers	Technical support by public organization - Engineering - Designing - Procurement - Quality Control - Study Tour Sales Promotion Management improvement Marketing
	2. Extension/training for sub-contracting job	Training by expert/ consultant - Casting - Gear Cutting - Heat Treatment - Forging - Basic Metal Works
	3. Building up the foundation of drawing foreign investment or joint venture	Granting tax incentives Creating opportunities for sub-contractors and the supporting industries
Long Term	1. Supporting local manufacturers for innovative products.	
	2. Establishment of joint venture companies or drawing foreign investment.	Import Restriction Import Surcharge Encourage Investment Tax Rebate and Exemption Sales Guarantee by the Government Credit Assistance, Low Credit

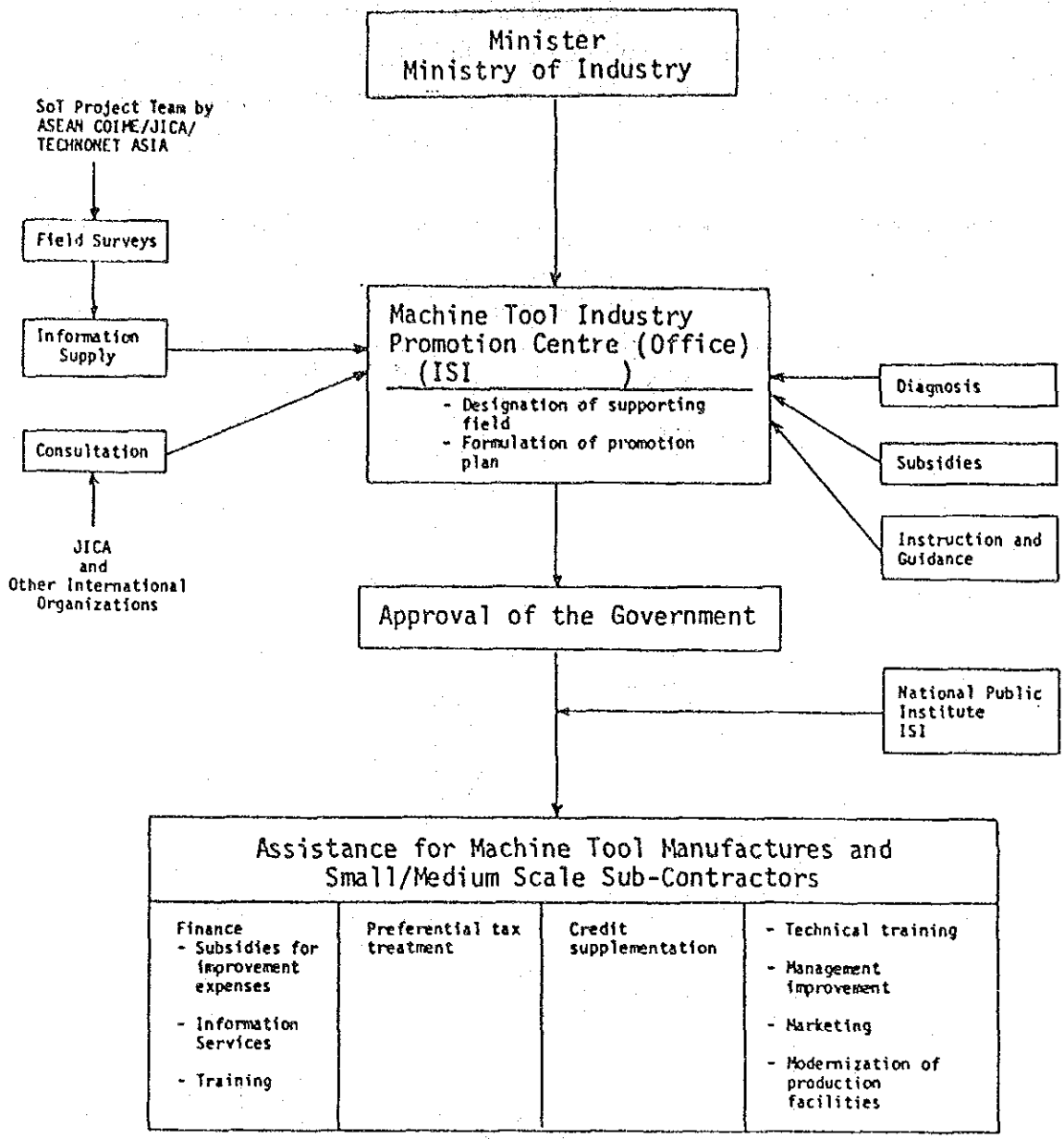


Figure 4.4.5 (1) Structure of the Machine Tool Industry Promotion Plan (THAILAND)

3) Implementation Plan :

Table 4.4.5 (73) shows the procedure for implementing the promotion plan, which are :

(1) Designation of supporting field,
(2) Formation of promotion plan,
(3) Picking objective firms from the existing firms which manufacture mahcine tools,
(4) Designation of the expert(s) and trainers,
(5) And consultancy and advisory services
   - Modernization of production facilities
   - Marketing
   - Training

The implementaion as shown in Table 4.4.5 (72) is a positive response to the government's policy of encouraging diversification of the manufacturing sector towards the machine tools industry. It may prove to be the most difficult but important endeavour for achieving self-sufficiency in the coming decades.

In Thailand, nothing is moving on the political side toward arranging cooperation programs with advanced countries, and the feeling is that it is not all that bad.

Table 4.4.5 (73) The Procedure of the Machine Tool Industry Promotion Plan

ITEMS \ STAGE	I	II	III	IV	V
Designation of supporting field					
Formulation of promotion plan - Diagnosis - Subsidies - Instruction and Guidance - Finance					
Approval of the Government					
Picking objective firms from the existing companies					
Designation of expert(s) and trainers					
Implementation - Training - Consultation - Modernization of production facilities - Marketing					

4.4.6 Automobile Parts

This time 334 enterprises have been surveyed. Of them 30 (9%), 12.8% of 235 subcontractors are automobile related enterprises. But there were no reply on what they were engaging in. Consider the situation analisis automobile parts industry, analysis of its problem point, promotion of automobile parts industry in Thailand supplemented with the information from the automobile industry association in Japan.

(1) Scale of Enterprises

1) Capital (Fig. 4.4.6-1 (Q-01-01))

As shown in Fig. 4.4.6-1 (Q-01-01) enterprises (50%, 15/30 companies) have capitals of less than ฿250 x 10^3, meaning that many of enterprises are small.

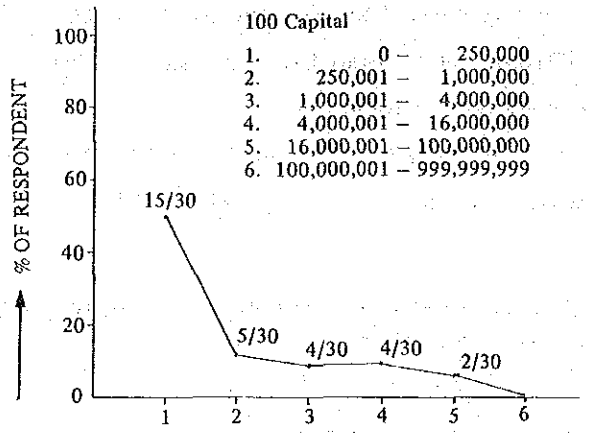


Fig. 4.4.6-1

2) Sales (Fig. 4.4.6-2 (Q-01-02))

70% of the enterprises (21/30 companies) has less than ฿4000 x 10^3 of annual sales, and only 10% has more than ฿16000 x 10^3. That is to say, many of automobile industry in Thailand are small enterprise.

Their sales is far lower than that of automobile and its attachment in Japan.

((Average sales per factory in Japan: 1.52 Billion Yen/Year, (Industrial Statistical Chart from MITI, 1984))

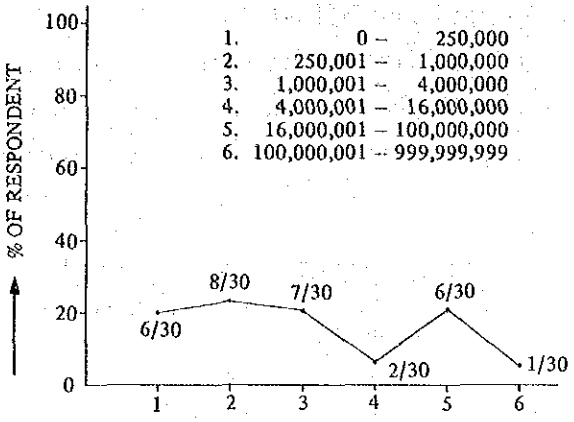


Fig. 4.4.6-2

3) Area of Site (Fig. 4.4.6-3 (Q-01-03))

60% of the enterprises (18/30 companies) has less than 2500m². But 37% (11/30 companies) has more than 6300 m².

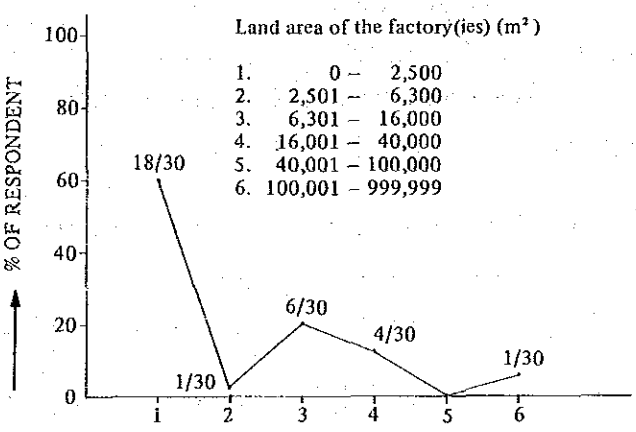


Fig. 4.4.6-3

4) Equipment Scale (Q-06)

97% of the enterprises (29/30 companies) has less than ฿ 250 x 10^3. It shows that equipment of most enterprises are small in scale.

Table 4.4.6-1 Equipment cost (Q-06)

	%	Number of company
฿ 250 x 10^3 or less	96.7	29/30
฿ 1000 – 4000 x 10^3	3.3	1/30

5) Number of employees (Fig. 4.4.6-4 (Q10-00))

Approximately 60% of enterprises (18/30 companies) has 50 employees or less and 40%, employees or more. It is almost the same as that of Japan where the number of employees per company in automobile and its attachment manufacturer is 48.7 persons.

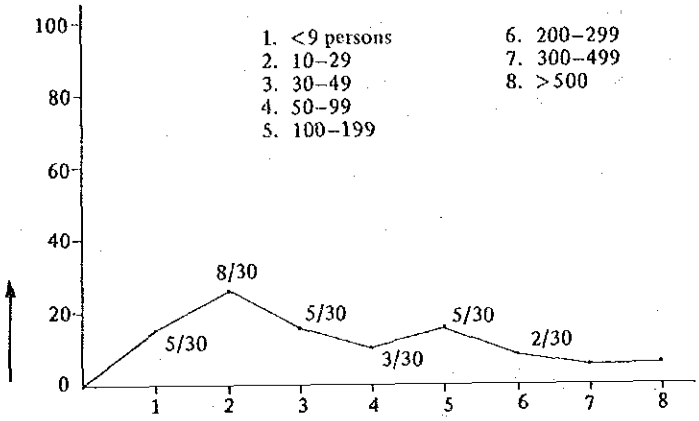


Fig. 4.4.6-4 Number of employees

6) Specialization Percentage (Table 4.4.6-2 (Q05-01))

Overwhelming majority of each metal processing industry have share of less than 20%. Any business has no large share. Sheet work/process industry and casting industry may be said to have a large share.

Table 4.4.6-2 Kind of Processes in Automobile Parts Industry

Process	0 - 20%	21 - 40%	41 - 60%	61 - 80%	81 - 100%
Machining	86.7% ($\frac{26}{30}$)	6.7% ($\frac{2}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	-
Casting	83.3% ($\frac{25}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	6.7% ($\frac{2}{30}$)
Forging	96.7% ($\frac{29}{30}$)	-	3.3% ($\frac{1}{30}$)	-	-
Heat Treatment	100.0% ($\frac{30}{30}$)	-	-	-	-
Plating	93.3% ($\frac{28}{30}$)	-	-	-	6.7% ($\frac{2}{30}$)
Welding	93.3% ($\frac{28}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	-	-
Printing	93.3% ($\frac{28}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	-	-
Sheetwork/Press	80.0% ($\frac{24}{30}$)	13.3% ($\frac{4}{30}$)	3.3% ($\frac{1}{30}$)	3.3% ($\frac{1}{30}$)	-

7) Kind of Products (Fig. 4.4.6-5, Table 4.4.6-3 (Q5-00))

Q05 Kind of products Own use/Subcontracting out/ Subcontracted in: (M/A)

1.Own 2.In 3.Out

1. Motor vehicles or parts
2. Industrial machinery or parts
3. Civil, structural & construction machinery or parts
4. Agricultural machinery or parts
5. Electrical & telecommunication machinery or parts
6. Transport & harbour equipment not classified elsewhere but including shipbuilding & repairing
7. Pipework or parts (except item 16)
8. Architectural/carpentry & building works or parts
9. Railway equipment & carriage parts
10. Working tools or parts
11. Metalworking machinery or parts (except item 17)
12. Moulds & dies or parts
13. Tableware/utensils or parts
14. Kitchen equipment
15. Engines & turbines
16. Pumps & valves
17. Machine tools
18. Gears
19. Other machineries & equipment or parts
20. Others, specify

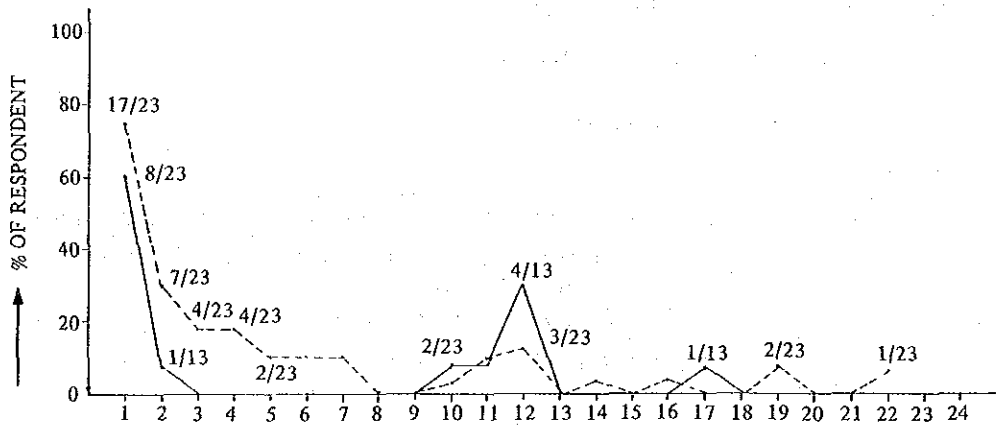


Fig. 4.4.6-5 (Q05-00) Kind of products

Motor vehicles or parts, of course, are ranked at top, but molds and dies of parts and machinery are ranked as product.
Many companies engage in two or three items.

Table 4.4.6-3 (Q05)

Ranking	Products	Own use
1	Motor vehicles or parts	61.5% (8/13)
2	Mold & dies of parts	30.8% (4/13)
3	Industrial machinery	7.7% (1/13)
3	Working tool	7.7% (1/13)
3	Metal working machinery	7.7% (1/13)
3	Machine tool	7.7% (1/13)
		Subcontracting in
1	Motor vehicles or parts	73.9% (17/23)
2	Industrial machinery or parts	30.4% (7/23)
3	Agricultural machinery or parts	17.4% (4/23)
3	Civil, structural, constructing machinery	17.4% (4/23)
4	Molt & dies or parts	13.0% (3/23)
		Subcontracting out
1	Motor vehicles or parts	50.0% (2/4)
2	Civil, structural, constructing machinery	25.0% (1/4)
3	Others	25.0% (1/4)

8) Subcontractors (Table 4.4.6-4, 5 (Q31-01))

Many of enterprises have no subcontractors.

Table 4.4.6-4 (Q31-01)

Kind of work

Machining	22/30 company – 0 8/30 company – 1 ~ 3 company
Casting	25/30 company – 0 3/30 company – 1 ~ 3 company 1/30 company – 7 ~ 10 company 1/30 company – 11 ~ 20 company
Forging	30/30 company – 0

Table 4.4.6-5 (Q31-01)

Kind of work

Heat treatment	27/30 company – 0 3/30 company – 1 ~ 3 company
Plating	27/30 company – 0 2/30 company – 1 ~ 3 company 1/30 company – 4 ~ 6 company
Painting	29/30 company – 0 1/30 company – 1 ~ 3 company
Welding	29/30 company – 0 1/30 company – 1 ~ 3 company
Sheetwork/pressing	23/30 company – 0 7/30 company – 1 ~ 3 company

(2) Production, Production Engineering and Quality Control

1) Monthly production capacity (Fig. 4.4.6-6 (Q30))

Fig. 4.4.6-6 shows that 53% (16/30 companies) of companies, the largest, produces 601 to 1500 pcs/M. 40% (12/30 companies) produces less than 300 pcs/M. Sales also shows many enterprises are small.

What is the rate of average monthly production (accumulation of different kinds of products is acceptables?) (S)

1. Less than 10 pieces
2. 11–150 pieces
3. 151–300 pieces
4. 301–500 pieces
5. 501–1,500 pieces
6. More than 1,500 pieces

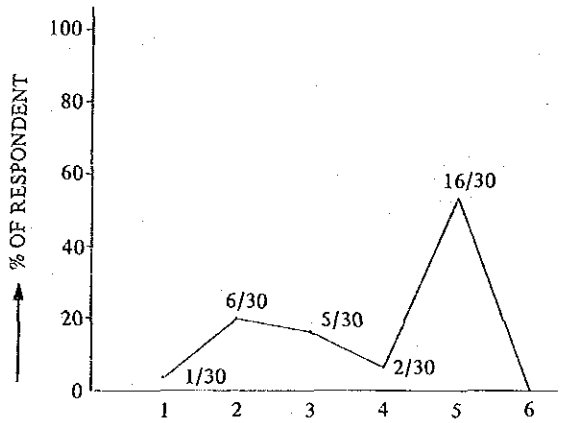


Fig. 4.4.6-6

2) Employees capable of reading a technical drawing (Fig. 4.4.6-7 (Q-41-01))

70% (21/30 companies) have two or more employees capable of reading technical drawing.

Q41 How many employees can understand the technical drawings? (S)

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

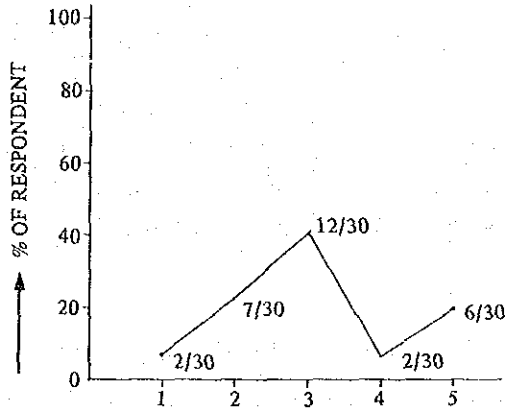


Fig. 4.4.6-7

3) Dimensional Accuracy of Product (Fig. 4.4.6-8 (Q43))

Most companies have accuracy of better than 1/10 mm.

Q43 What is the tolerance of your main products? (M)

1. 100 mm or rough estimate
2. 10 mm
3. 1 mm
4. 1/10 mm
5. 1/100 mm
6. Less than 1/100 mm

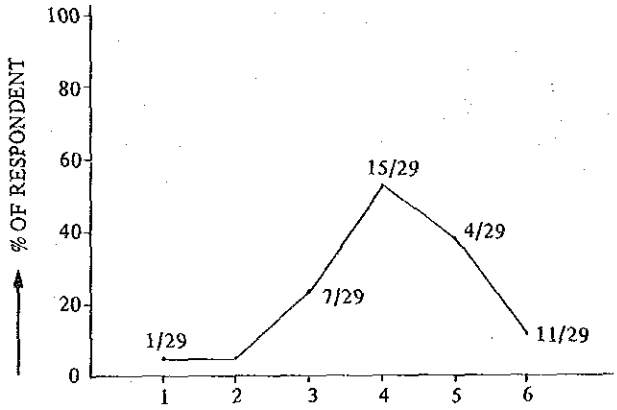


Fig. 4.4.6-8

4) Measuring/Testing Equipment (Q 42)

a. Length and Flatness

As shown in Fig. 4.4.6-9 , many companies have usual measuring and testing equipment, but not high class ones.

Q42 What kind of measuring tools does your factory use? (M)

1. Tape measure
2. Carpenter ruler
3. Steel ruler
4. Caliper
5. Varier caliper
6. Micrometer
7. Depth meter
8. Dial gauge
9. Cylinder gauge
10. Optimeter
11. Microscope
12. Thickness caliper
13. Precision level
14. Special purpose gauge (jig)
15. Thickness gauge

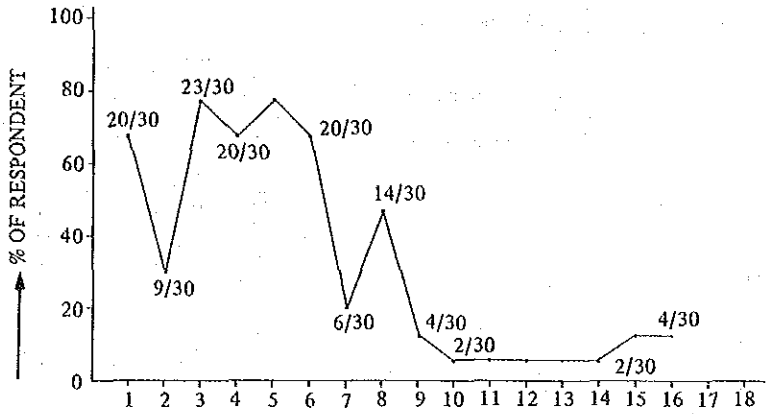


Fig. 4.4.6-9

b. Angle, squareness and parallelism (Fig. 4.4.6-10 (Q42))

Even simple tools such as squares are owned by 56% of companies. Few companies have other measuring tools. They are required to be equipped.

1. Angle/Squareness/parallelism
2. Angle plate
3. Steel protoractor
4. Universal benei protoractor
5. Square
6. Straight edge
7. Combination square set
8. Micro protoractor
9. Optical protoractor
10. Iron level
11. Precision level
12. Box precision level

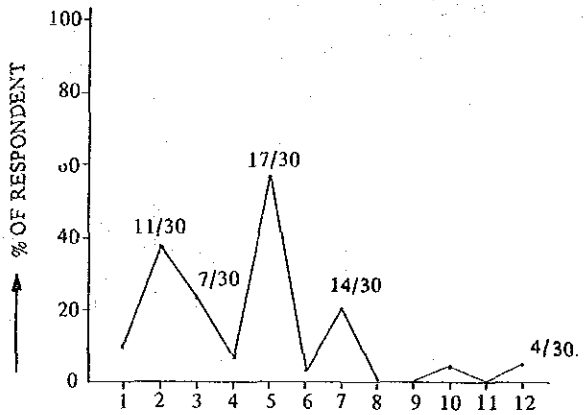


Fig. 4.4.6-10

c. Profile (Fig. 4.4.6-11)

Few companies have this kind of gauges. It is required to be equipped.

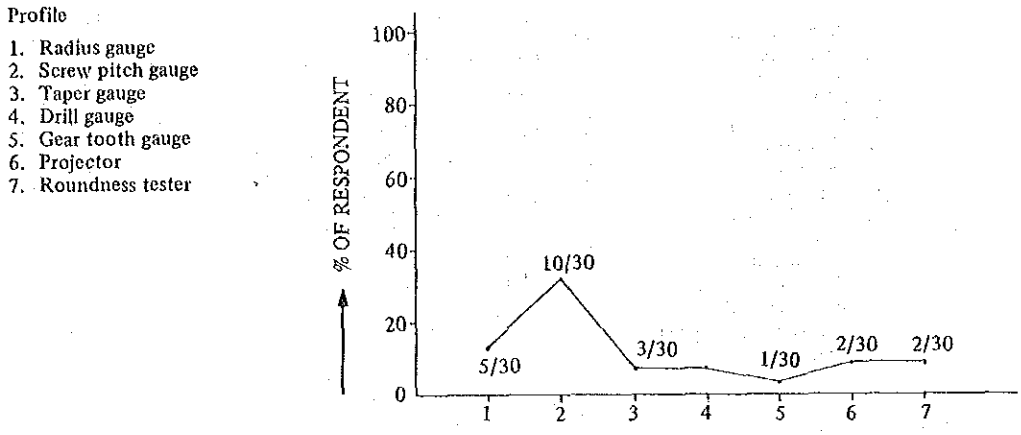


Fig. 4.4.6-11

d. Temperature (Fig. 4.4.6-12 (Q42))

Graph shows that few companies have thermometers. They are required to be equipped.

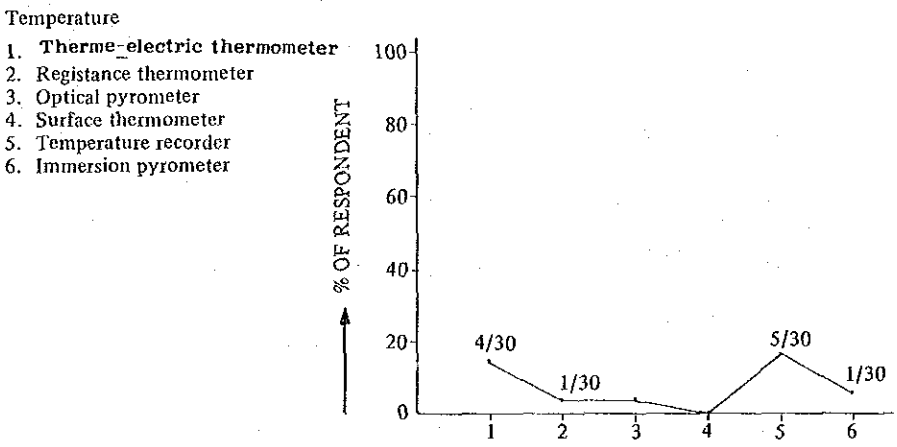


Fig. 4.4.6-12

e. Hardness (Fig. 4.4.6-13 (Q42))

Hardness
1. Brinell tester
2. Vickers tester
3. Rockwell tester
4. Share tester
5. Harnester

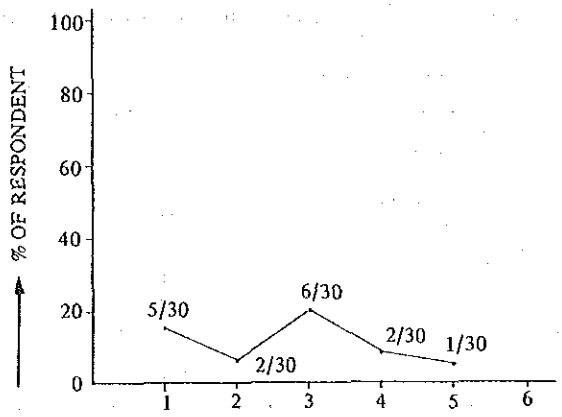


Fig. 4.4.6-13

Few companies have hardness testers. They must be equipped much more.

f. Machined surface roughness

Fig. 4.4.6- 14 indicates that few companies have surface roughness tester. They must be equipped much more.

Machined surface roughness
1. Standard piece for surface roughness (surface roughness scale)
2. Optical roughness tester
3. Electrical roughness tester
4. Interference roughness tester
5. Surface measuring instrument

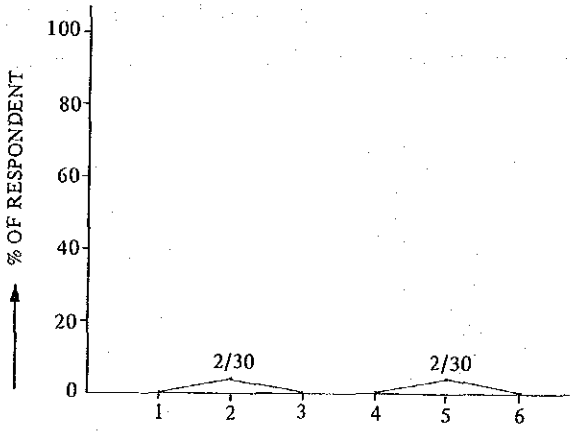


Fig. 4.4.6-14

g. Electric performance testing (Fig. 4.4.6-15)

Voltmeters (17/30 companies) and, ammeter (16/30 companies) are owned only by 50% of companies. This tester must be equipped sooner.

Electric performance testing

1. Wattmeter
2. Voltmeter
3. Ammeter
4. Power factor meter
5. Torque meter
6. Insulation resistance meter

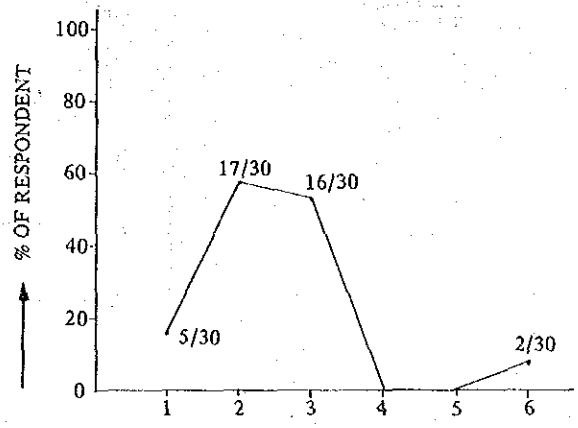


Fig. 4.4.6-15

h. Testing (Q42)

As shown in Fig. 4.4.6-16, for non-destructive inspection equipment, even a simple color checker is owned only by 10% of enterprises (3/30 companies). Expensive testing equipments may not be owned, but should be entrusted to the public institution for testing. Instruction and aid by public institution are required.

Testing

1. Colour checker
2. Magna flux tester
3. Ultra sonic tester
4. Tensile strength tester
5. Chemical analyser
6. Tachometer
7. Stop watch
8. Dynamometer
9. Noise meter
10. Vibrometer
11. Stroboscope

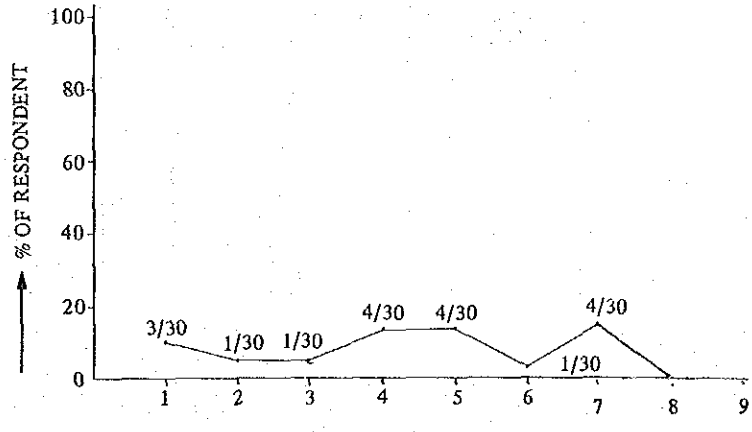


Fig. 4.4.6-16