| | | |
|---|---|---|
| Specialization Ratio (Average) (S2) | | 0.44 |
| 1 | MOTOR VEHICLES | 0.46 |
| 2 | INDUSTRIAL MACHINES | 0.36 |
| 3 | CIVIL STRUCTURAL AND CONSTRUCTION MACHINE | 0.47 |
| 4 | AGRICULTURAL MACHINE | 0.51 |
| 5 | ELECTRICAL & TELECOM MACH. | 0.5 |
| 6 | HARBOUR & SHIPPING EQUIP. | 0.67 |
| 7 | PIPEWORK | 0.44 |
| 8 | ARCHITECTURAL/CARPENTRY & HOUSEHOLD WORKS | 0.6 |
| 9 | RAILWAY EQUIP. & CARS | 0.41 |
| 10 | WORKING TOOLS | 0.5 |
| 11 | METALWORKING MACHINE | 0.33 |
| 12 | MOULD AND DIES | 0.4 |
| 13 | TABLEWARE & HOUSEWARE | 0.44 |
| 14 | KITCHEN EQUIP. & UTENSILS | 0.46 |
| 15 | TOYS | 0.38 |
| 16 | OTHER MACH. & EQUIP. | 0.35 |
| 17 | OTHERS | 0.44 |

By processes specialization is high in forging and plating, and low in machine assembly. By products, harbor equipment, shipbuilding and agricultural machinery take the lead in specialization, while metalworking machines and industrial machinery are falling behind.

The averages of 0.49 and 0.44 indicate that a single firm deals with two processes and two products on the average. Product specialization was considered by the size of employment, and results are shown in the graph below. It is evident that firms employing 33 – 99 people each take the lead in specialization, while their counterparts in the 11 – 30 and 100 – 199 people brackets are below the average. Greater specialization efforts are especially urged for firms of 30 or fewer employees.

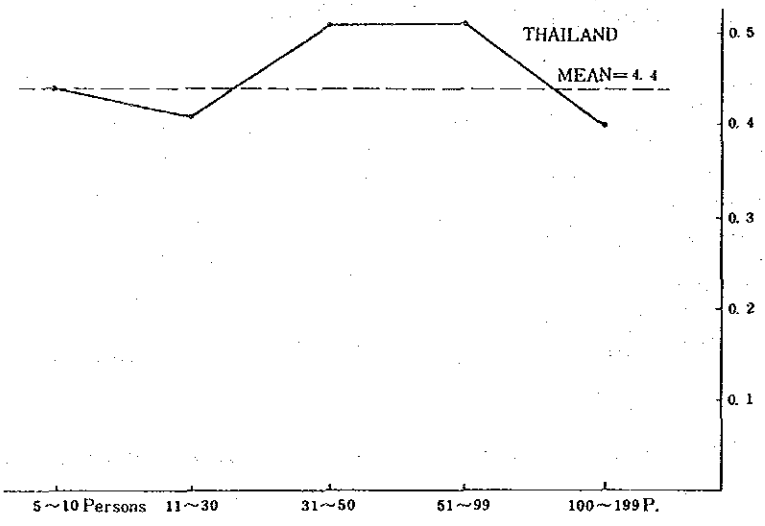


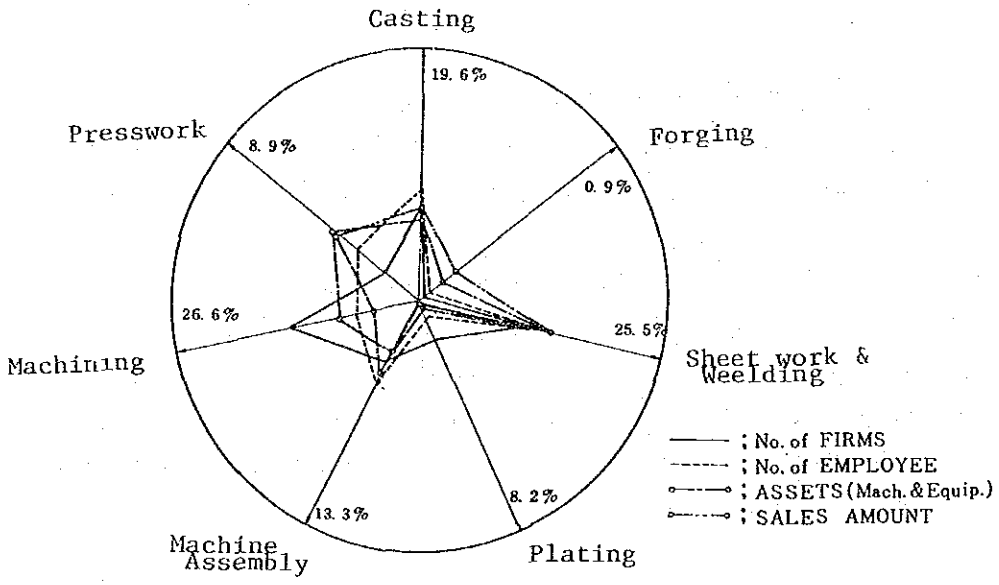

Fig. 4.2.6-1 Specialization Ratios & Employment Size

(2) Industry pattern

The number of firms, size of employment, fixed assets (equivalent to buildings/equipments reinstallation costs) and sales were considered by main processes and products. Results are shown in the circle graphs below.

From the standpoint of process distribution, the structure is relatively well balanced in terms of the number of firms. Machine assembly and casting are relatively labor intensive, but forging, plating and presswork are relatively capital intensive.

Machining have many participants, yet sales there are relatively small. This means excessive competition. As such, promotional measures to encourage machining firms to advance into the field of machine assembly are desired.




(%)

| Processes | No. of firms | No. of employee | Assets | Sales amount |
|---|---|---|---|---|
| Casting | 19.6 | 21.6 | 16.0 | 18.9 |
| Forging | 0.9 | 2.0 | 5.6 | 8.1 |
| Plate work | 22.5 | 22.9 | 26.1 | 25.9 |
| Plating | 8.2 | 3.7 | 1.6 | 1.1 |
| Machine assembly | 13.3 | 19.9 | 11.8 | 16.2 |
| Machining | 26.6 | 13.7 | 16.5 | 8.7 |
| Presswork | 8.9 | 16.1 | 22.4 | 21.1 |

Fig. 4.2.6-2 Process Diversity Analysis of Firms

By products motor vehicles, industrial machinery and agricultural machinery have a major impact on society. The other products, on the other hand, seem to manage to meet the basic demand on average in their respective relation to society.

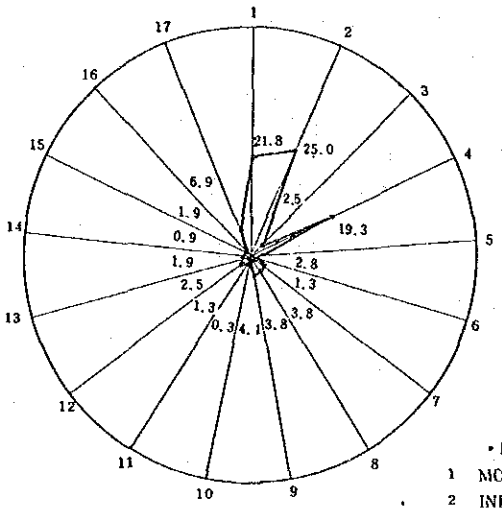



Fig. 4.2.6-3
Diversity of Products
(No.of Firms)

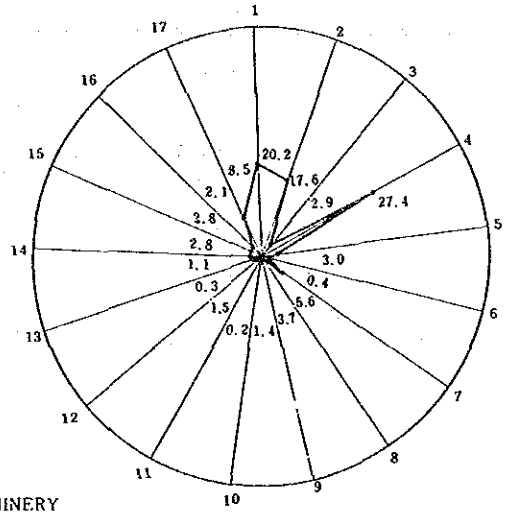



Fig. 4.2.6-4
Diversity of Products
(No.of Employee)

• LEGEND •

1 MOTOR VEHICLES
2 INDUSTRIAL MACHINERY
3 CIVIL MACHINERY
4 AGRICULTRAL MACHINE
5 ELEC-TELE-MACHINE
6 HARBOUR & SHIPPING
7 PIPEW ORK
8 CARPENTRY
9 RAILWAY AND CARS
10 WORKING TOOLS
11 METALW ORKING
12 MOUDS AND DIES
13 TABLE-HOUSEWARE
14 KITCHEN & UTENSILS
15 TOYS
16 OTHER MACHINERY
17 OTHERS

(3) Geographical distribution (number of firms)

The circuit graph below shows that the metalworking industry in Thailand is overwhelmingly located in the urban area. Compared with situations in such other countries as the Philippines and Indonesia, the Thai industry falls behind in extending operation to the countryside. Well balanced social development makes it necessary to promote decentralization of industrial activities into the countryside. The Thai government is expected to put in force proper measures for the purpose.

A close examination of current situations reveals the heaviest distribution in growth center. Even in the urban district, it is seen that the industry follows the government's lead in locating operation in growth center. From the industrial area standpoint, however, the share is 1.6% in terms of the number of firms and 1.4% by the size of employment. Programs to provide a complex for specialization-oriented small and medium scale firms engaged in metalworking should be drawn up and promoted for materialization.

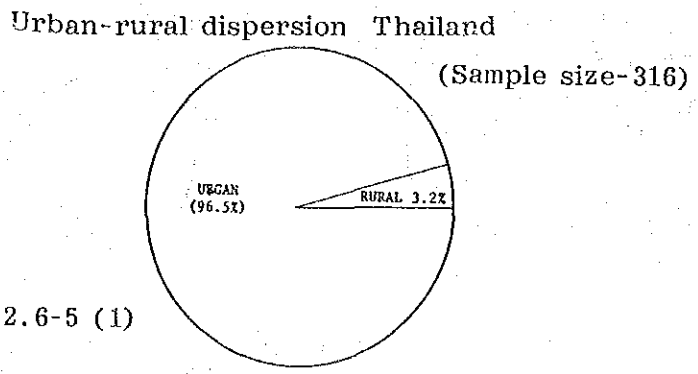



Fig. 4.2.6-5 (1)

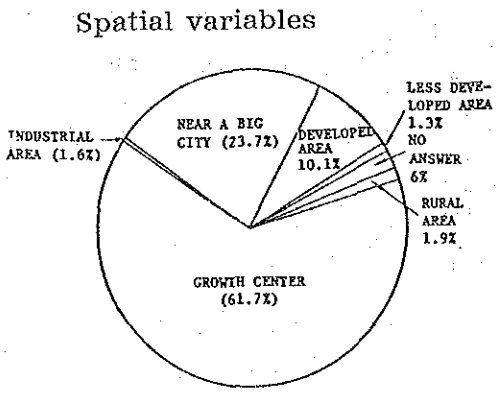



Fig. 4.2.6-5 (2)

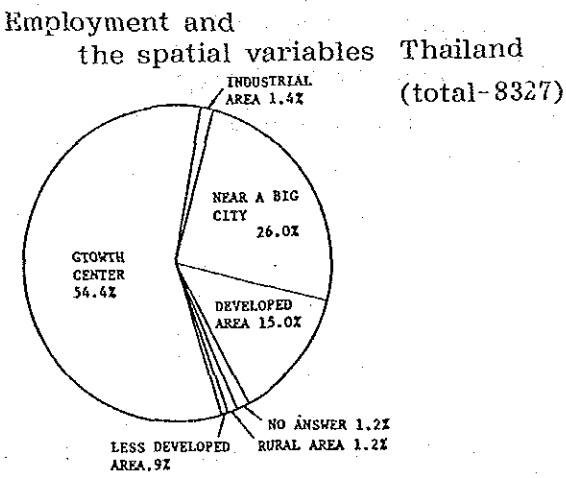



Fig. 4.2.6-5 (3)

(4) K'/L, O'/L and O'/K' patterns

In order to quantify the efficiency of business activities, assets (buildings/machinery) and sales per employee were considered by the size of employment and process. Results are shown in the graph below.

When considered in terms of the size of employment, the size of employment of 31 – 50 people is running business most efficiently both in terms of capital productivity & K'/L. Judging from the basic concept of small and medium enterprise management, it is considered essentially necessary to use to the best advantage the unique properties of labor intensive structure.

Capital turnover and sales per employee are proportional usually. In such fields as machining, however, K'/L is high while O'/L' is low. In order to deal with these problems with the industrial structure, the government is expected to step in with proper countermeasures.

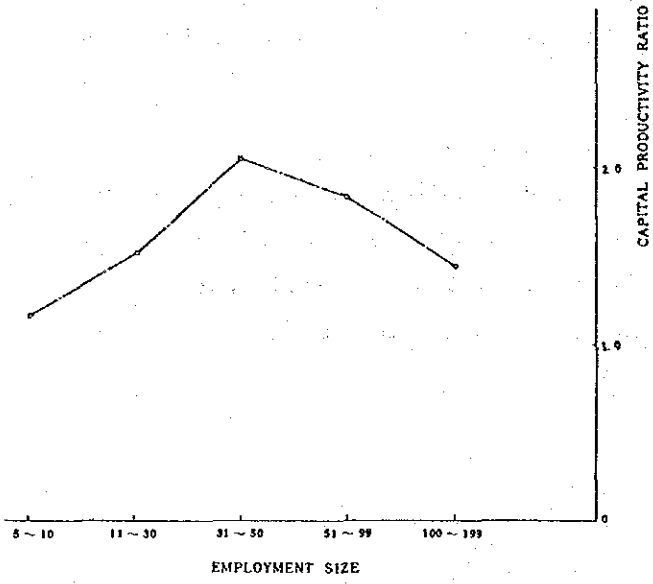



Fig. 4.2.6-6 Capital Productivity Ratio & Employment Size

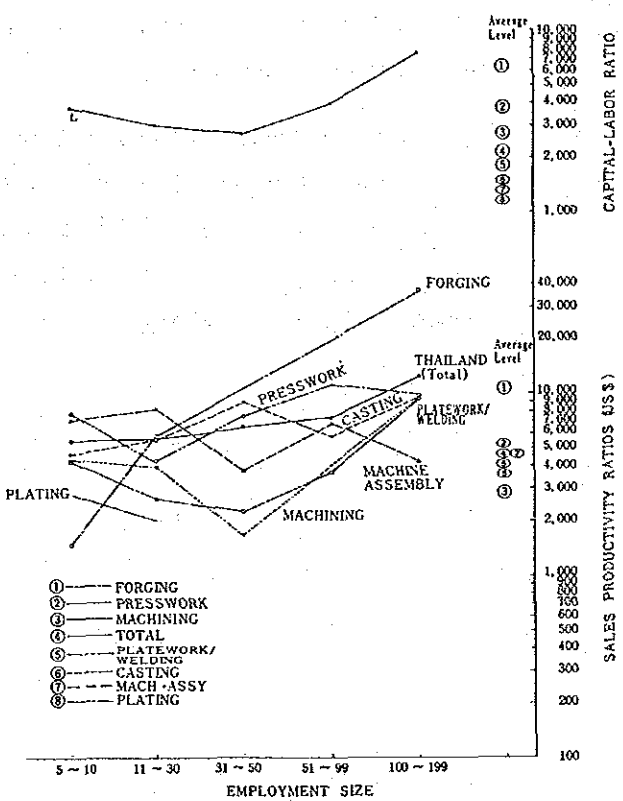



Fig. 4.2.6-7 Capital-Labor Ratio & Employment Size (Thailand) & Sales Productivity Ratio & Employment Size by Main Process (Thailand)

### 4.2.7 Distribution Structure

General situations of distribution are outlined below based on the joint study with Technonet/JICA/ISI in 1978, and its state at the subcontractor level is introduced based on findings in the survey covered by this report.

(1) Origin of orders (general)

About 83% of the firms under survey receive orders directly from clients (end users) followed by 41% from traders (middle men) and 8% from professionals (contractors). Transactions with end users are overwhelming.

(2) Origin of orders (primary subcontract item; Q70-13)

About 71% of subcontract business originates directly from contracting firms, followed by 34% from general markets, 17% from traders (middle men), 10% from dealers, 6% from contract traders, and 2% from others.

The overwhelming share (about 2/3 and over) of direct trading with contracting firms is natural because of the very nature of subcontract business.

The presence of traders and dealers (27%) and contract traders (6%) suggests that their role will become increasingly important as the industry structure gains in complexity and firms become more specialized.

(3) Origin of orders (secondary subcontract item; Q70-13)

Direct orders from manufacturing firms stand at about 71% just as the case of (2) above. Yet the significance of the role or function of distribution professionals, however, is weakened more or less, compared with (2), as seen in the fact the general markets, traders, dealers and contract traders account for 18%, 7%, 5% and 5% respectively.

## 4.3 Fundamental Viewpoint of This Survey

The metalworking industries contribute less than 3% to Thailands GDP in 1981.

However, it has strong linkages with other priority industries such as Agro-based, Chemical and Heavy industries. It's therefore very urgent to develop metalworking industries for the healthy growth of industries in Thailand.

Under the Fifth National Economic and Social Development Plan which is extend from 1982 to 1986, the metalworking industries has been identified as the industry which support leading industries such as mining, construction, textile, and automobile industries. The industrial restructuring committee which was established along with the policy of the Fifth National Economic and Social Development Plan, have been discussing on the restructuring of the metalworking industries.

The growth of the metalworking industries in Thailand is not still enough and most of metalworking firms are small and medium size having low level technology. It's therefore a matter of urgent necessity to turn these firms into modern ones which have a higher level of technology.

This survey was conducted to make concrete plans for promotion and development of small and medium scale metalworking industries.

### 4.3.1 Selection of Processes and Products and Priority of Them

The most appropriate manner for seeking the actual conditions of the metal working industry would be to make use of a matrix in which the abscissa (axis of X) and the ordinate (axis of Y) are products and technology respectively.

In the above matrix expression the axis of X (products) means its demand trends and also the axis of Y (technology) shows the feasibility of a production specialized in the industry.

The above selecting work was carried to find a conclusion in the following stages:

The preliminary survey group was dispatched in 1981 with the aim of prioritizing processes and products to be fostered. After executing the survey and having a discussion with the Thailand side, the group presented a conclusion which the priority order of the objects were to be arranged as the following manner, however, at this time some industrial machineries were not included in the object because they then had too many items as seen in Table 4.3.1-1 to be evaluated properly:

Agricultural machinery; motor vehicle; machine tool; electrical machinery; engine; turbine; office machine; radio; television; communication machinery; building and repair

of ship; railway transportation equipment; motorcycle; bicycle.

In the preliminary survey executed in 1983 the Thailand side presented their opinion saying that the products to be prioritized should be as illustrated below:

1) Agricultural machinery
2) Pump and valve
3) Machine tool
4) Hand tool and metal mold
5) Electrical parts and appliance
6) Car parts
7) Industrial machinery
8) Ship

With further study under the cooperation of the Thailand side, the priority order was decided as follows:

1) Agricultural machinery
2) Pump and valve
3) Gear
4) Motor vehicle related parts
5) Machine tool
6) Hand tool

On the prioritized processes, the preliminary survey group of 1981 had their viewpoint as seen in Table 4.3.1-2 in reference to the collaboration of JICA/TECHNONET ASIA.

The Thailand side indicated, in reference to the preliminary survey of 1983, the ranking of the prioritized processes calling for technical consultants of Japan.

The ranking was as follows:

1) Heat-treatment
2) Low-cost automation
3) Electro-plating
4) Welding and non-destructive test
5) Metal molds
6) Gear manufacture
7) Casting
8) Machine design

Further, the processes were finally prioritized on the subject after having additional discussion with the Thailand side. The conclusion was as described below:

1) Casting
2) Forging
3) Heat-treatment
4) Sheetwork and welding
5) Plating
6) Machine assembly
7) Machining
8) Presswork

The metalworking industry interrelations table in Table 4.3.1-3 is drawn out from an available input output table of Japan.

The former shows the current metalworking industry's relations in outline though the interrelation of the detailed items of product can not be seen from it.

For instance, as can be seen in the table of the metalworking industry interrelations table the rolled and forged steel and cast iron is first ranked of all industrial machinery, but the machinery itself is ranked second on the contrary.

Also in the fabricated metal products, the cast iron and rolled and forged steel is given the primary ranking in its input element.

On the output of the motor vehicles, the industrial machinery is first and followed by the cast iron and rolled and forged steel, the industrial electrical-machinery and the fabricated metal products.

On that of the ship and vehicles, the ranking is in the order of the cast iron and rolled and forged steel, the industrial machinery and the fabricated metal products. The interrelation of the above is as illustrated in Fig. 4.3.1-1 from which the conclusion of the survey on the selection of processes and products and priority of them would be approximately justified.

Table 4.3.1-1

| PRODUCT | Engine turbine | Agricultural machinery | Machine tool | Industrial machinery | Office machinery | Electrical machinery | Radio, TV communication machinery | Shipbuilding, shiprepairing | Railway machinery | Automobile | Bicycle, motorcycle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic supply (%) | 1.9 (7) | 1.6 (5) | 0.4 (1) | 6.9 (10) | 1.4 (2) | 1.8 (6) | 2.7 (8) | 1.6 (5) | 1.6 (5) | 13.2 (11) | 2.8 (7) |
| Import / Domestic demand (%) | 78.3 (10) | 45.6 (3) | 81.3 (11) | 71.9 (8) | 73.9 (9) | 65.9 (7) | 53.0 (5) | 10.7 (1) | 46.4 (4) | 53.9 (6) | 44.7 (2) |
| Labour expense / Value added (%) | 24.6 (5) | 28.5 (9) | 26.5 (7) | 28.7 (10) | 30.4 (11) | 23.6 (4) | 21.6 (3) | 26.8 (8) | 26.2 (6) | 13.0 (1) | 13.4 (2) |
| Depreciation / Value added (%) | 7.7 (3) | 15.8 (11) | 10.2 (7) | 12.1 (8) | 5.4 (1) | 12.4 (9) | 10.2 (7) | 11.4 (5) | 9.0 (4) | 13.9 (10) | 6.8 (2) |
| Total score | (25) | (28) | (26) | (36) | (23) | (26) | (23) | (19) | (19) | (28) | (15) |
| Priority | 6 | 2 | 4 | 1 | 7 | 4 | 7 | 9 | 9 | 2 | 11 |

The figure in ( ) means products ranking in each item and bigger figure show higher necessity and bigger effect of promotion.

Made by preliminary survey team in 1981 from Research Resources Company Ltd., "Feasibility of A Project To Develop Engineering Industries in Thailand".

Table 4.3.1-2

| | Casting | Forging | Sheetwork | Plating | Machine assembly | Machining | Presswork |
|---|---|---|---|---|---|---|---|
| Total technology level (5 points method) | 2.2 (6) | 2.6 (2) | 2.5 (3) | 3.6 (1) | 2.5 (3) | 2.2 (6) | 2.4 (5) |
| Number of firms (%) | 19.6 (5) | 0.9 (1) | 22.5 (6) | 8.2 (2) | 13.3 (4) | 26.6 (7) | 8.9 (3) |
| Number of employees (%) | 21.6 (6) | 2.0 (1) | 22.9 (7) | 3.7 (2) | 19.9 (5) | 13.7 (3) | 16.1 (4) |
| Assets (%) | 16.0 (4) | 5.6 (2) | 26.1 (7) | 1.6 (1) | 11.8 (3) | 16.5 (5) | 22.4 (6) |
| Sales amount (%) | 18.9 (5) | 8.1 (2) | 25.9 (7) | 1.1 (1) | 16.2 (4) | 8.7 (3) | 21.1 (6) |
| Total score | (26) | (8) | (30) | (7) | (19) | (24) | (24) |
| Priority | 2 | 6 | 1 | 7 | 5 | 3 | 3 |

The figure in ( ) means score of processes in each item and bigger figure show higher necessity and bigger effect of promotion.

Made by preliminary survey team in 1981 from JICA/TECHNONET ASIA Joint Research "SMALL AND MEDIUM SCALE METAL WORKING INDUSTRIES PHILIPPINES & THAILAND".

Table 4.3.1-3 The Metalworking Industry Interrelations

(Unit: Million yen)

| From \ To | Iron and steel | Cast iron, forged and rolled steel | Fabricated metal products | Non ferrous metal | Industrial machinery | Precision machinery | Industrial Electrical machinery | Electrical appliances for household | Motor vehicles | Ship and vehicles |
|---|---|---|---|---|---|---|---|---|---|---|
| Iron and steel | 766 | 14,610 | 1 | 2 | | 58 | 6 | | | |
| Cast iron, forged and rolled steel | | 8,210 | (1) 4,201 | 39 | (1) 4,797 | 216 | (2) 1,602 | (3) 676 | (2) 2,381 | (1) 1,840 |
| Fabricated metal products | | 24 | 163 | 8 | 325 | 61 | 4 | 89 | 408 | 183 |
| Non ferrous metal | 80 | 533 | (2) 1,160 | 3,433 | (3) 1,120 | (3) 286 | (1) 2,926 | (2) 864 | 369 | 165 |
| Industrial machinery | 158 | 262 | 106 | 36 | (2) 4,175 | (2) 355 | 293 | 52 | (1) 3,011 | (2) 562 |
| Precision machinery | | | | | 280 | (1) 462 | 76 | | 8 | 54 |
| Industrial electrical machinery | | | | | 514 | 6 | (3) 1,300 | (1) 2,258 | 612 | 113 |
| Electrical appliances for household | | | 30 | | | | | | | |
| Motor vehicles | | | | | | | | | 1,432 | |
| Ship and vehicles | | | | | | | | | | 47 |
| Others | 21,500 | 10,290 | 5,903 | 8,156 | 10,248 | 3,419 | 9,413 | 6,709 | 8,326 | 4,419 |
| Total | 22,504 | 33,929 | 11,564 | 11,674 | 21,459 | 4,863 | 15,620 | 10,648 | 16,547 | 7,383 |

The figure in ( ) shows the ranking of the input amount.

Made from "Japanese Industrial Structure" (Association of Industrial Structure Research, in 1964).

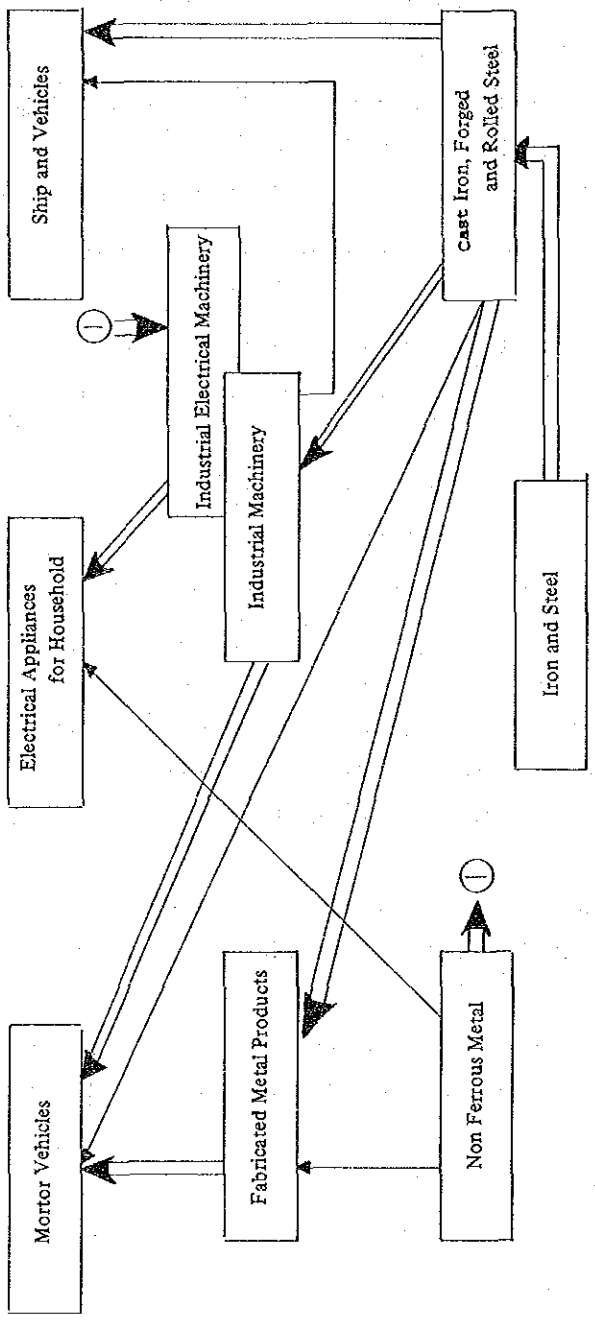



Fig. 4.3.1-1 Input Structure

4.3.2 Site Survey and Analysis of Survey Results

(1) Outline of Site Survey

The site survey was performed by questionnaire system. The questionnaires were written out in different forms each containing one of the following parts:

Part 1: Concerning the contractor firm

Part 2: Concerning the subcontractor firm from the contractor's eye.

Part 3: Questions of general nature concerning small/medium metalworking firms

Part 4: Questions particular to individual metalworking processes and products.

The contents of the questionnaries were also clasified as underwritten:

- General

  Business background; Personnel and labour affairs; Sales; Production, technical affairs; Accounting; Management; labour environment; Regional environment; Subcontractors' structure.

- Individual technology (Classified from processes and products.)

  Material supply; Production facilities; Technology;

In view of the fostering and promotion of the small and medium scale metalworking industries by linking the small and medium scale firms and big ones into closer relations with each other, a great stress was laid on the field work on the subcontract structure.

Also in consideration of that deficient delivery and quality, control capability of the small and medium scale metalworking firms would have been derived mainly from their unqualified designing and engineering ability, the field work was closely made on the basis of the above acknowledgment.

Further more, another focused light was thrown upon the face of the regional environment, since the industrialization in Thailand concentrates on the Bangkok metropolitan area.

The related area to the survey is in the outskirts of Bangkok including within 100km from the city in principle, because firms more than seventy (70) percent of the metalworking industries concentrate in the region.

Responses were received from a total of 334 firms, among which were:

99 respondents to Part 1, of which 66 respondents also covered Part 2

235 respondents to Part 3

228 respondents to Part 4

Among the 99 respondents to Part 1 were some which were not themselves metalworkers

but which had large linkage-effect on metalworking industries and regularly subcontracted out to them. Also included were others which were supposed to subcontract out in the nature of case, but at present no longer subcontracted work outside their own firm.

Among the questionnaires returned from the 235 Part 3 respondents were a number that were improperly filled in, and the actually utilizable responses numbered 228. These 228 responses were from firms engaged in the different metalworking processes as listed in Table 4.3.2-1. Only a very small number of responses were obtained concerning the individual products.

Table 4.3.2-1 NUMBER OF RESPONSES FROM FIRMS ENGAGED IN DIFFERENT METALWORKING PROCESSES (PART 4 QUESTIONNAIRES)

| METALWORKING PROCESS | NUMBER OF RESPONDENTS |
|---|---|
| Casting | 50 |
| Forging | 3 |
| Heat treatment | 6 |
| Sheetwork and welding | 16 |
| Electroplating | 46 |
| Machine assembly | 8 |
| Machining | 80 |
| Presswork | 19 |
| TOTAL | 228 |

The questions were written in one of the three following forms:–

- Single answer (yes/no)
- Multiple answer (mark the printed inscription that is applicable)
- Real answer (inscribe the applicable value, figure, or fact etc.)

The responses contained in the returned questionnaires were processed by computer. The treatment was mainly to simply totalize the answers that were common; some correlative analysis was, however, also made to seek interrelationships between different question items. The values or figures indicated for the "real answer" items were, in principle, classified into a number of groups, each group representing a band in the spectrum, and treated as a common answer. Certain question items, however, were treated quantitatively to derive weighted averages.

The respondents were divided into the following 6 categories.

1. Those that had some/many/very many occasions of undertaking subcontracted work for the JICA/TECHNONET ASIA Joint Research Project.
2. Joint-venture firms with Japanese partnership, and their subcontractor firms.
3. Joint-venture firms with non-Japanese partnership, and their subcontractor firms.
4. Purely indigenously capitalized firms, and their subcontractor firms
5. Independent local firms
6. Firms established during the past 3 years

This classification was adopted for the following objects.

- Time series analysis (Category 1)
- Comparative analysis from view point of ownership (Category from 2 to 5)
- Trend analysis of newly established firms (Category 6)

The numbers of respondents in the 6 categories above were as follows.

| CATEGORY | PART 1 RESPONDENTS | PART 3 RESPONDENTS |
|---|---|---|
| 1 | 1 | 43 |
| 2 | 22 | 13 |
| 3 | 14 | 6 |
| 4 | 55 | 28 |
| 5 | – | 119 |
| 6 | 7 | 19 |
| TOTAL | 99 | 228 |

4.3.3 General Analysis of Survey Results

(1) Results Obtained on Contractor Firms, and on Subcontractor Firms Viewed from Their Contractors

The survey on contractors was covered by the Part 1 questionnaire; the Part 2 questionnaire covered the subcontractor firms viewed from their contractors.

The following pages summarize the general situation of the contractors and noteworthy observations made by them on their subcontractors.

1) General Situation of Contractor Firms

Roughly 75% of the respondents have seen 6 to 20 years since their establishment (cf. Q1001). The era of their establishment (1964 to 78) corresponds to the first period of private industry promotion in the Thai Kingdom (1961–71), when private industries were encouraged to produce articles to substitute imported goods, and the second period (1972–76) when exports were encouraged. It is further of note that 44% of the respon-

dent firms were established in the 10 years from 1964 to 73, which indicates the importance of developments marked during the first period of private industry promotion, which aimed at substitution of imported articles.

In respect of the sizes of respondent firms, they fall in a wide range in terms of capital, from very small to very large firms. According to SIFO definition, small firms are those capitalized at less than B5 million; roughly 40% of the responding contractor firms are of capital below B4 million (cf. Q1001–2). The same wide distribution is seen also in terms of the size of personnel employed: In this respect, the contractor firms divide almost equally into the three categories of "large", "medium" and "small" enterprises, as defined in the joint study undertaken in 1976 by the Thammasat Universities and NIDA (cf. Q1005).

In respect of product distribution also, the goods manufactured by the contractor firms cover a wide range of articles: roughly 1/3 of the respondents make products related to the automotive industry, followed by those producing industrial, agricultural, and electrical/telecommunication equipment, each branch accounting for more than 10% of the number of contractors (cf. Q1003).

By far the largest majority of the contractor respondents market their products within Thailand, but roughly 1/4 are also selling to neighbor developing countries. Slightly less than 10% have found outlets in the newly industrialized and industrialized countries (cf. Q1007).

In the matter of product quality and technology level, more than 90% of the contractor firms report defect rates after shipping to be below 5%, and those further reporting less than 1% account for about 67%. As for the number of employees that can understand technical drawings, more than 95% of the contractor firms have at least 1 such employee; those that have more than 10 employees account for roughly 40% of the firms.

The following tables compare different data indicative of the product quality and technological level of the respondents; they clearly evidence the advantageous position of the contractor in relation to subcontractor and small/medium firms.

| DEFECT RATE (%) | CONTRACTOR FIRMS (%) | SUBCONTRACTOR FIRMS* (%) | SMALL/MEDIUM FIRMS (%) |
|---|---|---|---|
| More than 30 | 0 | 2.9 | 0.9 |
| 21–30 | 0 | 2.9 | 0.5 |
| 11–20 | 2.0 | 1.5 | 4.7 |
| 6–10 | 5.1 | 8.8 | 14.6 |
| 2– 5 | 25.5 | 33.8 | 35.7 |
| Below 1 | 67.4 | 50.1 | 43.6 |
| TOTAL | 100.0 | 100.0 | 100.0 |

*SUBCONTRACTOR FIRMS = Subcontractor firms viewed from their contractors.

| EMPLOYEES WHO CAN UNDERSTAND TECHNICAL DRAWINGS | CONTRACTOR FIRMS (%) | SMALL/MEDIUM FIRMS (%) |
|---|---|---|
| 0 | 4.1 | 29.8 |
| 1 | 18.6 | 18.2 |
| 2– 4 | 22.7 | 34.2 |
| 5–10 | 16.5 | 9.8 |
| More than 10 | 38.1 | 8.0 |
| TOTAL | 100.0 | 100.0 |

(Data source questionnaires)

| | | |
|---|---|---|
| Defect rate: | Contractor firms | Q1013 |
| | Subcontractor firms | Q2504 |
| | Small/medium firms | Q49-9 |

Number of employees who can understand technical drawings:

| | | |
|---|---|---|
| | Contractor firms | Q1014 |
| | Small/medium firms | Q41 |

2) Work Subcontracted Out by Contractors; Subcontractor Firms Viewed from Their Contractor Firms

A considerable portion of the subcontractor firms are of size equal or larger than their contractors (cf. Q1027); the kinds of assistance extended by contractor to subcontractor are principally technical in nature (supply of technical drawings, trouble-shooting, follow-up), and no cases are reported of advances in money (capital investment, loan) or in kind (supply of materials)–(cf. Q1028).

The types of processes and kinds of products subcontracted out are spread over a large range (cf. Q2100, 2200). In terms of processes, roughly half of the contractors subcon-

tracted out casting work, followed by presswork and machining, for which many contractor firms regularly subcontracted out work to 1–3 subcontractor firms.

The products subcontracted out were predominantly standardized components and machine parts.

The major motives given by contractor firms for subcontracting out were to complement their own technological know-how and to lower production cost.

A point to be noted is that 40% of the contractor firms do not have in their organization a department charged with supervising their subcontractor firms (cf. Q1037–8).

Subcontracting out to foreign firms is also actively practiced; subcontractors in Japan constitute an outstanding majority (cf. Q1031–2).

In respect of room for improvement pointed out by contractors concerning their subcontractors, by far the largest majority mention quality rather than price or delivery period.

Quality improvement is called for by the largest number of contractors in respect of casting work, followed by mentions of electroplating, machining and presswork (cf. Q1032).

As concerns very effective measures to be established by the public services for promoting the practice of subcontracting out, the greatest number of contractors mention financial assistance. Subcontractors on their side, point out the need they feel for more sustained technical advice and guidance.

For themselves, the subcontractor firms mention as very effective means for extending their subcontracted business, apart from improvement of their own product quality and reliability, their acquisition of higher design and manufacturing capability, worker skill, and of more modern production and measuring equipment (cf. Q1039).

In respect of future plans envisaged by the contractor firms concerning their policy on subcontracting out, more than half the number of contractors are considering either (a) to maintain their present rate of subcontracting out, or (b) to change their policy only if circumstances so demanded. What deserves note is that more than 3 times the number of contractor firms considering intensification of in-house processing are planning on the contrary to depend more on subcontracting out. In line with this trend, while the majority of contractor firms are considering to maintain their present relations with their subcontractors, a greater number of the remaining contractors are thinking of strengthening their ties with their subcontractors than those contemplating to cut off or relax their ties (cf. Q2309, 2313).

Payment by 2- to 3-month credit is the most current practice for settlement between contractor and subcontractor (cf. Q2403).

In respect of general management and technological level, most of the contractor firms view their subcontractors as representing a normal or above-normal level (cf. Q2307, 2308), and this view is substantiated by the large number of contractor firms expecting that eventual cessation of their assistance to their subcontractors should have no consequence at all (cf. Q2303).

In respect of defect rate, the subcontractor firms compare unfavorably with their contractors, but rank higher than in the corresponding evaluation under Part 3 covering small/medium subcontractor firms (cf. Q2504, Q49-9). As for delays in delivery, the fairly good systems for schedule control possessed by the subcontractor firms do not appear to be operating effectively to prevent the relatively frequent occurrence of delivery delays (cf. Q2602, 2603).

(2) General Situation of Small/Medium Firms, and Their Relations with Contractor Firms

Information on the general situation of small/medium firms and their relations with contractor firms was assembled on the Part 3 questionnare.

The following pages summarize the general situation presented by the small/medium metalworking firms and their relations with contractor firms, together with some observations on their technological level, and frequency of subcontracted work.

1) General Situation of Small/Medium Metalworking Firms

The majority of respondent small/medium firms have been established in the period between 1964 and 78, which further substantiates the significance of this period, as it was indicated in the case of contractor firms. The difference from contractor firms lies in the comparatively larger portion represented by the younger firms less than 5 years old, and the conversely smaller portion of those older than 10 years, resulting in a relatively flat distribution over the years (cf. Q01, Q1001).

In respect of size of the firms, roughly 90% of the respondents are capitalized at less than B4 million, which ranges them in the category of "small and medium" firms in SIFO definition. A parallel trend is seen in respect of the number of employees: More than 70% employ less than 50 (cf. Q01-1, Q10). Also, the same fraction of firms operate as private firm—and not as joint stock company (Q07).

Comparison with contractor firms in respect of employee wages reveals both contractor and small/medium firms having their largest group of employees receiving monthly

salaries in the range from 2,501 to 4,000. The difference between the two categories of firms appears in the next largest group, which is represented by employees receiving 1,601 to 2,500 in the case of small/medium firms, whereas the contractor firms have their next largest group receiving 4,001 to 6,300, indicating the superiority of their wage level. The average ages and durations of service of employees do not differ significantly between the two categories of firms.

In respect of personnel organization, a clear difference from contractor firms is seen in the number of small/medium firms with no employee assigned specifically to quality control, design or engineering, and though to less extent, to sales and cost estimation (cf. Q10-1, Q1005-1). The difference between the two categories of firms is also evident in respect of the level of education received by the employees. More than 50% of the contractor firms count university graduates among their employees, while the corresponding proportion lowers to about 25% in the case of small/medium firms (cf. Q11, Q1006).

In respect of distribution in terms of type of production process, small/medium contractors engaging wholly or in part in machining account for about 54%, followed by those similarly engaging in sheetwork/welding, accounting for 1/3, and by casting, presswork and electroplating, each accounting for roughly 1/5, and lastly forging and heat treatment, each accounting for less than 10% (cf. Q02).

Sales outlets are predominantly domestic, as with contractor firms; less than 5% have found customers in developing and other countries abroad, representing a much smaller percentage than in the case of contractor firms, as may well be expected (cf. Q20, Q1007).

In respect of product quality and technological level, the small/medium firms compare unfavorably with contractor firms, as already mentioned in the preceding Section.

In respect of industrial standards applied in manufacture, the largest number of small/medium firms adopt those of their customers or else their own, in contrast to the large number of subcontractor firms applying JIS (cf. Q44, Q1016). Less than 10% of the small/medium firms have professional inspectors permanently assigned, and only about 20% of them communicate work instructions to their employees in the form of technical drawings. These data are indicative of low technological level and product quality (cf. Q46-1, 47, Q1016-1).

In respect of management policy items envisaged by the small/medium firms for developing their business, the items mentioned are the following, listed in the order of the frequency with which they are mentioned (In detail, refer to Fig. 4.3.3-1).

① Research and development aimed at raising general technological level
② Enhancement of market share
③ Improvement of productivity
④ Reduction of labor cost
⑤ Research and development on products; quality control.

In respect of measures by Government that should contribute very effectively to extending their business, as showned in Figure 7.1.1, the respondents mention in largest number financial aid and tax exemption, followed by technological and technical information services (including technical consultation, testing, training services), and promotion of exports (cf. Q74).

2) Relations with Contractor Firms

Small/medium firms that mention undertaking subcontracted work to any extent number 167, accounting for more than 70% of the respondents in this category. It is notable that a relatively larger portion of them undertake subcontracted work quite frequently. Those that do this constantly number 75, accounting for 33% (cf. Q70).

The motives given by small/medium firms for seeking subcontracted work are in more than half of the cases to ensure stable workload; very few firms mention transfer of technology as motive.

Table 4.3.3-1 compares the relations with contractor firm maintained by the small/medium firms—derived from the Part 3 responses—with those by the subcontractor firms —from the Parts 1 and 2 responses.

A slight difference is seen in the distribution of manufacturing processes undertaken by the lesser firms, but the product distribution is much the same.

A notable revelation appears in the responses on the expected consequence of an eventual cessation of technical assistance given by contractor to subcontractor. Both the subcontractor and small/medium firms consider in large majority that such an eventual cessation should have no consequence at all, which indicates relatively loose technical ties linking contractor and subcontractor, and conversely a strong independence in technical matters shown by the subcontractor and small/medium firms.

A strong contrast is seen, on the other hand, between the attitudes held by the contractor and by small/medium firms concerning delivery dates, product quality and guarantees: The contractor firms show a distinctly severer attitude toward these matters compared with the lesser firms.

3) Correlation between Frequency of Subcontracted Work and Technological Level

In full awareness of the limited number of factors considered, a number of correlations have been sought between the data indicative of technological level and frequency of subcontracted work. The results are detailed in Table 4.3.3-2. The following paragraphs summarize the notable points revealed from the analysis.

- Frequency of delays in delivery is lower with firms undertaking little or no subcontracted work.
- The number of firms with no employee capable of understanding technical drawings does not differ between those frequently and infrequently undertaking subcontracted work.
- Firms more frequently undertaking subcontracted work tend to have more advanced systems for dealing with product defects.
- The technological levels evaluated by the interviewers do not differ to any appreciable extent between firms frequently and infrequently undertaking subcontracted work.
- The number of firms not performing R & D does not differ appreciably between those frequently and infrequently undertaking subcontracted work.

On the whole, within the limited number of factors taken up, no meaningful correlation was discerned between frequency of subcontracted work and technological level.

The factors taken up, and sources of data were:—

| | |
|---|---|
| – Frequency of subcontracted work undertaken: | Q70 |
| – Technological level | |
| = Delays in delivery | Q36 |
| = Number of employees who can understand drawings | Q41 |
| = Dimensional tolerances | Q43 |
| = Rate of defects in product affer shipment | Q49-10 |
| = Technological level as evaluated by interviewers | Q49-10 |
| = Expenditure for R & D in reference to total sales | Q45-1 |

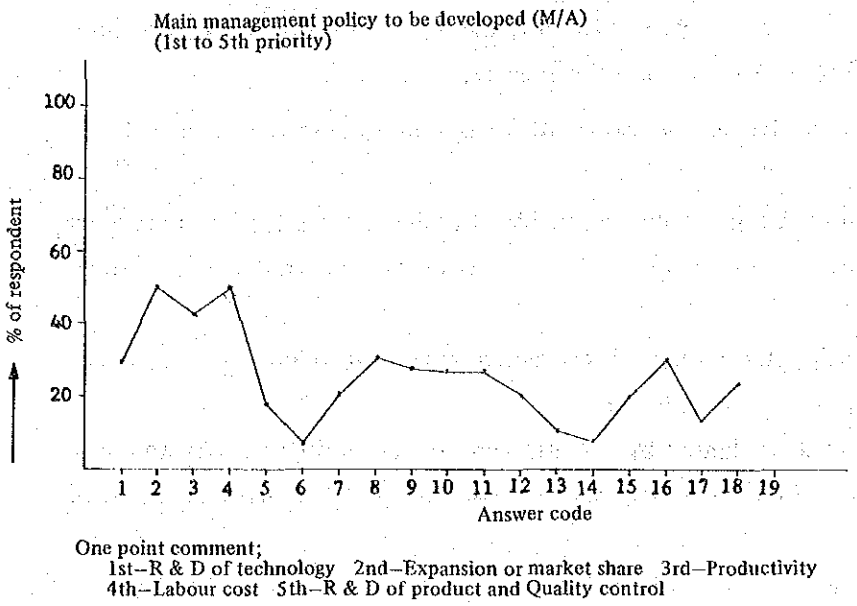

Main management policy to be developed (M/A)
(1st to 5th priority)
% of respondent
100
80
60
40
20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Answer code
One point comment;
1st–R & D of technology 2nd–Expansion or market share 3rd–Productivity
4th–Labour cost 5th–R & D of product and Quality control
1. R & D of product 5
2. R & D of technology 1
3. Productivity 3
4. Expansion of market share 2
5. Upgrading qualification 14
6. Diversification of products 18
7. Own capital 12
8. Labour cost 4
9. Material cost 7
10. Capital cost 8
11. Overhead cost 9
12. Production control 12
13. Process control 16
14. Design engineering 17
15. Cost control 11
16. Quality control 5
17. Human resources 15
18. Training of workers 10
19. Others (Specify)

Figure 4.3.3-1

Table 4.3.3-1 Comparison of Part 3 Responses with Those of Parts 1 and 2

| PART 3 (Question of general nature concerning small and medium metalworking firm) | PARTS 1 AND 2 (Concerning the subcontractor firm viewed from their contractor) |
|---|---|
| **Manufacturing processes subcontracted in/out** | |
| Q02 - Greatest number of subcontractors undertake machining, followed by those doing casting, sheetwork/welding, electro-plating. Very few do forging or heat treatment. | Q2100 - Greatest number subcontract out casting work, followed by those giving out press-work and machining; few give out forging or heat treatment work; very few machine assembly. |
| **Types of products subcontracted in/out** | |
| Q04 - Distributed over a wide range of products, but which largely possess the common character of being standardized components or machine parts. | Q2200 - Concentrated in standardized components and machine parts. |
| **Mode of payment for subcontracted work** | |
| Q26 - (a) Cash + credit, and (b) 2 - 3 months credit. | Q2403 - 2 - 3 months credit account for the greatest number. |
| **Instructions to subcontractor from contractor concerning delivery terms and product quality** | |
| Q49-6, Q34 - 60% receive either no instructions or only verbal instructions. | Q2501 - 32% give instructions verbally; none give no instructions in this connection. |
| **Relative sizes of firms contractor and subcontractor** | |
| Q70-1 - Greatest number have contractors that are larger than themselves, followed by those that are of equal size. | Q1027 - Greatest number of contractor have subcontractors that are of equal size, followed by those that have subcontractors larger than themselves. |

(to be continued)

Table 4.3.3-1 (Cont.)

| PART 3 (Question of general nature concerning small and medium metalworking firm) | PARTS 1 AND 2 (Concerning the subcontractor firm viewed from their contractor) |
|---|---|
| **Kind of technical assistance received/given** | |
| Q70-2 - Distributed over a wide range, and no predominant kind of assistance is indicated. | Q1028 - Greatest number render assistance with technical know-how in the form of drawings etc., followed by those aiding with trouble-shooting and follow-up cell. |
| **Consequences expected upon cessation of technical assistance from contractor to subcontractor** | |
| Q70-4 - Greatest number expect no consequence at all. | Q2303 - Greatest number expect no consequence at all. |
| **Guarantee covering subcontracted work** | |
| Q70-7 - Greatest number provide no guarantee. | Q2304 - Less than 5% receive no guarantee. |
| **Future plans on subcontracted work** | |
| Q70-9 - 45% plan to extend their business in sub-contracted work; 40% plan to maintain their present level of business. | Q2309 - 44% plan to maintain their present level of subcontracting out; less than 30% plan to increase their level. |
| **Relations between contractor and subcontractor firms** | |
| Q70-14 - 56% plan to maintain their present level of alliance with their subcontractor; 35% plan to strengthen their ties. | Q2313 - 60% plan to maintain their present level of alliance with their subcontractors; 27% plan to strengthen their ties. |
| **Rate of defective products occurring after shipment** | |
| Q49-9 - 44% report less than 1%; 36% 2 - 5%. | Q2504 - 50% report less than 1%; 34% 2 - 5%. |
| **Frequency of delays in delivery** | |
| Q36 - 6% report frequent occurrence; 46% report it occurring sometimes. | Q2603 - 15% report frequent occurrence; 44% report it occurring sometimes. |

Table 4.3.3-2 Correlation between Frequency of Subcontracted Work and Technological Level

(Unit: Number of firms)

| Q70-00-01 / Q36 | | Total | Subcontracting-in: No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Total | | 28 | 12 | 40 | 23 | 13 | 74 | 190 |
| Delayed delivery | Very often (1) | 12 | 1 | 1 | 2 | 5 | 1 | 2 | |
| | Sometimes (2) | 86 | 9 | 3 (a) | 22 | 11 | 3 | 38 (c) | |
| | Rarely (3) | 39 | 6 | 5 | 7 | 3 | 5 | 13 | |
| | Very rare (4) | 22 | 3 | 1 (b) | 4 | 2 | 2 | 10 (d) | |
| | Not at all (5) | 31 | 9 | 2 | 5 | 2 | 2 | 11 | |
| | Total | 190 | | | | | | | |
| | | | | | | | | | |

$$\frac{b}{a+b} = 65\%$$

$$\frac{d}{c+d} = 44\%$$

Table 4.3.3-2 (Cont.)

| Q70-00-01 / Q41 | | Total | Subcontracting-in: No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
|---|---|---|---|---|---|---|---|---|---|
| Total | | Total | 29 | 13 (a) | 41 | 24 | 13 | 73 (d) | 193 |
| Number of employees who can understand drawing | None (1) | 61 | 12 | 3 (b) | 13 | 6 | 1 | 26 (e) | |
| | One person (2) | 38 | 5 | 3 | 9 | 3 | 2 | 16 | |
| | 2 - 4 persons (3) | 62 | 6 | 4 | 14 | 11 | 6 | 21 | |
| | 5 - 10 persons (4) | 17 | 2 | 1 | 4 | 3 | 2 | 5 | |
| | More than 10 (5) | 15 | 4 | 2 (c) | 1 | 1 | 2 | 5 (f) | |
| | Total | 193 | | | | | | | |
| | | | | | | | | | |

$\frac{b}{a}$ = 36%

$\frac{e}{d}$ = 31%

$\frac{c}{a}$ = 14%

$\frac{f}{d}$ = 6%

Table 4.3.3-2 (Cont.)

| Q43 \ Q70-00-01 | | Total | Subcontracting-in | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
| Total | | | (29) a' | 9 (a) | 59 | 32 | 14 | (91) d' | (d) 234 |
| The tolerance of your products? | 100mm or rough estimate (1) | 1 | | | | | | 1 | |
| | 10 mm (2) | 28 | (1) b' | (b) | 6 | 3 | | 18 e' | (e) |
| | 1 mm (3) | 78 | 12 | 3 | 14 | 5 | 7 | 37 | |
| | $\frac{1}{10}$ mm (4) | 62 | 9 | 5 | 15 | 6 | 6 | 21 | |
| | $\frac{1}{100}$ mm (5) | 50 | 6 c' | 1 | 19 | 13 | | 11 f' | |
| | Less than 1/100 mm (6) | 15 | 1 | (c) | 5 | 5 | 1 | 3 | (f) |
| | Total | 234 | | | | | | | |

$\frac{b}{a}$ = 2.6% $\frac{e}{d}$ = 14%

$\frac{c}{a}$ = 21% $\frac{f}{d}$ = 29%

$\frac{b'}{a'}$ = 3.4% $\frac{e'}{d'}$ = 21%

$\frac{c'}{a'}$ = 24% $\frac{f'}{d'}$ = 15%

Table 4.3.3-2 (Cont.)

| Q49-10 \ Q70-00-01 | | Subcontracting-in | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
| Total | | 26 | 11 (a) | 33 | 21 | 10 | 73 (d) | 174 |
| Defect management system (S/A) | 1. Not applicable | 7 | 2 | 3 | 4 | 2 | 10 | 28 |
| | 2. Emprically | 14 | 6 (b) | 13 | 6 | 5 | 41 (d) | 85 |
| | 3. Analysis of causes as a whole | 5 | 2 | 15 | 8 | 3 | 12 | 45 |
| | 4. 3 + their monetary terms conversion | | (c) | 1 | 1 | | 2 (f) | 4 |
| | 5. 4 + either for each kind of product or process | | | 1 | 2 | | | 3 |
| | 6. 4 + both for each kind of product & process | | 1 | | | | 7 | 8 |
| | 7. Others | | | | | | 1 | 1 |

$\frac{b}{a}$ = 54%

$\frac{e}{d}$ = 47%

$\frac{c}{a}$ = 22%

$\frac{f}{d}$ = 38%

Table 4.3.3-2 (Cont.)

| Q49-13 \ Q70-00-01 | | Subcontracting-in | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
| Total | | 26 | 12 (a) | 34 | 23 | 12 | 73 (c) | 180 |
| Assessment of technical level (S) | 1. Very low | | | 2 | | | | 2 |
| | 2. Relatively low | 2 | 1 | 2 | 7 | 3 | 11 | 26 |
| | 3. Normal/Average | 18 | 8 | 20 | 13 | 6 | 47 | 112 |
| | 4. Relatively high | 5 | 3 | 10 | 3 | 3 | 13 | 37 |
| | 5. High | 1 | (b) | | | | 2 (d) | 3 |
| | 6. Extremely high | | | | | | | |
| | | | | | | | | |

$\frac{b}{a} = 24\%$

$\frac{d}{c} = 22\%$

Table 4.3.3-2 (Cont.)

| Q45-01-01 \ Q70-00-01 | | Subcontracting-in | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
| Total | | 28 | 11 (a) | 36 | 23 | 11 | 72 (d) | 181 |
| How much to the sales do you spend on research and developments? (S) | None | 18 | 7 (b) | 15 | 15 | 4 | 50 (e) | 109 |
| | Less than 0.5% | 7 | 2 | 3 | 4 | 2 | 13 | 31 |
| | 0.6 - 1% | | 1 | 4 | 1 | 1 | 4 | 11 |
| | 1.1 - 2% | | 1 | 8 | 1 | 1 | 3 | 14 |
| | 2.1 - 3% | 1 | | 2 | | | | 3 |
| | More than 3% | 2 | | 4 | 2 | 3 | 2 | 13 |
| | | | | | | | | |

$\frac{b}{a} = 64\%$

$\frac{c}{d} = 60\%$

4.3.4 Correlative Analyses in Reference to Category of Firm

As mentioned under Section 4.3.2, the respondents were divided into six categories. The firms belonging to these categories were processed in the following manner in performing the various analyses.

- Category 2 (joint-venture firms with Japanese partnership), Category 3 (joint-venture firms with non-Japanese partnership) and Category 4 (purely indigenously capitalized firms) were mutually compared in analyzing data from Part 1 and Part 2 questionnaires.
- Small/medium firms were divided into those undertaking subcontracted work from Category 2 contractors, from Category 3 contractors, and indigenously capitalized/independent firms (Category 4 and Category 5 firms grouped into 1 category), for analyses of Part 3 questionnaire data.
- Time series analysis was performed on trends detectable in the firms of Category 1 (those having occasions of undertaking work subcontracted for the JICA/TECHNONET AWIA Joint Research Project) between the results from the survey made 5 years and from the present survey (Part 3).
- Analysis of trends discernible in the activities of firms belonging to Category 6 (firms established during the past 3 years).

Note: The respondents to the Part 3 questionnaire were counted independently as separate firms when their activities classified them as belonging to more than 1 category. Consequently the total number of responses add up to more than the total number of respondents.

(1) Comparative Analysis between Firms in Categories 2, 3 and 4 (Joint-Venture firms with Japanese partnership, Joint-venture firms with non-Japanese partnership and purely indigenously capitalized firms)

Notable characteristics bringing out the differences between the firms belonging to these three categories are extracted in Table 4.3.4-1.

In respect of size of firm in terms of registered capital, large firms capitalized at over B16 million account for roughly 70% of the total number in Category 2; the corresponding values are 40% for Category 3. For those in Category 4, small/medium firms capitalized at

less than B4 million account for more than 50%, showing a marked contrast.

In respect of types of product manufactured, firms of all three categories number most in automotive and automotive component production; concentration in this type of product is particularly marked in Category 2 firms. These firms are also characterized by their adoption of JIS as manufacturing standard, in contrast to the scattered distribution in this respect shown by the firms in other categories.

In respect of frequency of subcontracted work, a large number of firms in all three categories undertake this frequently; the tendency is particularly strong in Category 2 firms (67%).

In respect of number of employees, the trend is the same as for size of firm in terms of registered capital: A large number of Category 2 firms employ more than 200; those employing less than 200, in contrast, account for a larger part in Category 4.

In respect of the firms to which subcontracts are awarded, contractor firms in both Categories 2 and 3 subcontract more than 20% of subcontracted work to their subsidiaries, in contrast to those in Category 4, which patronize their subsidiaries to far less extent.

In respect of the types of process subcontracted out, casting is predominant is the case of Category 4 firms; those in the other two categories show a scattered trend.

In respect of the motives given for undertaking subcontracted work, many Category 4 firms mention complementation of technological know-how, which contrasts with those in the other two categories.

In respect of the expected consequence of an eventual cessation of technical assistance given by contractor to subcontractor, firms in Categories 3 and 4 mostly foresee no consequence at all, while many Category 2 firms fear risk of impaired product quality and increased delivery delays.

In respect of instructions on delivery date and quality, none of the Category 2 and 3 firms have indicated doing this by word of mouth only, whereas roughly half of those in Category 4 practice this.

In respect of product defect rate and frequency of delay in delivery, markedly low values are indicated by Category 2 firms compared with those in Categories 3 and 4.

(2) Comparative Analysis between Small/Medium Firms Undertaking Subcontracted Work from Category 2 Contractors, from Category 3 Contractors, and Those in Categories 4 and 5

The limited number of respondents in the groups of firms undertaking subcontracted work from Category 2 and 3 contractors renders simple comparisons somewhat problematic, but the observations given below should still serve in gleaning characteristic trends, and as such, they are summarized in Table 4.3.4-2.

In respect of size of firm, in terms of both registered capital and number of employees, those subcontracting for Category 2 contractors are largely in the medium size group, while in the case of those subcontracting for Category 3 contractors, and even more in the case of Categories 4 and 5 firms, the distribution is more biased toward the smaller-sized firms.

In respect of type of production process, the largest number engage in machining, in all three categories of small/medium firms. No common trend is seen among the 3 categories of firms concerning their second most frequent choice of process.

In respect of delays in delivery, the number of employees that can understand technical drawings, means of communicating instructions, and product defect rate, the firms subcontracting for Category 2 contractors compare favorably against all others. These firms, on the other hand, are in large part considering to maintain their present status in respect of future plans for subcontracting work and of relations with their contractors, whereas the other two categories of small/medium firm show a more positive attitude in their future policy. In respect of manufacturing standards, a large majority of those subcontracting for Category 2 contractors apply JIS, while the others show no significant trend.

The relatively positive attitude shown for their future policy by the Categories 4 and 5 firms, which can be considered to represent the majority of indigenous capital small/medium size metalworkers, and their relatively unfavorable position in respect of technological level would indicate that extending their business in subcontracted work should provide an effective means of promoting the small/medium metalwork industry.

(3) Time Series Analysis on Trends Detectable in Category 1 Firms

1) Trend Seen in Frequency of Subcontracted Work

As mentioned in Section 4.3.2, the Category 1 firms are those that have reported to have had occasion to undertaken subcontracted work sometime, often or very often for the JICA/TECHNONET ASIA Joint Research Project. In this survey respondents are divided into the 6 groups that undertake such work (1) not at all, (2) rarely, (3) sometimes, (4) often, (5) very often, and (6) constantly.

Table 4.3.4-3 indicates the changes seen between the previous and present surveys. Firms that report lowering of subcontracting frequency number 17 (41%), no change 5 (12%), and increase 19 (47%): A fairly intense turnover is revealed.

2) Change in Frequency of Subcontracted Work Correlated with Technological Level

Taking up the Category 1 firms in the 3 Groups by occasion to undertaken subcontracted work sometime (Group 1), often (Group 2) and very often (Group 3), those in each of these groups have been analyzed to seek a correlation between the change in frequency of subcontracted work and relevant data indicative of technological level—frequency of delivery delays, average length of delivery delay, means of communicating work instructions, product defect rate. The results are presented in Table 4.3.4-4.

To point out some notable trends revealed from this Table, in the case of firms in Group (1) above, some anomalous results have appeared:—

- Delivery delays are rarer with firms that have lowered their frequency of subcontracted work.
- Means of communicating work instructions have tended to improve with firms recording similarly lowered frequency.

On the other hand--

- Product defect rate has properly lowered with firms that have raised their frequency of subcontracted work.

Taking the case of firms in Group (2)—

- Delivery delays occur at the same rate between firms that have raised and those that have lowered their frequency of subcontracted work.
- Means of communicating work instructions have improved with firms recording lowered frequency of subcontracted work.
- Defect rate shows do difference.

The foregoing results fail to bring out any consistent correlation between change in the frequency of subcontracted work and data indicative of technological level.

3) Analysis of Change in Technological Level during The Past 5 Years

The question items concerning delivery delay frequency, number of employees that can understand technical drawings, dimensional tolerances, product defect rate and applied manufacturing standards are common with the previous survey carried out 5 years previously. Comparisons made on the responses to these items are given in Table 4.3.4-5.

Overall evaluation taking general account of all items results in 21 firms considered to have raised their technological level, 11 firms considered to have remained unchanged, and 13 considered to have deteriorated, giving an average level that can be judged to have improved in the 5 years. In particular respect of defect rate, only 2 firms have seen an increase of this rate; 21 have remained unchanged, and 20 have managed to lower their defect rate. In respect of the number of employees that can understand technical drawings, 11 firms have seen increase, 22 have remained unchanged, and 10 have suffered decrease, with a net result of unchanged situation. In respect of delivery delay frequency, the overall trend is toward deterioration.

The correlation between change in frequency of subcontracted work and technological level proved to be as follows.

In overall evaluation, the firms have in large part raised their technological level, and this is uncorrelated with change in frequency of subcontracted work. The trend of uncorrelated improvement is particularly evident for product defect rate, and the same result characterizes also the other data indicative of technological level.

4) Trend Shown by Firms Established during The Past 3 Years

Analysis of the trend shown by the firms classified under Category 6 in Section 4.3.2 resulted in the data presented in Fig. 4.3.4-1, for the production processes and products.

The greatest number of firms coming to be established engage in machining, followed by those engaging in sheetwork/welding, in presswork, and machine assembly. No new firms have engaged in casting work. Added to this are several firms engaging in precision machining, from which is can be judged that mechanical work is attracting the greatest attention among the metalwork industries.

In respect of products, the automotive and associated components account for a predominantely high percentage of newly established firms; also representing a high fraction is industrial machinery, supplemented in modest extent by agricultural, construction and telecommunication equipment.

While the limited number of firms covered precludes possibility of conclusive judgment, it may be considered that the Thai Government's policy of replacing imported goods by indigenous products, with foremost priority accorded to the automotive industry and agricultural machinery industry, is seeing its effect felt in the small and medium metalworking industry.

Table 4.3.4-1 Comparison of Characteristics between Categories of Respondent Firms

| ITEM | CATEGORY 2 (Japanese partnership joint ventures) | CATEGORY 3 (Non-Japanese partnership joint ventures) | CATEGORY 4 (Indigenously capitalized firms) |
|---|---|---|---|
| Registered capital (Q1001-2) | About 70% of respondents concentrated in the large firm group of over B16 million | Greatest portion in the large firm group of over B16 million (over 40%), followed by about 30% in the next largest group of B4 million to B16 million | Concentrated (over 50%) in the small and medium size group of below B4 million |
| Products manufactured (Q1003) | Over 50% of respondents associated with automobile industry | Greatest portion (about 30%) associated with automobile industry; product items somewhat widely scattered | Greatest portion (over 30%) associated with automobile industry; product items very widely scattered |
| Number of employees (Q1005) | Concentrated (over 60%) in the group of large firms employing more than 200 | 43% employ more than 200; 50% employ between 50 and 200 | 20% employ more than 200; 33% employ between 50 and 200 |
| Sales outlets (Q1007) | 33% sell only within their own region; 67% sell nationwide; 29% also export to developing countries | None sell only within their own region; 86% sell nationwide; 36% also export to developing countries; 7% export further to newly developed and developed countries | 64% sell only within their own region; 87% sell nationwide; 24% export also to developing countries; 9% export further to newly developed and developed countries |
| Product defect rate (Q1013) | 68% report less than 1% | 77% report less than 1% | 62% report less than 1% |
| Number of employees understanding technical drawings (Q1014) | 10% employ none; 57% employ more than 10 | 7% employ none; 72% employ more than 10 | 2% employ none; 26% employ more than 10 |
| Engineering standard applied (Q1016) | 96% apply JIS | 29% apply ASTM; 29% BS; 21% JIS; 21% DIN; 21% TIS; 29% their own standard | 46% apply JIS; 15% ASTM; 13% DIN; 50% their own standard |
| Whether or not Government subsidy ever received (Q1041) | 42% have received | 8% have received | 8% have received |
| Expenditures for R & D (Q1043) | 70% spend nothing | 36% spend nothing | 30% spend nothing |
| Frequency of subcontracting out (Q1026) | 19% never subcontract out; 67% often or very often | 31% never subcontract out; 46% often or very often | 19% never subcontract out; 48% often or very often |

Table 4.3.4-1 (Cont.)

| ITEM | CATEGORY 2 (Japanese partnership joint ventures) | CATEGORY 3 (Non-Japanese partnership joint ventures) | CATEGORY 4 (Indigenously capitalized firms) |
|---|---|---|---|
| Kind of firm to which work is subcontracted (Q1027) | 24% to associated firm; 29% to firm of same size; 18% to bigger firm | 22% to associated firm; 22% to firm of same size; 33% to bigger firm | 2% to associated firm; 54% to firm of same size; 31% to bigger firm |
| Number of firms to which work is subcontracted out (Q1029) | Greatest number subcontract out work to 1 - 3 subcontractor firms; some to more | Majority subcontract out to 1 - 3 firms | Majority subcontract out to 1 - 3 firms |
| Kind of process subcontracted out (Q2100) | 31% subcontract out casting work; 25% sheetwork/welding; 44% presswork | 38% subcontract out casting work; 25% electroplating; 38% machining; 38% presswork | Predominant portion (62%) subcontract out casting work |
| Kind of product subcontracted out (Q2200) | 56% subcontract out standardized components | 44% subcontract out standardized components; 33% auxiliary materials; 33% products to be processed | 75% subcontract out standardized components |
| Work subcontracted abroad (Q1031/21) | 100% of respondents subcontract out to Japan | Work subcontracted out to Japan, USA, Europe etc. | Almost 100% subcontract out work to Japan; about 20% to Taiwan; some also to ASEAN countries |
| Whether or not a section/person is charged with managing subcontracted work (Q1037) | 53% have none | 33% have none | 38% have none |
| Motive for subcontracting out (Q1038) | Greatest portion mention their own convenience, followed by those mentioning reduction of cost and those giving ensurance of quality | Greatest portion mention reduction of cost, followed those mentioning own convenience | Greatest portion mention supplementation of technological capability, followed by those mentioning own convenience and those giving reduction of cost |
| Consequence expected upon cessation of technical assistance to subcontractee (Q2303) | More than 60% fear risk of impaired product quality and increased delivery delays | 67% expect no consequence at all | 71% expect no consequence at all |
| Instructions to subcontractee concerning delivery terms and product quality (Q2501, Q2601) | None give instructions only verbally | None give instruction only verbally | 50% give instructions only verbally |
| Defect rate on subcontracted products (Q2504) | 38% mention less than 1% | 67% mention less than 1% | 48% mention less than 1% |
| Frequency of delays in subcontracted product delivery (Q2603) | 63% mention it occurring sometimes; 19% that it occurs often | 11% mention it occurring sometimes; 11% that it occurs often | 43% mention it occurring sometimes; 15% that it occurs often |

## Table 4.3.4-2 Comparison of Characteristics between Firms Undertaking Subcontracted Work for Different Categories of Subcontractor Firms

| | CATEGORY 2 (Subcontractor of Japanese partnership joint ventures) | CATEGORY 3 (Subcontractor of non-Japanese partnership joint ventures) | CATEGORY 4 (Subcontractor of indigenously capitalized firms); and CATEGORY 5 (independent firms) |
|---|---|---|---|
| Number of employees (Q10) | Roughly 50% employ between 50 and 200 | More than 50% employ less than 50 | More than 80% employ less than 50 |
| Registered capital (Q10-1) | 55% are small/medium firms capitalized at less than B4 million | More than 70% are small/medium firms capitalized at less than B4 million | 90% are small/medium firms capitalized at less than B4 million |
| Kind of process subcontracted in (Q02) | Great portion subcontract in machining, followed by those doing machine assembly | Great portion subcontract in machining, followed by those doing sheetwork/welding, and electroplating | Greatest portion subcontract in machining, followed by those doing casting work |
| Products subcontracted in (Q04) | Concentrated in standardized components | Standardized components; processed products | Standardized components; assembled products |
| Frequency of delays in subcontracted product delivery (Q36) | Roughly 75% mention it occurring rarely or never | 57% mention it occurring rarely or never | 47% mention it occurring rarely or never |
| Number of employees understanding technical drawings (Q41) | 5.3% employ none | 29% employ none | 34% employ none |
| Means of communicating work instructions (Q47) | Roughly 50% communicate by means of drawings | Roughly 30% communicate by means of drawings | Roughly 11% communicate by means of drawings |
| Defect rate on subcontracted products (Q49-9) | 72% mention less than 1% | 43% mention less than 1% | 40% mention less than 1% |
| Frequency of subcontracting in (Q70) | 60% subcontract in constantly | None subcontract in constantly; 50% often | 42% subcontract in constantly |
| Guarantee covering subcontracted products (Q70-7) | 28% provide no guarantee | 17% provide no guarantee | 52% provide no guarantee |
| Future plans on undertaking subcontracted work (Q70-9) | 56% plan to maintain present status | 83% plan to maintain present status | 36% plan to maintain present status; 42% plan to expand gradually |
| Future plans on relations with subcontractor firm (Q70-14) | 53% plan to maintain present status | 83% plan to tighten their ties with subcontractor | 54% plan to maintain present status; 36% plan to tighten their ties with subcontractor |
| Engineering standard applied (Q44) | Predominant portion apply JIS | Greatest portion are those applying JIS and those applying own standard, followed by those applying customer standard | Greatest portion apply customer standard, followed by those applying own standard, and those applying JIS |

Table 4.3.4-3 Changes in Frequency of Subcontracted Work

(Unit: Number of firms)

| Previous survey categories on frequency of undertaking subcontracting work \ Q70-00-01 | This time survey categories on frequency of subcontracting-in | | | | | | |
|---|---|---|---|---|---|---|---|
| | No (1) | rarely (2) | sometimes (3) | often (4) | very often (5) | constantly (6) | Total |
| Total / Total | | | | | | | 41 |
| Sometimes (3) | 8 | 4 | 4 | 5 | 1 | 10 | 32 |
| Often (4) | | | 2 | | | 1 | 3 |
| Very often (5) | | | 2 | 1 | 1 | 2 | 6 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

→ Went down

→ No change

→ Went up

Table 4.3.4-4 Correlated with Technological Level

| Techno Category | This Survey Category | Q36 | Q37 | Q47 | Q49-9 | |
|---|---|---|---|---|---|---|
| Sometimes (3) | No (1) | 3.1 | 1.5 | 1.1 | 5.6 | Went down |
| | Rarely (2) | 3.2 | 1.6 | 1.5 | 4.7 | |
| | Sometimes (3) | 2.7 | 1.7 | 1.0 | 4.7 | No change |
| | Often (4) | 2.6 | 1.7 | 1.0 | 5.6 | Went up |
| | Very often (5) | 2.0 | 1.0 | 1.0 | 6.0 | |
| | Constantly (6) | 3.0 | 1.6 | 1.0 | 5.3 | |
| Often (4) | Sometimes (3) | 3.0 | 1.0 | 2.5 | 5.5 | Went down |
| | Constantly (6) | 2.0 | 2.0 | 1.0 | 4.0 | Went up |
| Very often (5) | Sometimes (3) | 2.0 | 1.0 | 1.0 | 3.5 | Went down |
| | Often (4) | 2.0 | 2.0 | 2.0 | 5.0 | |
| | Very often (5) | 4.0 | 2.0 | 1.0 | 6.0 | No change |
| | Constantly (6) | 2.0 | 2.0 | 1.0 | 4.0 | Went up |

Q36 Delayed delivery (S/A)

1. Very often
2. Sometimes
3. Rarely
4. Very rare
5. Not at all
6. Others (Specify)

Q37 Average term of Delayed delivery (S)

1. Less than 3 days
2. 4 days to one week
3. 2 to 4 weeks
4. 1 month to 2 months
5. 3 months to 4 months
6. More than 5 months

Q47 How do you instruct your workers to produce the product? (S/A)

1. Sample/rough sketch/verbal instruction
2. Technical drawing
3. Own design technical drawing
4. Others, specify_____

Q49-9 Defect Rate after shipping (S)

1. More than 30%
2. 21 - 30%
3. 11 - 20%
4. 6 - 10%
5. 2 - 5%
6. Below 1%

Each figure which show the technological level is calculated by the following formula:

$$\text{Formula} = \frac{A1 + A2 + \cdots\cdots An}{n}$$

n = Number of firms which are applied to each item

An = Answer number the n-th firm answered to the relevant question

## Table 4.3.4-5 Change in Technological Level During 5 years between Surveys

| | | Technological level | | FREQ. OF SUBCONTR. WORK THIS SURVEY (Q70-01) | FREQ. OF DELIVERY DELAYS* THIS SURVEY (Q36) | FREQ. OF DELIVERY DELAYS* LAST SURVEY (Q33) | NUMBER OF EMPLOYEES UNDERSTANDING DRAWINGS* THIS SURVEY (Q41) | NUMBER OF EMPLOYEES UNDERSTANDING DRAWINGS* LAST SURVEY (Q41) | DIMENSIONAL TOLERANCES* THIS SURVEY (Q43) | DIMENSIONAL TOLERANCES* LAST SURVEY (Q43) | PRODUCT DEFECT RATE* THIS SURVEY (Q49-9) | PRODUCT DEFECT RATE* LAST SURVEY (Q40) | ENGINEERING STANDARD APPLIED* THIS SURVEY (Q44) | ENGINEERING STANDARD APPLIED* LAST SURVEY (Q44) | OVERALL EVALUATION** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All firms | | | Improved | 19 | 13 | | 11 | | 10 | | 20 | | 18 | | 21 |
| | | | Unchanged | 5 | 12 | | 22 | | 16 | | 21 | | 8 | | 11 |
| | | | Deteriorated | 16 | 19 | | 10 | | 10 | | 2 | | 15 | | 13 |
| Change in frequency of undertaking subcontracted work | Increased | | Improved | 19 | 5 | | 2 | | 2 | | 10 | | 5 | | 6 |
| | | | Unchanged | | 6 | | 12 | | 7 | | 8 | | 3 | | 7 |
| | | | Deteriorated | | 8 | | 5 | | 5 | | 1 | | 10 | | 6 |
| | | | Not clear | | | | | | 5 | | | | | | |
| | Unchanged | | Improved | 5 | 2 | | 1 | | 3 | | 1 | | 3 | | 3 |
| | | | Unchanged | | | | 2 | | 1 | | 4 | | 2 | | 2 |
| | | | Deteriorated | | 3 | | 2 | | | | | | | | |
| | | | Not clear | | | | | | 1 | | | | | | |
| | Decreased | | Improved | 16 | 5 | | 6 | | 3 | | 8 | | 7 | | 8 |
| | | | Unchanged | | 6 | | 7 | | 5 | | 6 | | 2 | | 6 |
| | | | Deteriorated | | 5 | | 3 | | 5 | | 1 | | 4 | | 2 |
| | | | Not clear | | | | | | 3 | | 1 | | 4 | | 2 |

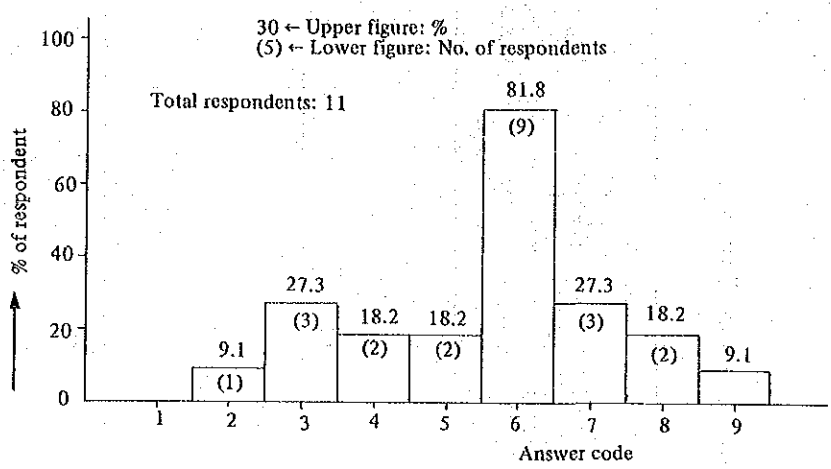
*) Changes in level for individual items: Firms were compared for their responses to the previous and present surveys, and classified into groups of "improved", "unchanged", and "deteriorated" technological level. The numerals given in the above table indicate the number of firms belonging to each group.

**) Overall evaluation: The firms were similarly classified into three groups on the basis of their total score over all items.

Q02 Type of your subcontrated in processes (M)

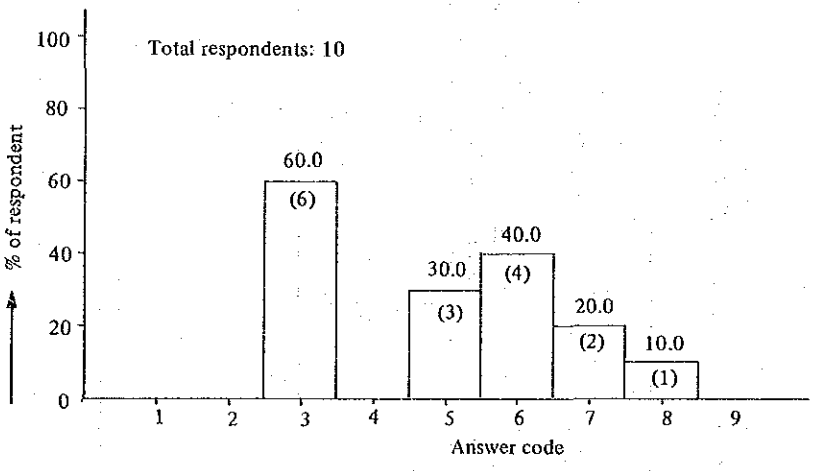
1. Casting
2. Forging
3. Sheetwork & welding
4. Plating
5. Machine assembly
6. Machining
7. Presswork
8. Precision machining
9. Heat treatment

One point comment;

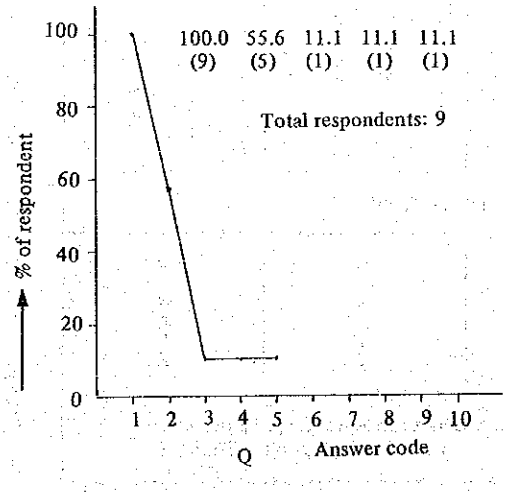



Q02 Type of your own processes

One point comment;




Q05 Kind of products subcontracted in (M)




1. Mortor 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

Fig. 4.3.4-1 Firms Established during The Past3 Years

## 4.4 Present Situation and Problem by Products

### 4.4.1 Agriculture Machinery

(1) Agriculture machinery in Thailand

The agriculture in Thailand is the industry that occupies the first place as well in the Gross National Product as in the Exports. The Thailand Government is promoting the mechanization of agriculture for the improvement of productivity of the rice and other agricultural products as well as for the increase of the exports. Of the mechanization of the agriculture, what is given the most importance is the diffusion of the tractors and the nationalization of its manufacture.

In the present investigation, we have tried to outline the actual situation of the industry of agriculture machinery and to extract its problems and its countermeasures.

1) Outline of the Industry of Agriculture Machinery

① Kind of manufactured machines

Generally what is called agriculture machinery has come developing in accordance with the kind of agriculture and according to the form of each work. Accordingly their classes and models vary widely. As for the tractors that the Thailand Government is promoting preponderantly, we can see a great variety of them as is seen in the Fig. 4.4.1-1 . However, in Thailand, the models that are produced and used mainly are (2)-1, as smaller type and (3)-2 as larger type.

Photo 4.4.1-1 shows the Thailand made single shaft type tractor (smaller type), and Photo 4.4.1-2 shows the double shaft type tractor (larger type): Exhibition in the Ministry of Agriculture of Thailand.

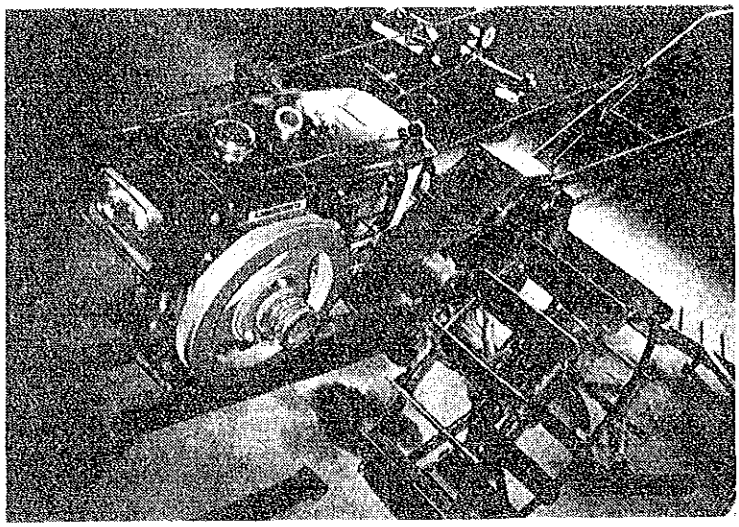


Photo 4.4.1-1

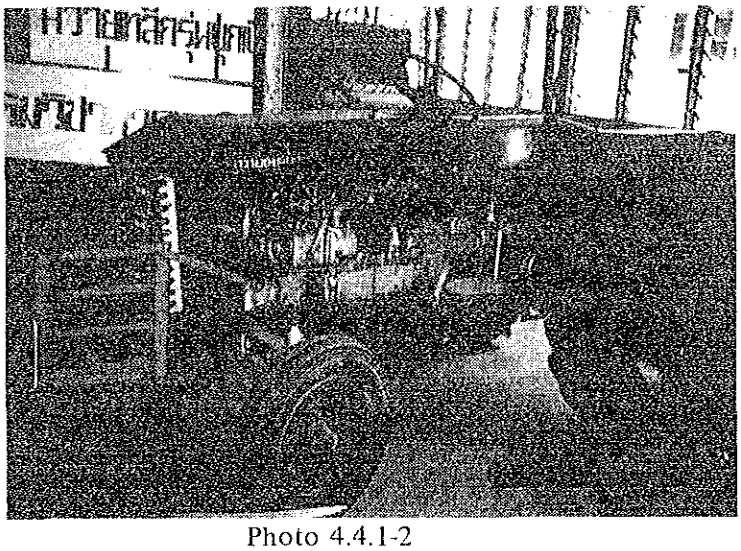
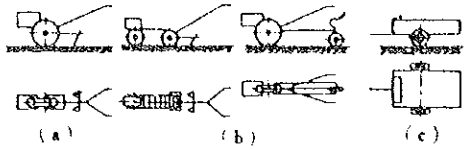
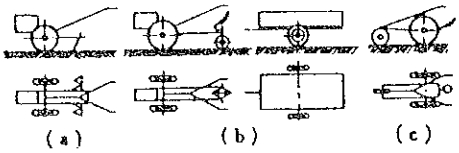


Photo 4.4.1-2

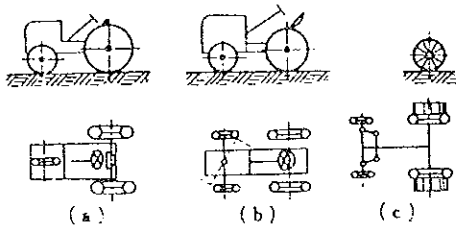
(1) Single track type tractors




(2) Single shaft type




(3) Double shaft type tractor (Rear wheels driving)




(4) Double shaft type tractor (Four wheels driving)

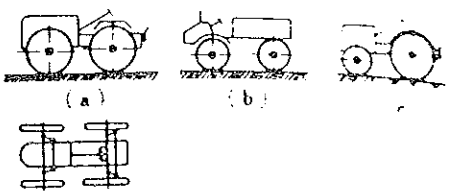



Fig. 4.4.1-1 Shapes of the Tractors Seen Structurally

② Situation of the tractor industry

Actually it is said that there are 120 to 130 companies in Thailand that manufacture the agricultural tractors, and of those some ten (10) companies are said to be the major manufacturers.

There are also some three (3) joint companies, but they are mainly dedicated to the assembly of the engines and depend on the subcontractors for the processing of the parts.

In Thailand, the single shaft type tractors are divided roughly in three classes.

– High Class: These are of high quality, and except engine, all the parts are imported from Japan, and some of them have six (6) forward speed change, two (2) backward speed change and steering clutch. The horse-power is mostly 8–10 PS and their price is about ฿.50,000. Some 2,000 units are imported annually.

– Middle Class: Some are Chinese made and some are Thailand made and have two (2) or three (3) forward speed change and one (1) backward speed change, and some of the Chinese made models have steering clutch. Actually Chinese made ones are predominant and this fact being hindrance to the upbringing of the proper enterprise of Thailand, a regulation of importation is exercised.

– Low Class: These are mainly of national manufacture and have only one (1) or two (2) forward speed change and their price is low.

The manufacture of the engine of said tractors is monopolized by the above-mentioned three (3) Thailand-Japanese joint companies, but it was obligated to realize the nationalization of their manufacture up to 80% by 1983, and it seems that this has been attained roughly in more than 70%.

(2) Actual Condition of the Industry of Agricultural Machinery

In the present investigation, of the 126 machine work firms, object of the investigation, 14 firms answered as agricultural machinery firms. It is not possible to know completely the general conditions of the agricultural machinery firms in Thailand with the 10% of them, but it will be possible to grasp an outline of the actual conditions and its problems. Accordingly, we are exposing below the results of this investigation and the results of the analysis of the various data.

1) Circumstances of the Firms and their Magnitude

① Age of the Firms (Q 01)

In Thailand, most of the firms that manufacture agricultural machinery have more than 6 years of history, and in the present investigation, all of the answered firms are more than 6 years of age, and more than half is more than 11 years old, and this fact suggests that the firms have sufficient ability for the agricultural machinery.

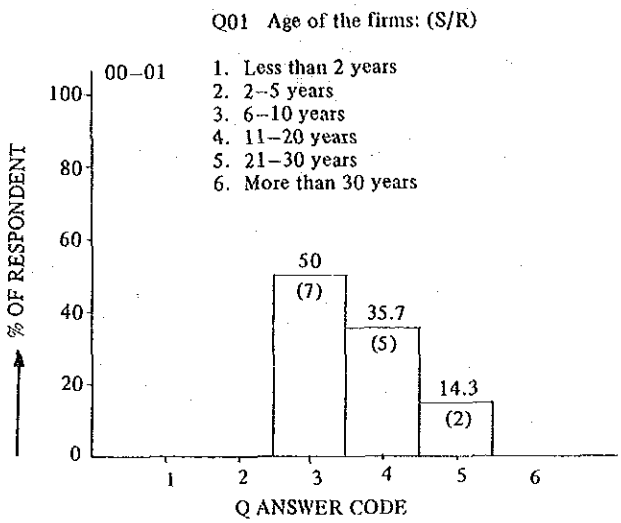



Fig. 4.4.1-2

② Capital and Sales Amount (Q 01-1, 2)

Observed in the aspect of the company capital, the firms whose company capital is under ฿250,000 occupy 35.7% of the totality. But those whose capital is over ฿.160,000,000 occupy 28.6% of the totality, therefore compared with the machine work industry in general, the magnitude of the agriculture machinery firms are growing.

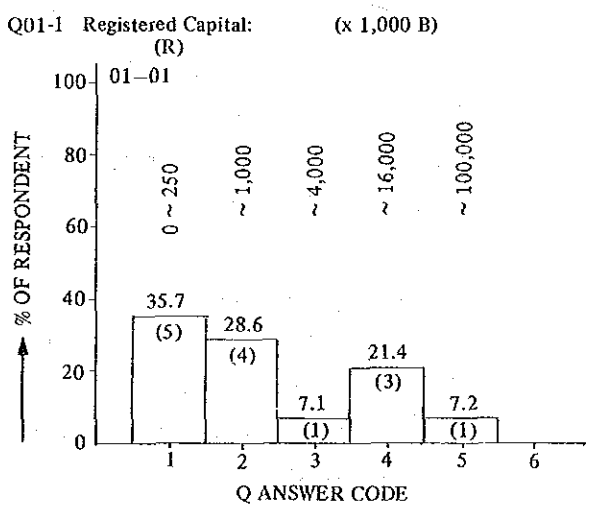



Fig. 4.4.1-3

Fig. 4.4.1-4 shows the comparison of the capital of the agriculture machinery firms with that of the machine work industry in general.

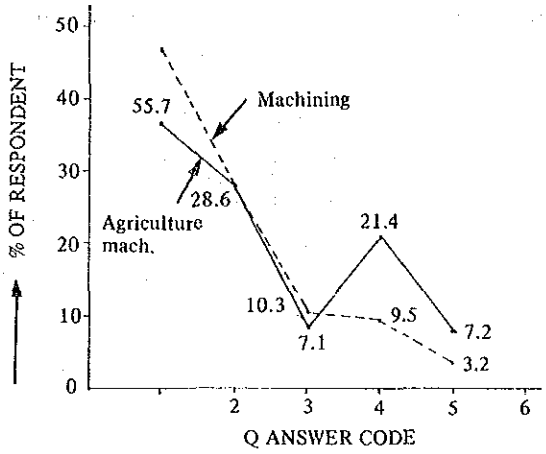



Fig. 4.4.1-4

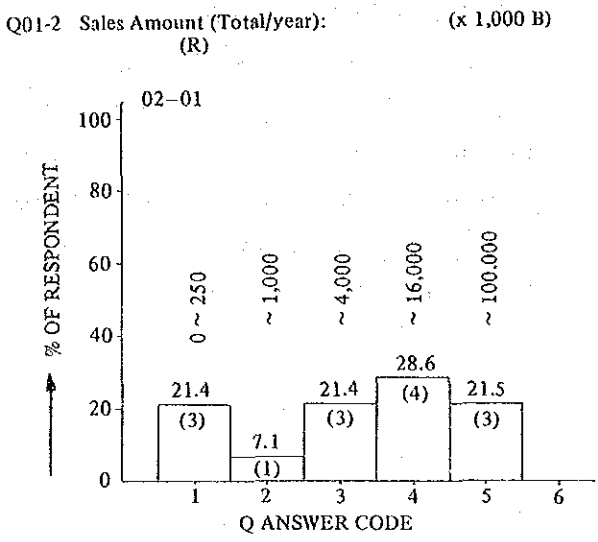



Fig. 4.4.1-5

Then observed in the aspect of the sales amount of the agriculture machinery, the firms with the sales over ฿4,000,000/month occupy the 71.5% namely more than half of the total firms, and the ratio of sales against the capital is higher than that of the machine work industry in general.

Fig. 4.4.1-6 shows the comparison of the sales amounts between the machine working industry in general and the agriculture machinery firms. In the Fig., against the 51.6% of the firms of sales amount over ฿4,000,000/month in the machine working industry in general, in the agricultural machinery industry, the firms with the sales amoung over ฿4,000,000/month occupy the 71.5%, and the difference becomes larger especially in the firms with the sales amount over ฿16,000,000/month.

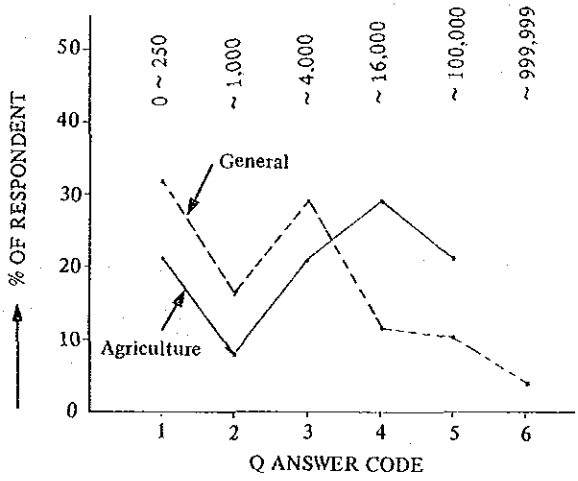



Fig. 4.4.1-6

③ Estate and Floor Area (Q 03, 04)

The estates of the plant with the area under 2500 m² occupy 64.3% of the totality, and the building with the floor area under 2500 m² occupy 71.4% of the totality. However, while the firms that have the area of estate over 16,000 m² occupy 21.4%, the floor area of those firms is below 6300 m², and this indicates us that there are plants that have sufficient surplus area of estate, but generally speaking, the estate of most of the firms is totally occupied by the plant.

Q 94 shows that 50% of the firms are considering the transference of the plant, and they indicate as the top reason of said transference the narrowness of the plant.

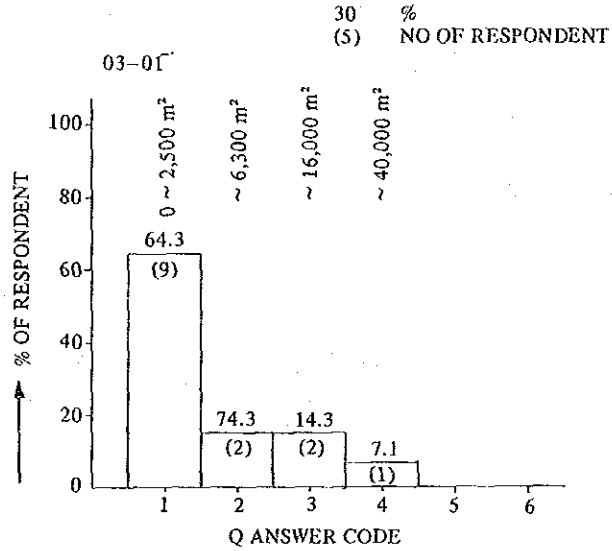



Fig. 4.4.1-7

Q01-3 Please give information concerning your factory, location, estate, building structure and floor area. (R/A)

| Address of Factory | Estate (m²) | Factory Building | |
|---|---|---|---|
| | | Structure | Floor Area (m²) |
| 1. | 2. 03–01 | 4. Reinforced concrete<br>5. Iron steel<br>6. Wooden<br>7. Special foundation | 3. 04–01 |
| 21. | 22. 03–02 | 8. Concrete floor<br>9. Earth floor<br>10. Single-story<br>11. Multi-story | 23. 04–02 |

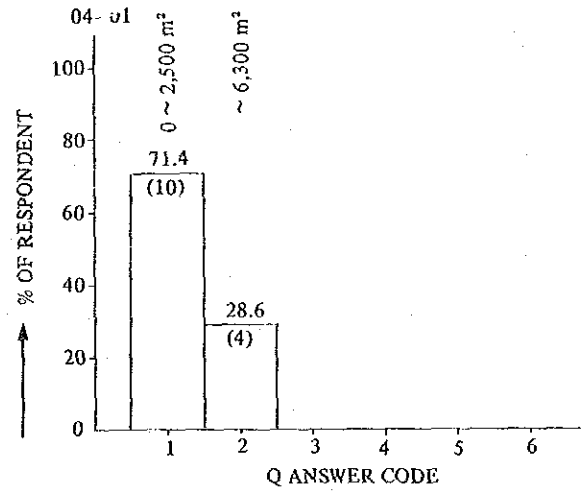



Fig. 4.4.1-8

2) Service Years of Employees (Q 10)

As for the number of the employees, the firms with the employees over 50 and the firms with the employee under 49 occupy 50% respectively. Of these employees, nearly the half are skilled workers who constitute the central element of the agriculture machinery firms, and at the same time this fact indicates the importance of the agriculture machinery.

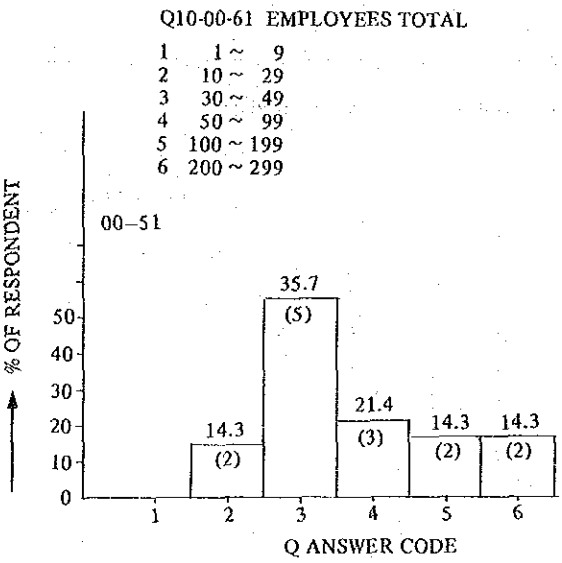



Fig. 4.4.1-9

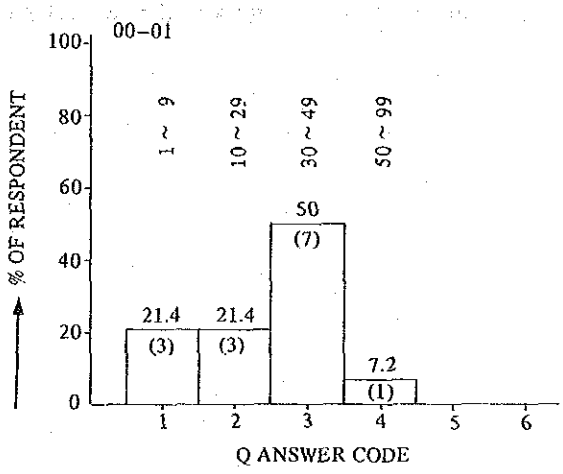



Fig. 4.4.1-10

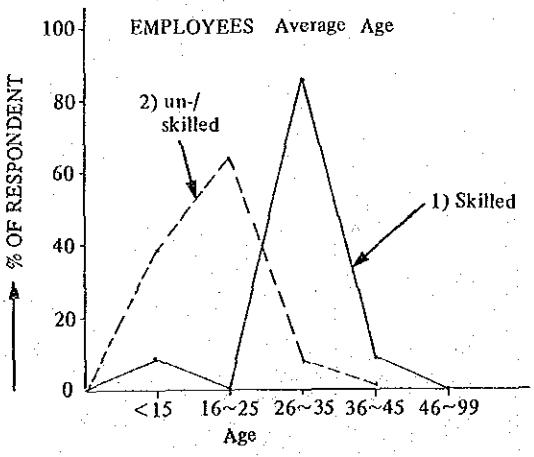



Fig. 4.4.1-11

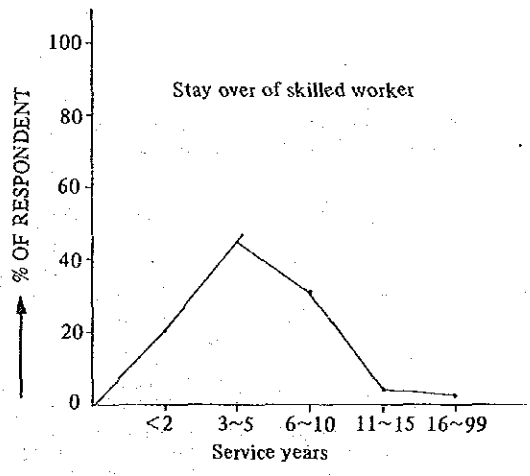



Fig. 4.4.1-12

Fig. 4.4.1-11 shows the distribution by age of the skilled and unskilled workers in the total employees. When observed in the average of the machine working industry in general, the workers of age from 26 to 35 years occupy the larger part.

Fig. 4.4.1-12 shows the service years of said skilled workers, and those of 3–5 years occupy the most part and then come those of 6–10 years. The skilled workers with the 3–5 service years leave us some doubt on the degree of their skill.

3) Products and Subcontracts (Q 04, 05)

① Products

The products that the firms that manufacture the agricultural machinery fabricate by themselves are, beside the fabricated goods, mostly the standard components and the assembled goods.

And the works that they effectuate as subcontracted works will be naturally, in larger part, for the goods that are suitable for their equipments and their techniques.

Q04 Own use/Subcontracting-out/Subcontracted-in goods (M/A)

1. Service & repair only
2. Auxiliary materials
3. Basic materials
4. Standard component/parts
5. Fabricated goods
6. Assembled goods
7. Integrated goods (Fabricated & Assembled goods)
8. Others (Specify)

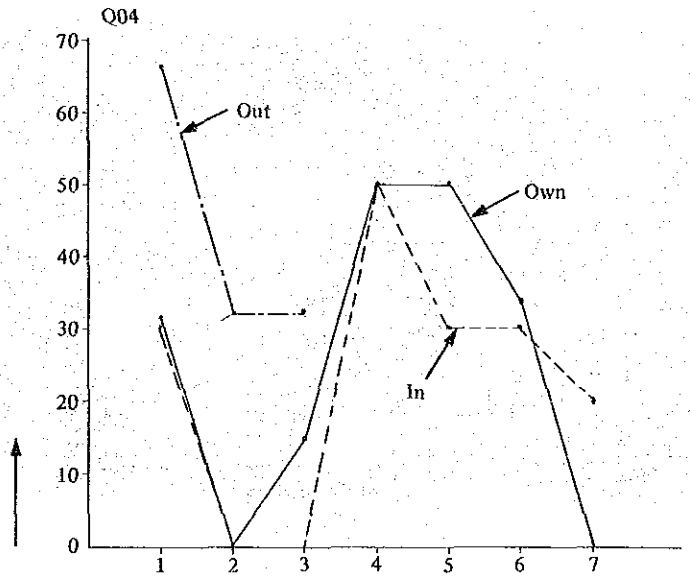



Fig. 4.4.1-13

As for the unfabricated materials, one third of the firms depend on the outside supply, and in the firms of fabrication of agriculture machinery, it seems that the section of unfabricated materials and the section of fabrication have become specialized departments.

Photo 4.4.1-3 shows the press of steel plate and a part of the fabricated goods.
Photo 4.4.1-4 shows the ductile fabricated goods or the case of the fabricated goods of FC 25 class. The fabrication of the parts of this kind is the work suitable for the machining center, and judged by their termination, they seem to have been fabricated, with sufficient precision, in a plant specialized to a certain degree.

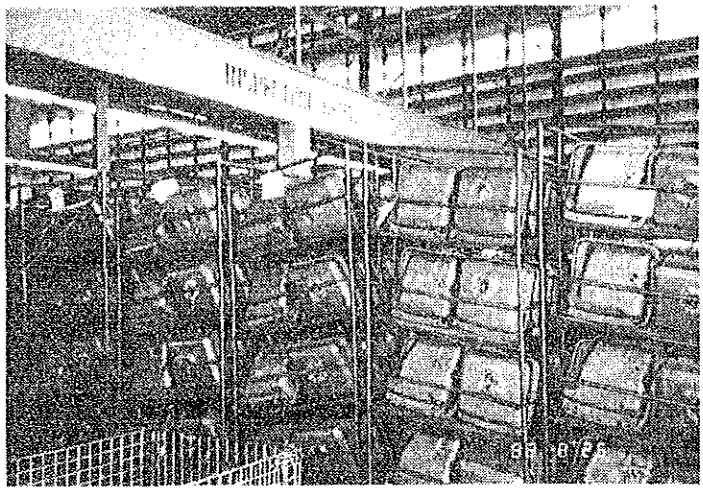


Photo 4.4.1-3

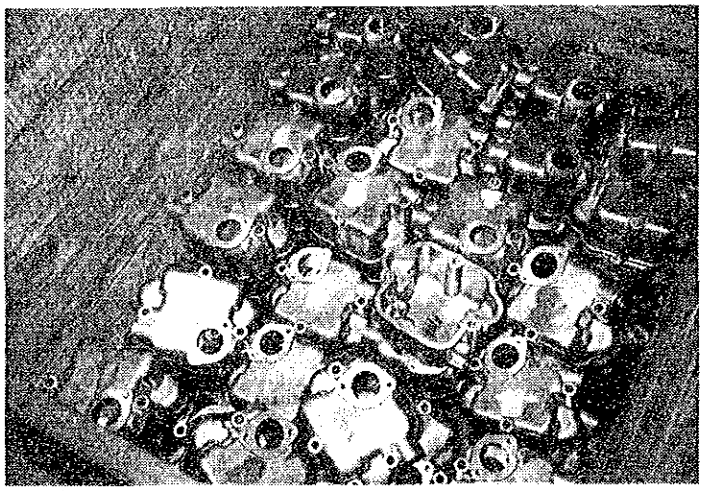


Photo 4.4.1-4

② Situation of Subcontracting (Q 05)

Fig. 4.4.1-14 shows the goods fabricated by the proper firm of fabrication of agriculture machinery as subcontracted-in goods, and the goods fabricated by them as subcontracted-out goods.

It is natural that, being firms related with agricultural machinery, the larger part of the fabricated goods are the agriculture machinery and its component parts. Only 1 or 2 firms subcontract-out their works.

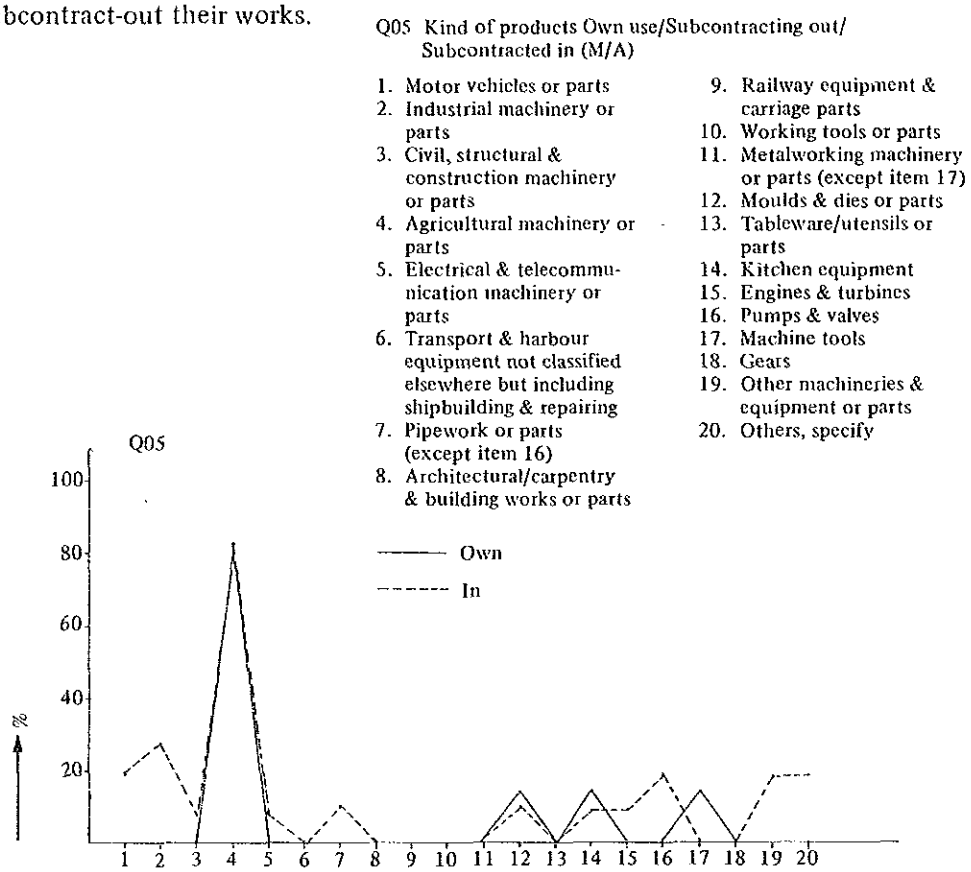



Fig. 4.4.1-14

For the promotion of the industry of agriculture machinery in Thailand, in the first place, it is necessary to foster the department of the unfabricated material in order to produce the casted goods and welded goods, unless, it is no use to desire the development of the machine work industry nor the elevation of the productivity.

4) Sales and Marketing Aspect

(1) Quantity of back order

As for the quantity of back order, 64% of the firms have the works for more than 16–30 days, and compared with the machining industry in general, it is in a little more stabilized state of operation.

Those firms that have works in hand for less than 7 days or that have no works in hand at all, seem to be the firms of seasonal subcontractors, characteristics to the agriculture machinery.

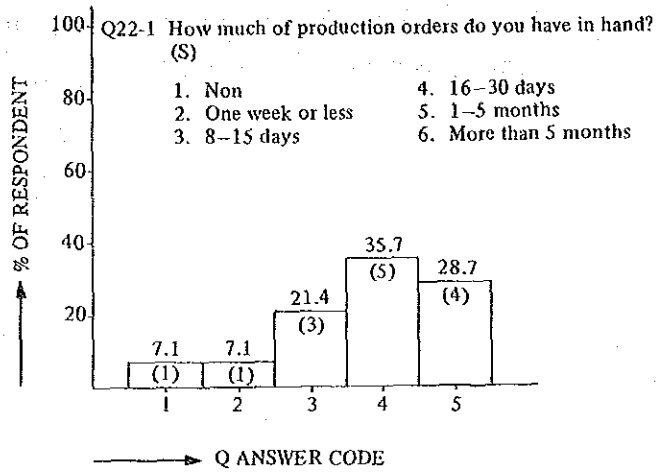



Fig. 4.4.1-15

(2) Customers (Q 20)

As for the customers of agriculture machinery, most of them are for the national customers, having the whole of Thailand as market.

However, as for the agriculture machines, except tractors, such as implements, attachments, etc., the products adapted to the local characteristics are required, and it is considered that these products (for example tractors and turn-up attachments) are somewhat different from those products shown in Fig. 4.4.1-16, destined to the whole national area.

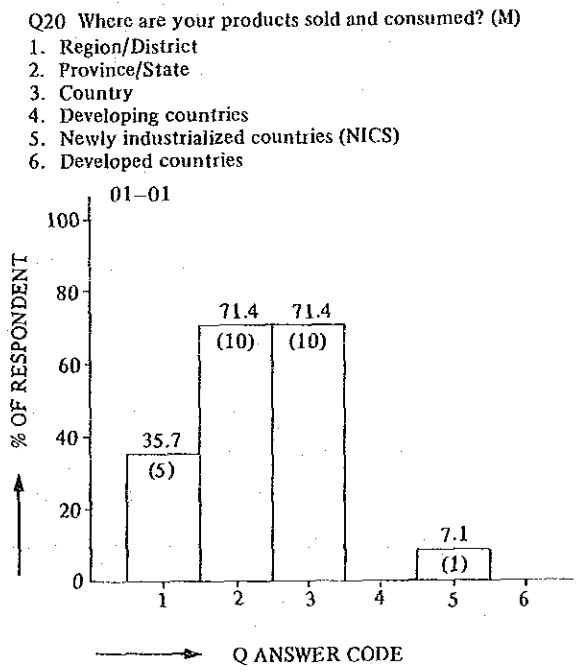



Fig. 4.4.1-16

③ Price of the Products (Q 24, 27)

As for the price, 64% of the firms fix the price at the market price and nearly 30% of the firms fix the price at a price lower than the market price. In general, the price of a small tractor in Thailand is about ฿30,000, and if the price of the engine occupies about 60–70% of the said price, it will require sufficient efforts to be able to sell the remaining parts of the tractor at a price lower than the market price.

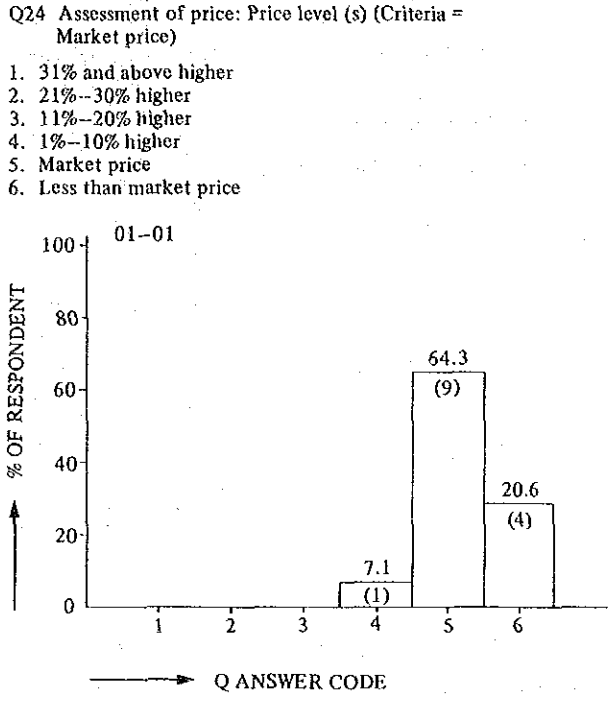



Fig. 4.4.1-17

And, as for the cost of fabrication, about 40% of the firms decide it comparing with their own estimation, and some 24% of the firms decide it comparing with market price, or give or receive orders fixing a price for a period of time. The reason by which it is possible to fix the price in such a way seems to be that due to the elevation of the technique of manufacture to a certain extent, the use of data is permitted.

5) Conditions of Manufacture

① Number of fabricated parts and equipment

Fig. 4.4.1-18 shows the number of parts fabricated in a month by the firms of manufacture of agricultural machinery. 64% of the firms produce more than 300 pcs/month and even 50% of them produce over 600 pcs/month. In view of this fact, it seems that the standardization of parts to a certain extent and a lot production of parts of agriculture machinery is being effectuated. And it is also supposed that, of all the firms, those of production of parts under 151–300 pcs/month are realizing the fabrication of spare parts or parts of larger size, and the firms of production of parts over 601 pcs/are realizing the fabrication as a department of a parent company.

Q30 What is the rate of average monthly production (accumulation of different kinds of products is acceptable)? (S)

1. Less than 10 pieces
2. 11–150 pieces
3. 151–300 pieces
4. 301–600 pieces
5. 601–1,500 pieces
6. More than 1,500 pieces

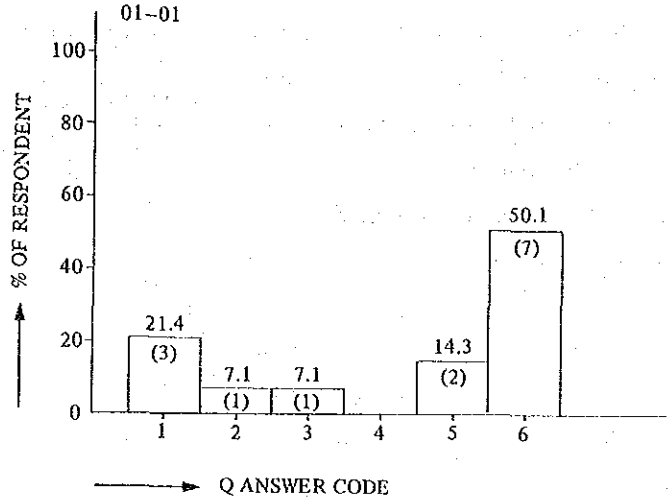



Fig. 4.4.1-18

To receive the orders, as subcontractor, of the fabricated goods shown in the Photos 4.4.1-3 & 4.4.1-4, the firms must elevate, hereafter, the productivity and the precision of their products, but, at first, they must be acustomed to the fabrication with jigs, and then shall point to the fabrication by machining center, etc.

(3) Technique of Production

1) Understanding of the Drawings (Q 41)

As is shown in Fig. 4.4.1-19, in the 28.6% of the total firms, only one person can understand the drawings, and in the 35.7% 2–4 persons can understand the drawings. And in the 28.5% of the total firms, even no one understands the drawings.

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

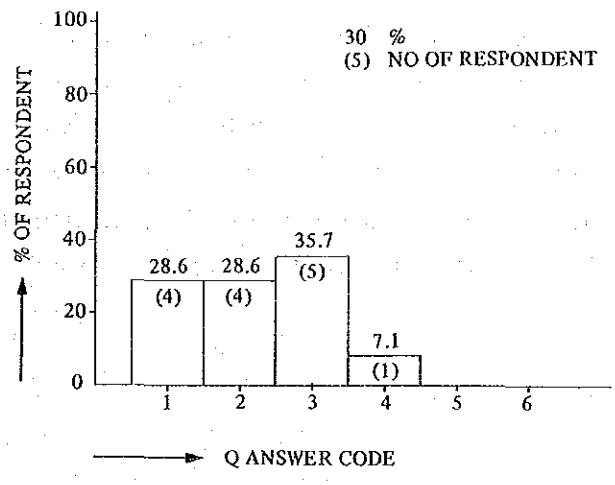



Fig. 4.4.1-19

It is worrying that the percentage of the persons that understand the drawings is low, in spite of the fact that more than half of the total firms count on more than 50 employees, a percentage higher than that of the machine work industry in general. However, taking into consideration that they do not fabricate much the goods other than agricultural machinery, we may suppose the repeated fabrication of the same products or the fabrication by templates, jigs, etc.

2) Measurement, Tolerance and Standard

1 Employed Instruments (Q 42)

Fig. 4.4.1-20 shows the instruments used in the firms, according to which, much of 1. Tape measure, 2. Carpenter ruler, 3. Steel ruler, 4. Caliper, etc. are used and 6. Micrometer is used very little, and in view of these data, it may be considered that more operations of welding, pressing, etc. are effectuated than that of machining. The Fig. plotted in a diagram the first nine instruments in order of the frequency of their use.

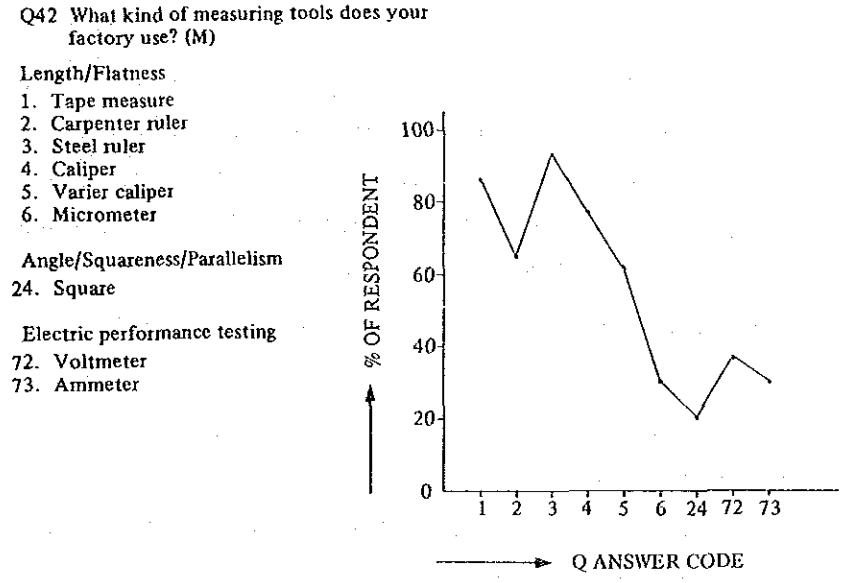



Fig. 4.4.1-20

2 Tolerance (Q 43)

Of the tolerances of the fabricated products, the 61.5% of 1 mm. is the highest, and the 53.8% of 0.1 mm. is the second highest: Observed in the aspect of the tolerance and of the use of instruments, it is supposed that, in case of tractors, the production is structure of body and also the production of attachments is frequent.

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

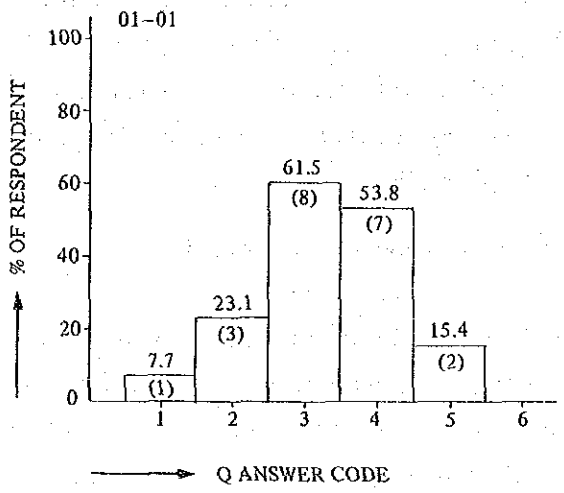



Fig. 4.4.1-21

3 Standard (Q 44)

The standards used most for the agriculture machinery are the standards of the clients (buyers), its proportion being 64.3%. Then comes TIS with 21.4%, which exceeds 14.3% of JIS, of the percentage of the use. Taking into consideration that in the Machining in general JIS is used more frequently than TIS, it reflects that the Thailand Government is putting emphasis on the development of the agriculture machinery.

Besides, the use of the proper standards occupies 28.6% and also DIN, ASTM are in use.

3) Quality Control

1 System of Inspection (Q 46-1)

As for the quality control, half of the total firms exercise the total inspection, and 57% exercises the extract inspection, and only very few of 7.1% does not exercise the inspection at all, and this indicates that every firm pays much attention to the quality of the products.

Q46-01 Please give informations on your quality control system, i.e. the inspection systems, checking items and the feed back system. (M)

The inspection system is (are):

1. Systematic inspections are not available, "When trouble occurs check"
2. First articles inspection
3. Single sampling inspection
4. Multiple sampling inspection
5. Sequantial sampling inspection
6. Total (100%) inspection
7. Without acceptance or purchasing inspection
8. With acceptance or purchasing inspection by standard inspection documents

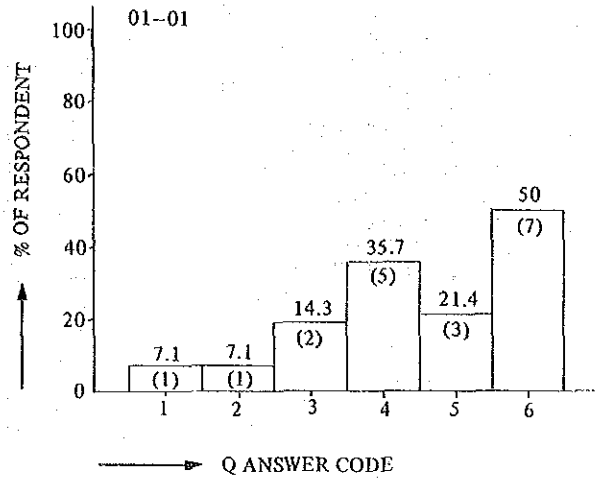



Fig. 4.4.1-22

Whom is it inspected by?

11. Workers themselves
12. Manager or the owner
13. Professional staff, patrol
14. Professional staff, stationary

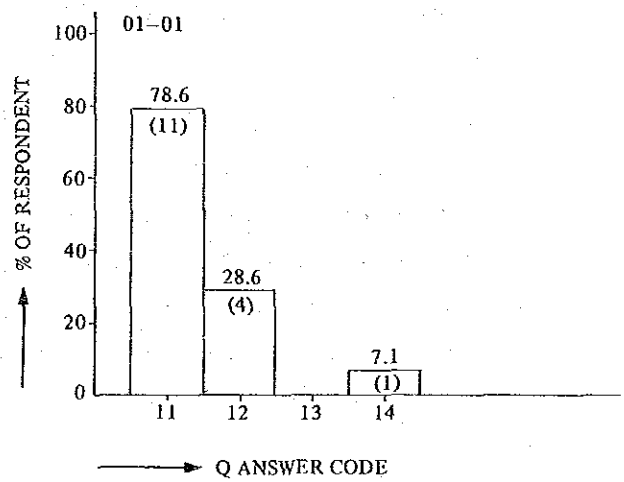



Fig. 4.4.1-23

In 78.6% of the firms, the inspection is effectuated by the workers, and the firms in which the specialists effectuate the inspection occupy a very small percentage of 7.1%.

As the checking items, visual and sensory are the most and the small percent of 7.1% of the size inspection is easily supposed by the little use of the instruments. A firm exercises the magnaflux inspection (welded part), which suggests that the elevation of the sense for the quality of products.

Checking methods and items are:

21. Visual check
22. Sensory check
23. Dimensional check
24. Clearance check for moving parts
25. Hardness check
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

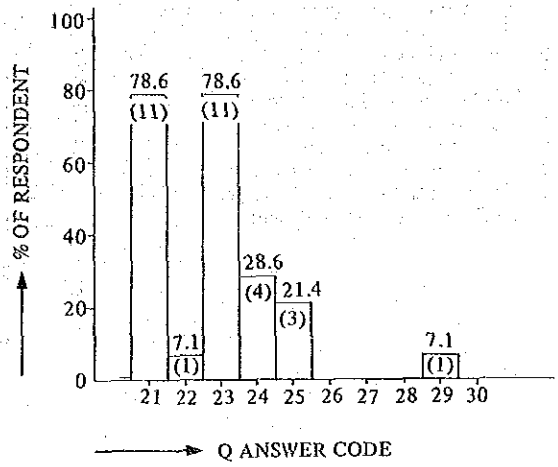



Fig. 4.4.1-24

The feedback of the records of inspection is limited to the circulation by the operators and the manager, and it is the theme to be considered in the future to decide what is to be made when there occurs a defect or by the circulation of the records of inspection.

2 Occurrence of Defects and Inspection

As for the occurrence of the defects after the delivery, as is shown in Fig. 4.4.1-25, nearly 72% of the firms is limited within 2–5%. However, as is shown in the following Fig., as for the countermeasures against the defects, the firms that have no countermeasures at all or those that resolve them empirically occupy 72%.

Q49-9 Defect Rate after shipping (S)

1. More than 30%
2. 21–30%
3. 11–20%
4. 6–10%
5. 2–5%
6. Below 1%

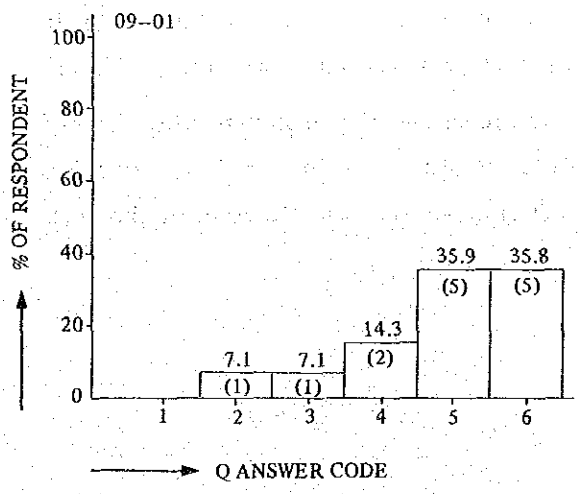



Fig. 4.4.1-25

Q49-10 Defect management system (S/A)

1. Not applicable
2. Emprically
3. Analysis of causes as a whole
4. 3. + their monetary terms conversion
5. 4. either for each kind of product or process
6. 4. both for each kind of product & process
7. Others (Specify)

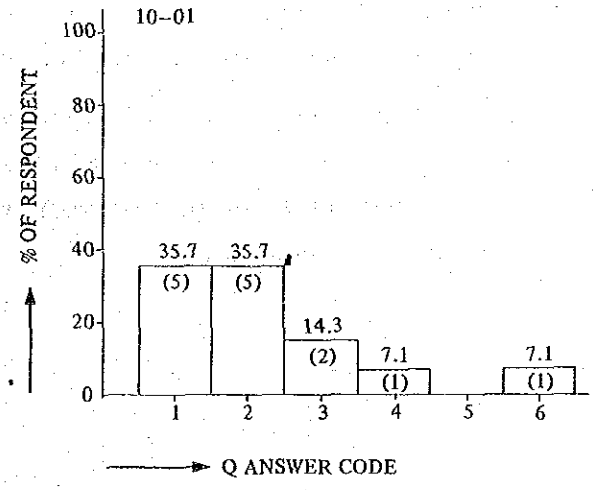



Fig. 4.4.1-26

It is the matter for the future to study if the lack of occurrence of defects is the cause of the lack of control system or if the lack of control system impedes the detection of defects. Anyway, as far as the firms continue without control system of defects or to resolve them empirically, it is not expected the permanent control and improvement of quality of products. It will be one of the means to try to elevate the technical level to instruct the said firm that is exercising the magnaflux test and to compare the products of said firm with the products of other firms, or to prepare analogous products in an official entity as Institute of Industrial Instruction, etc., in order to educate the trainees or the makers in general showing them actually the comparison between the prepared samples and the ordinary products.

4) Control of Production

1 Instruction of the Specifications of the Order (Q 43, 49-6)

In case of placing orders with the subcontractors, more than 80% of the contracting firms instruct the specifications verbally. This means that there does not exist any agreement of quality and delivery time, nor responsibility. The form of order shall be established in order to make clear the range of responsibility.

Q34 Instruction of delivery time from the subcontractor (S/A)

1. None
2. Yes, verbal instruction only
3. Yes, by purchase order specification
4. Yes, by short term agreement
5. Yes, by long term agreement
6. Others (Specify)

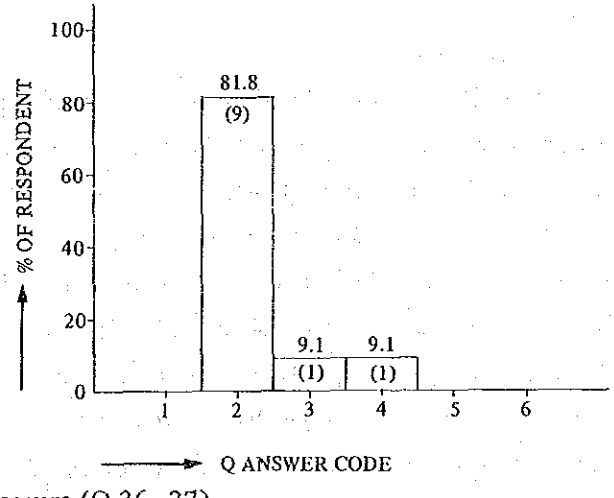



Fig. 4.4.1-27

2 Delay in Delivery and Countermeasure (Q 36–37)

As for the delivery time of the goods, more than 50% of the firms explain that there is not established the delivery time or there occurs delay very rarely.

Q35 Preventive measures for delayed delivery (S/A)

1. No action
2. Occasional check of deference between planned & actual schedule
3. Weekly check of deference between planned & actual schedule
4. Daily check of deference between planned & actual schedule
5. Permanent follow up of necessary action by special staff
6. Others (Specify)

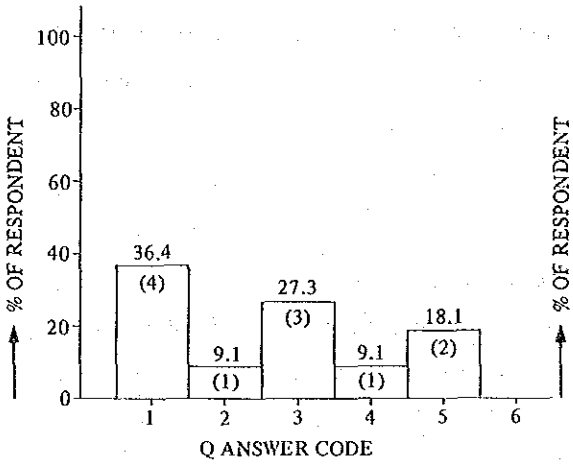



Fig. 4.4.1-28

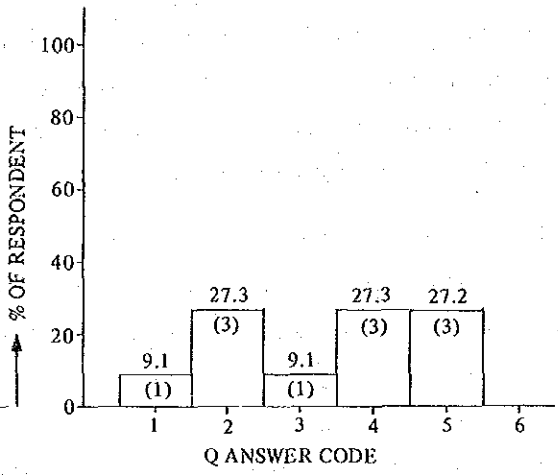



Fig. 4.4.1-29

But, in more than one third (1/3) of the firms, there occur, some times or frequently, delays in delivery. And even 36% of the firms nave no countermeasure against it, and this suggests, together with what is exposed in the preceding clause, the necessity of elevating the concerns about the delivery time. Fig. 4.4.1-30 shows the contrast between the actual aspect of delay in delivery time and the countermeasures against it. In this Fig., it is natural that in the firms of No. 5 that are exercising the daily check of current condition and actual situation, most of the firms do not have any delay in the delivery time at all. But it is strange that, in spite of rather large number of the firms that do not take any countermeasures, the number of the firms in which delay occur frequently is very few. It seems that this is caused by the difference of the contents.

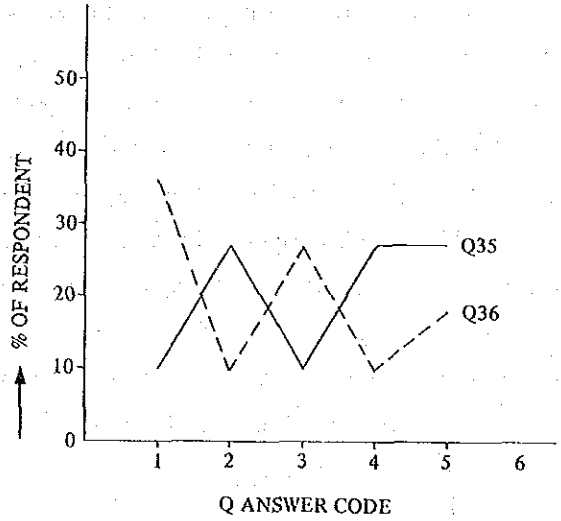



Fig. 4.4.1-30

3 Control of the Schedule of Working Days (Q 37, 39)

Of the delay of delivery, 55.5% is under 7 days, and on the other hand, even 22.3% is of 1 to 2 months. As for the cause of delay, 37.5% of the firms considers that the careless program is its cause, and other firms arrtibute it to the delay of materials, to the too short delivery time, to the shortage of labor. But, to realized the effective control of the schedule of working days, it is indispensable that the firm knows precisely its own equipment and capacity, the conditions of its parent company or its subcontractors, elaborates the schedule of working days, comparing it with the actual conditions of the firm itself, and to executes the day's work in accordance with the schedule, always checking the actual situation in comparison with the schedule. It is not possible to realize the effective control only by seeing the superficial progress of the production. When the question is considered in this way, the firms, except those that consider the careless schedule as cause of the delay, seem to have an optimism that attributes some part of their own responsibility to other causes.

5) Equipments

Fig. 4.4.1-31 shows the metal fabrication machinery equipped in the firms. The most in the number is Universal lathe, and Bench drill, Surface grinder, Shaper follow it. In view of the instruments, tolerances mentioned in 1 and 2 of the clause 2), the reason for the large number of Surface grinder can not be understood. It may be that the grinders

for the finish of surface of the beads of welding are considered as Surface grinder. Observing the 1 and 2 of the clause 2) and Fig. 4.4.1-30, it is known that milling machines, electrospark machines, NC Lathes are not used. Conclusion from this investigation alone seems to indicates that the main works of the firms of fabrication of agricultural machinery are fabrication of attachments of plowing machine, assembly or reparation. In the future it will be desirable to point toward the fabrication of the parts of engine, and for that, it will be possible to start with the elevation of techniques of reparation of engine, of fabrication of parts, developing into the fabrication of parts of the larger firms. For this purpose, the equipping of instruments, elevation of technique of instrumentation, elevation of precision of the machine tools will be indispensable. It is not necessary to mention that as its prerequisite, the elevation of quality of materials is indispensable condition.

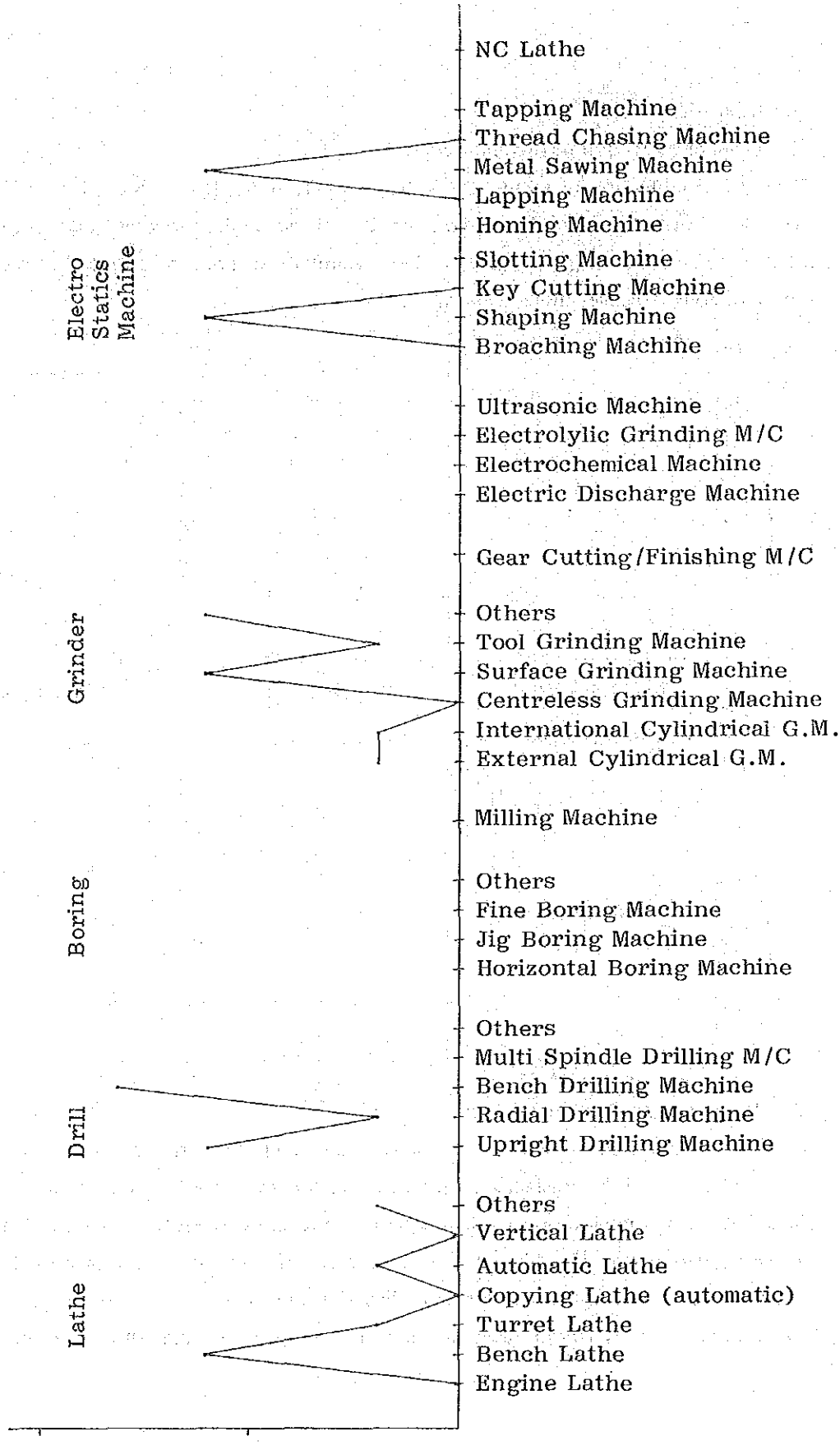

NC Lathe
Tapping Machine
Thread Chasing Machine
Metal Sawing Machine
Lapping Machine
Honing Machine
Slotting Machine
Key Cutting Machine
Shaping Machine
Broaching Machine
Ultrasonic Machine
Electrolylic Grinding M/C
Electrochemical Machine
Electric Discharge Machine
Gear Cutting/Finishing M/C
Others
Tool Grinding Machine
Surface Grinding Machine
Centreless Grinding Machine
International Cylindrical G.M.
External Cylindrical G.M.
Milling Machine
Others
Fine Boring Machine
Jig Boring Machine
Horizontal Boring Machine
Others
Multi Spindle Drilling M/C
Bench Drilling Machine
Radial Drilling Machine
Upright Drilling Machine
Others
Vertical Lathe
Automatic Lathe
Copying Lathe (automatic)
Turret Lathe
Bench Lathe
Engine Lathe
Electro Statics Machine
Grinder
Boring
Drill
Lathe

Fig. 4.4.1-31

6) Education

1 Level of education of the employees (Q 11)

The level of education of employees is shown in Fig. 4.4.1-32–37. More than 70% of the firms does not have any graduate of university, college and junior collge, and on the other hand, the firms that employ many workers, graduates of primary school or of secondary school of course of over three years, are visible.

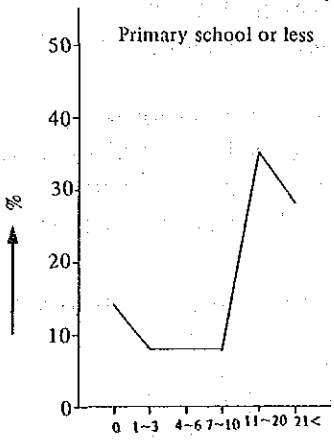



Fig. 4.4.1-32

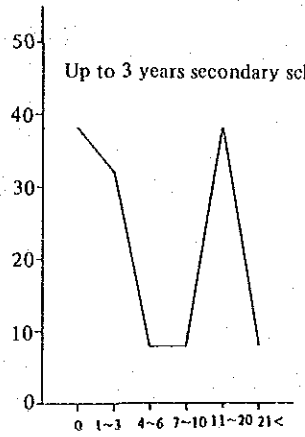



Fig. 4.4.1-33

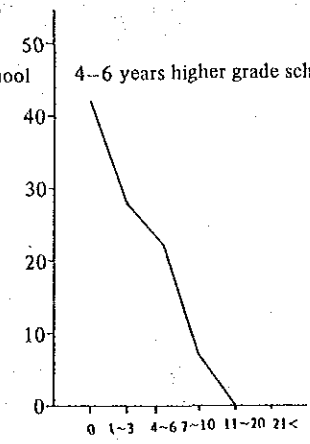



Fig. 4.4.1-34

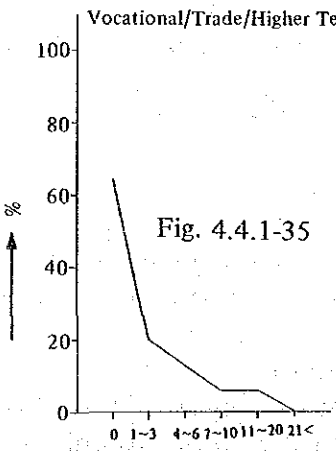



Fig. 4.4.1-35

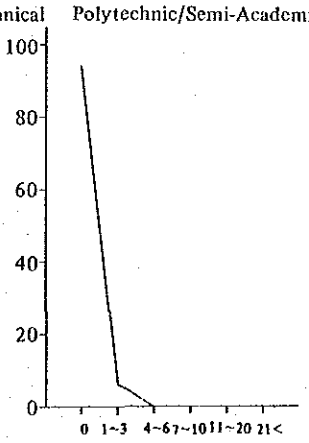



Fig. 4.4.1-36

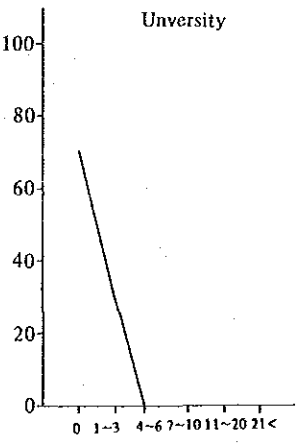



Fig. 4.4.1-37

2 Training in the job site (Q 14)

As for the training in the job site, as many firms as 71.4% of the totality are doing the O.J.T. education, but considering with basis on the level of education in the preceding clause, much of the elevation of technique can not be expected from the simple training of the manual skill in the job site. For the job site training, it is necessary to fix in the first place, the aim, and then to accomplish this aim, it is necessary to decide that the education is made by whom, teaching what, how and for how many hours. In the job site

training, in the first place, the bases of mathematics, method of reading of drawings, etc., necessary in the job site shall be taught, and then the teaching shall be transferred gradually to the professional training.

Q14 Training system (M/A)

1. None
2. Man to man (OJT)
3. Whenever necessary (Inhouse)
4. Attend to training cource/seminar/ workshop (Outside)
5. Periodically according to planned scheme
6. Others (Specify)

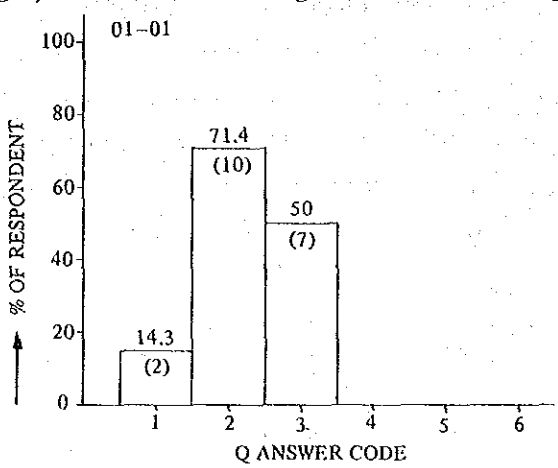



Fig. 4.4.1-38

In this case, it is considered as a method of training, to try the level up of the skilled workers entrusting them with the practical training of the unskilled workers systematically.

(4) General

1) Purchase of the Materials (Q 50)

Fig. 4.4.1-39 shows the materials and second hand parts used by the firms.

The large number of the Raw material of No. 7 seems to indicate that they are the bodies or attachments by welding, and the None of the No. 1 seems to indicate that they are dedicated to reparation. It is desired that starting by collection of second hand parts gradually and making them into a shape, the technique of fabrication of tractors of small size class is learned, elevating in this way the value added.

As for the material in hand, 43% of the firms have materials for 1–2 months in hand, but is desirable to reduce the stock of material in hand, elevating the distribution system and the production of the raw materials.

Q50-1 What do you purchase used or second-hand parts and raw materials, such as gears, bearings, motors, etc., as key components of your products? (M/A)

1. None
2. Gears
3. Bearings
4. Bushes
5. Motors
6. Steel plates
7. Raw materials
8. Others (Specify)

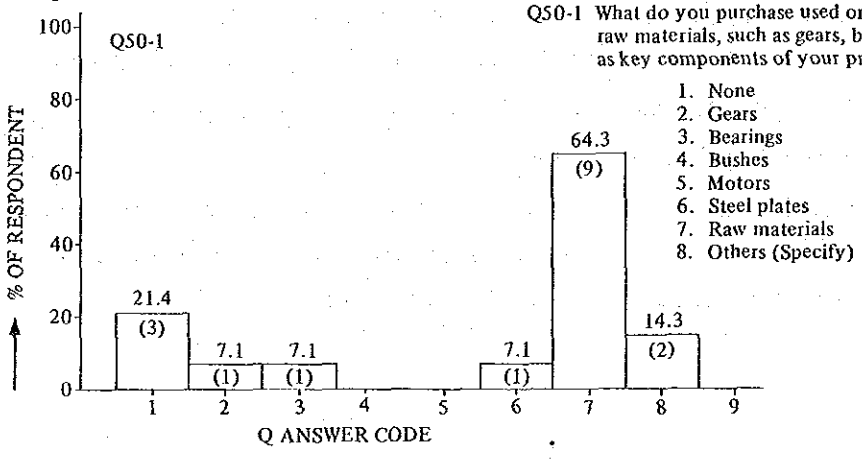



Fig. 4.4.1-39

2) Operation (of Business)

1 Condition of subcontracting (Q 70-00)

In the firms related with agricultural machinery, the most part (77.8%) of the firms, object of this investigation, is receiving orders from their parent companies, and the difference of number between the firms that are not receiving the orders from the parent companies and these firms are very great.

Q70 Do you make subcontracting in/out? (S)

| | 1. In | 2. Out |
|---|---|---|
| 1. No | 11 | 11 |
| 2. Rarely | 21 | 21 |
| 3. Sometimes | 31 | 31 |
| 4. Often | 41 | 41 |
| 5. Very often | 51 | 51 |
| 6. Constatly | 61 | 61 |

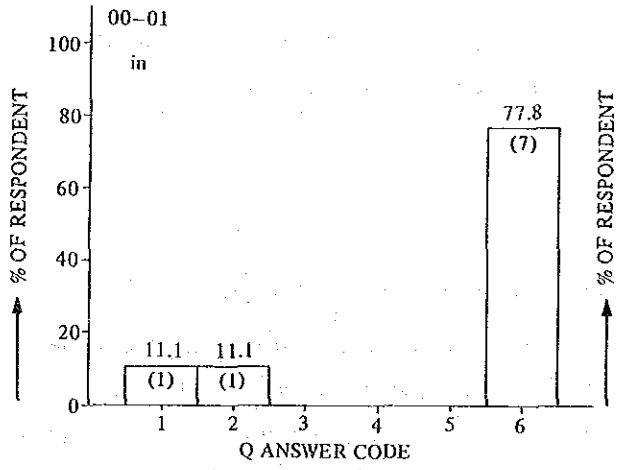



Fig. 4.4.1-40

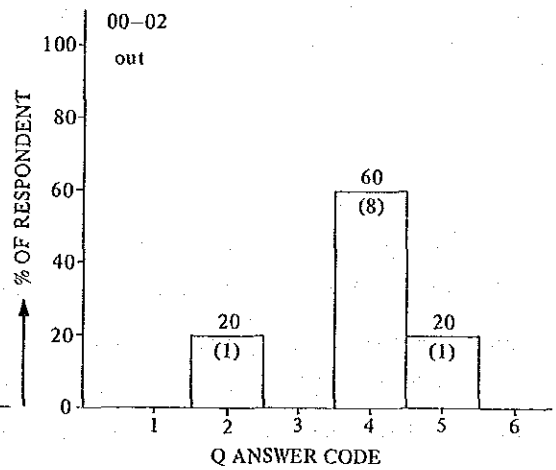



Fig. 4.4.1-41

And of these, 60% is sharing their work with the second subcontractors, and this seems to indicate that there exists some division of works among the firms of the same line.

2 Parent Companies and Subcontractors of the Works (Q70-01, 02)

Half of the firms are receiving the order of works from the firms larger than themselves, and orders from the firms of similar size are more than the orders received from the governmental enterprises or foreign companies.

As for the subcontractors, in most case the subcontractor is of larger size than the ordering company itself, and this seems to be due to that the fabrication of the larger pieces are ordered to a larger firm because of the available equipments.

Q70-1 Where do you make your subcontracting work to/from? (M/A)

1. From 2. In

1. Not applicable
2. Parent company/Affiliated company
3. Companies of the same scale
4. Companies of the larger scale
5. Government organization
6. Companies with foreign equity
7. Others, specify

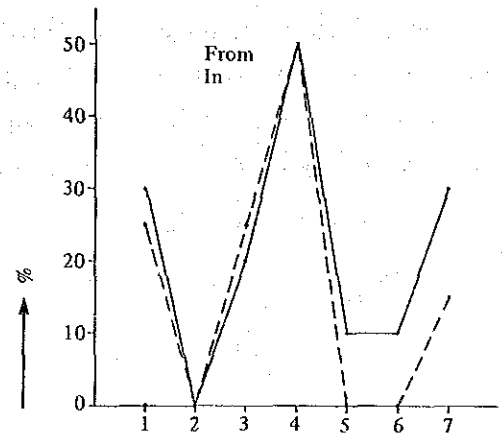



Fig. 4.4.1-42

It is also to be taken into consideration that the subcontractors, on receiving the initial order of some piece, solicit to the parent company advices and financial assistance, and countermeasures against it shall be considered.

3 Countermeasures for Claims (Q 70-8)

As for the countermeasures against claim, owners or managers are in charge of them, and in this respect compared with the machine work industry in general where most of the firms are not taking any countermeasure, this is a desirable trend in the point that it makes clear where the responsibility lies.

Q70-8 After care of claims by you (M/A)

1. None
2. Marketing staff
3. Marketing/Production staff
4. Manager
5. Owner
6. Others (Specify)

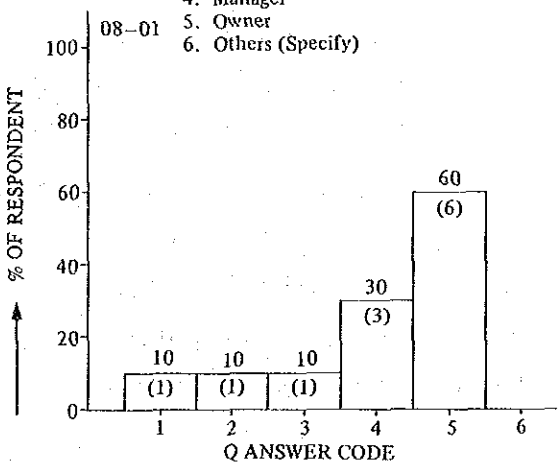



Fig. 4.4.1-43

4 The minimum quantity of the order (Q 70-12)

The fact that the minimum quantity of order is, in 60%, less than 10 pieces, and it is not known whether it is due to that the firms object of this investigation are mostly fabricating attachments of tractors or whether they are simply subcontractors as buffer.

Anyway, this makes difficult the judgment on considering the modernization of the equipments or the means for elevation of productivity.

However, if the firms analyze the contents of their own works of fabrication, and classify the works of same kind, they will find that the works of same kind are unexpectedly many, and if the modernization is considered with focus on these works of same kind, an unexpectedly good method may be found.

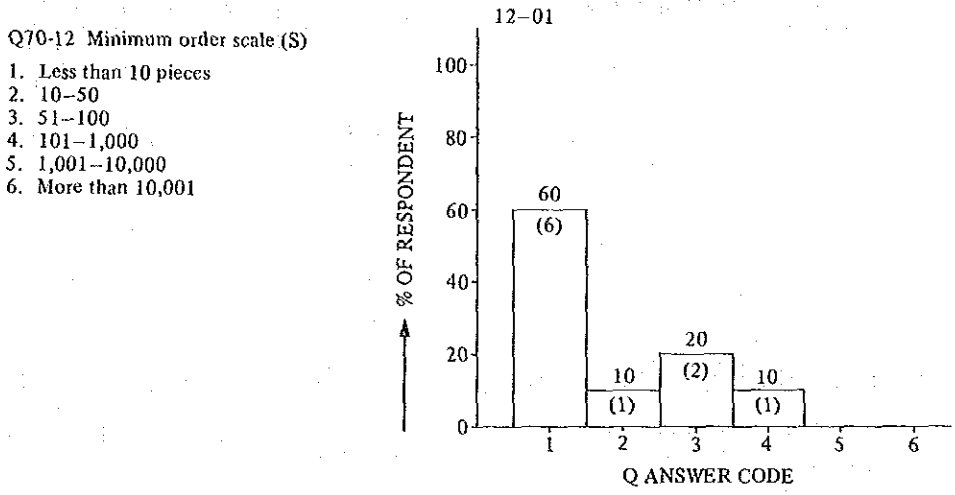



Fig. 4.4.1-44

5 Other routes of subcontracting

More than 50% of the reception of orders and the secondary subcontracts are effectuated directly with the ordering firms, without intermediation of business firm. This makes the business more payable but taking into consideration the assurance of the quantity of works and the extension of the sales market, the source of information, it is a problem to be considered in the future how to use the business firms.

6 The future and the hope as subcontractor (Q 70-09, 10)

More than half (55.6%) of the firms are considering that the works of subcontracting will continue in actual situation and 33.3% of them consider the increase in the future.

And it is considered natural that 62.5% hopes the constant quantity of works and 50% is hoping the extension of the market.

Table 4.4.1-1 shows the first 8 items of the 18 main aims of control for the exploration and development of the proprietor.

Table 4.4.1-1

| Q73 | Main management policy to be developed (1st to 5th priority) | |
|---|---|---|
| 1 | Quality control | 69.2% |
| 2 | Material cost | 61.5 |
| 3 | R & D of technology | 53.8 |
| 4 | Productivity | 53.8 |
| 5 | Expansion of market share | 46.2 |
| 6 | R & D of product | 38.5 |
| 7 | Labour cost | 30.8 |
| 8 | Training of workers | 23.1 |

3) Actual Governmental Policy and its valuation (Q 74)

Q74 Preferable government assistances and assessment f of existing ones (M/A) (1st to 5th priority)

Technical/Information services by public organization
11. Training services
12. Consultancy services
13. Information services
14. Testing services
15. Laboratory
16. Standardization national
17. Quality control
18. Seminer/symposium

Financial/Marketing support Encouraging investment
21. Tax rebate and tax exemption
22. Credit assistance
23. Subsidy
24. Marketing

Protection of dometsic products
31. Import surcharge
32. Import restriction
33. Export promotion

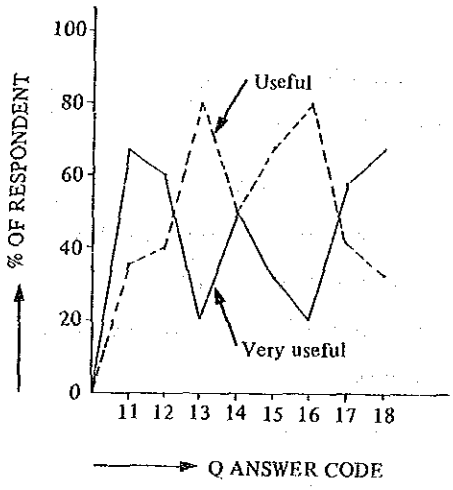



Fig. 4.4.1-45

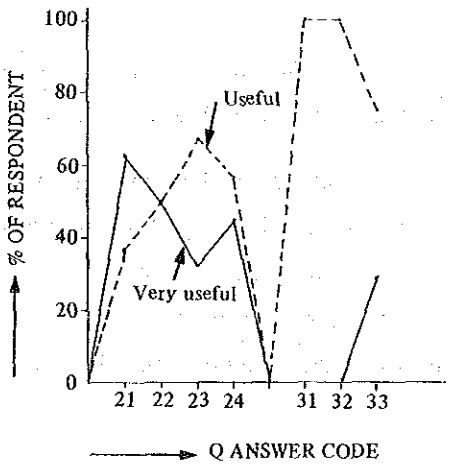



Fig. 4.4.1-46

The Fig. 4.4.1-45 & 46 show the summary on the various policies that the government and the public technical organizations are exercising.

As for the policies relative to the technical aspect, more than 60% appreciates the training, seminar and consulting for their effect.

Of the tax system, subsidy and export-import policy, the rebate or exemption of tax is highly appreciated for being very effective. And the concern for marketing is higher than that for the policy of subsidy, etc., and the percentage of effectiveness is getting higher. This may be taken as a testimony of that the government is placing emphasis on the development of agriculture machinery.

4) Environmental Pollution (Q 90)

For the claim of environmental pollution, 76.9% of the answers is negative. The contents of the claim is noise and smoke represent a high percentage of 66.7%, and next comes bad smell. And the two cases of countermeasures taken for the calim obtained satisfactory result. For the drainage of the plant, 85.7% of the firms uses the public sewer system. The rest of the firms depends on the pools.

5) System of cooperation with other firms (Q 91)

In the agriculture machinery industry, half of the firms wishes to execute the works in cooperation with other firms, and other half do not wish it.

Of the reasons of the cooperation in the execution of works, the first is to receive orders in joint or to receive orders as subcontractor, and in the second come the firms that wish to purchase materials in joint or exploit the new products or technique of production in joint.

And a great many number or 83.3% of firms wishes to obtain a cooperating firm, and its reason is same as the reason for the desire of cooperative organization.

6) Environment of the plant and plan of transference (Q 93, 94)

Each one of the firms is almost content with the present environment. But about 21% of firms is feeling unsatisfactory with it. And, as for the transference of the plant, one third (1/3) of firms has a plan and as for its reason, as is seen in Fig. 4.4.1-47, the insufficence of estate is overwhelming and the poor traffic comes next.

Do you have relocation program of your factory? (S)
If the answer is Yes, please answer the following question.

Q94-2 What are the major reasons?
Please choose 3 major reasons. (M)

1. The estate is limited
2. Poor condition of procurement materials
3. Far from the customers
4. Poor surrounding road condition
5. Poor supplying water and electric power
6. Poor drainage situation
7. Deterioration of machines and equipment
8. Diversification and/or increase of production
9. Quitting for public works

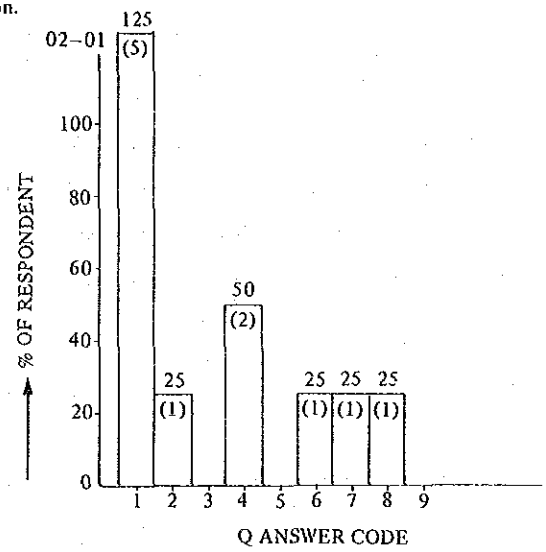



Fig. 4.4.1-47

(5) Valuation of the Industry of Agriculture Machinery

1) Technique of Fabrication

The agriculture machinery, as is stated in the clause 1) of (1), comprehends various kind of plowing machines and control machines and in addition, tractors and combines with mobile part, of which, the technique of fabrication of the small tractors and their attachments are commented here.

The technique of fabrication of tractor is studied divided in the following four (4) items:

1 Engine
2 Body
3 Attachment
4 Spare parts and piece parts

1 Engine

The engine has three hundred (300) different kinds of parts, and it is not favorable to fabricate all of them by a firm alone, but is recommendable to fabricate them by subcontracting. However, according to this investigation, with respect to their equipments, instruments, etc., the investigated firms have not capacity to fabricate the part related with the engine. The principal reasons of it is as follows:

1. The work is not realized according to the drawing (3) 1)
2. Very few of the instruments can measure till 0.01 mm (3) 2)
3. Some of the equipments are not available (Cylindrical grinder, Boring machine, Milling machine, etc.) (3) 5)

4. Insufficient concern for the quality control (3) 3)
5. Unskilled for the fabrication by jigs (3)

However, the firms investigated actually are fabricating piston head with NC lathe and simple boring machine, therefore, if they are given a high quality material, provided with tools and methods, and if the manager or the owner is willing, it will be proved that they can well fabricate the parts of engine.

2 Body

As for the body, it seems that they have sufficient capacity to fabricate it, but it will be necessary to learn the bases of techniques of welding, of casting, of inspection and to improve them, and also to elevate the technique of gear cutting and of fabrication of chains, etc. At the moment, it shall be started with fabrication of frame, handle, facing, and then shall be proceeded to the transmission system and to the parts related with wheels.

3 Attachments

Of the attachments, the same will be said as of the above said body, but it will be possible to elevate the self fabrication percentage quicker than the works related with body.

4 Spare parts and machine parts

Individual agriculture machines are made in locality, and it is necessary to standardize the standard of joint and setting point.

If they doesn't, it will be difficult to product the spare parts and good products, at low cost.

And it is necessary to make fames to recognize the importance of the quality of the material and heat treatment at all parts.

2) Equipments

In the firms investigated this time, the main works seem to be fabrication of the structure of body, attachments, etc., accordingly, lathes, drills, shapers were the main equipments. But with these equipments, the fabrication of the parts of engine is difficult. In case when, in the future, the fabrication of parts of high added value is pointed, it is necessary to fix the aim, to be equipped with machine tools and instruments with high precision and to establish the maintenance system of the same.

3) Quality Control

As for the quality control, sufficient attention is paid to the total inspection, etc., but the visual and sensorial inspection by the operator occupies the most case yet, and, in general, most of the firms does not study yet what is most important, how and based on what kind of standard it shall be effectuated, accordingly, in regard to the quality of products, one more step of efforts is required.

4) Control of Production

As for the control of production, this seems to be the most delaid section. In the first place, in order to resolve the question of delay in delivery, its cause shall be detected by using the fishbone technique, etc., being it important to solve the problems one by one.

(6) Proposal for the Elevation of the Technique of the Fabrication of Agricultural Machinery

In order to elevate the technique of the fabrication of the agriculture machinery in Thailand, it is necessary to learn the bases of the machine works perfectly, and to promote the production and distribution of the instruments, tools, etc., related with it. And the first steps that shall be followed will be the standardization of the parts of the agriculture machinery, and at the same time, in regard to the technical skill, the complete reparation of the various machines shall be pointed, and then the remodelling of them will be aimed, and thus gradually steps shall be taken to the fabrication of the proper products of each firm.

4.4.2 Pump/Valve

(1) Outline of pump/valve products

1) Kinds and characteristics of pump products (From "General Consideration of Pumps" Printed by Nippon Kogyo Shuppan)

① The kinds of pumps are shown in Table 4.4.2-1

Table 4.4.2-1 Kinds of Main Pumps

| | |
|---|---|
| Turbopumps | Centrifugal pump<br>Oblique flow pump<br>Axial flow pump |
| Reciprocating pumps | Piston pump<br>Plunger pump<br>Rotary plunger pump<br>Diaphragm pump |
| Rotary pumps | Gear pump<br>Screw pump<br>Vane pump<br>Vortex pump |
| Special pumps | Jet pump<br>Air lift pump |

2) Kinds and Characteristics of Pumps

① Turbopumps

The discharge of turbopump can be made from the small flow till the large flow of more than 1,000 $m^3$/min, and the head can be made from approximately 1 m till approximately 200 kg/$cm^2$, so the applications are many compared with other pumps, and the usage is extended over many fields.

Among these pumps, the centrifugal pump is used most in large quantities, and among them the most standard type is the horizontal shaft single suction single-stage centrifugal pump. When indicating the production results of these (1964, weight percentage in Japan) they are as follows:

| | |
|---|---|
| Centrifugal pump | 78.5% |
| Oblique flow pump | 14.4% |
| Axial flow pump | 7.1% |

② Reciprocating pumps

Though they are of small discharge they can make the high head, being approximately maximum 700 kg/$cm^2$.

③ Rotary pumps

They are adequate to the liquid transportation of high viscosity.

④ Other pumps

3) Usage and Kinds of Pumps

The usage and kinds of pumps are shown in Table 4.4.2-2.

Table 4.4.2-2 Usage and Kinds of Pumps

| Usage | Kinds of Pumps |
|---|---|
| Farmland irrigation and drainage | Centrifugal pump, oblique flow pump and axial flow pump |
| For mine | Centrifugal pump |
| For iron and steel | Centrifugal pump, oblique flow pump and reciprocating pump |
| Waterworks, water intake and water supply | Oblique flow pump and centrifugal pump |
| Sewage and waste water | Centrifugal pump and oblique flow pump |
| Chemical plant | Centrifugal pump, reciprocating pump, rotary pump and other special pumps |
| For hydraulic equipment | Reciprocating pump and rotary pump |

4) Materials Used in the Pump

The pump is composed of many parts. The material of pump is selected taking into account that it is influenced by the liquid quality of fluid to handle and pump specification, operating conditions, material combination of every sections, etc.

Table 4.4.2-3 show materials used against various kinds of liquids.

Table 4.4.2-3 Materials Used Against Various Kinds of Liquids (Mechanical Engineering Manual)

| Kind of liquid | Impeller and diffuser | Casing |
|---|---|---|
| Clear water | Bronze, brass, special bronze, case steel, cast iron | Cast iron and cast steel |
| High-temperature water | Cast steel, special bronze and special cast steel | Cast steel (2 to 5% of Cr and small quantities of Mo) |
| Sea water | Bronze, special bronze and monel metal | Bronze, special bronze and cast iron |
| Sand containing mud water | Bronze, special steel, white pig iron and soft rubber coating | Cast steel, special cast steel, white ingot steel, soft rubber casting and cast iron |
| Sulfuric acid | Hard lead, lead, stainless steel, hastelloy ABC, por celain, glass, acidproof earthenware, carbon, plastic, rubber and iron | |
| Nitric acid | High silicon cast iron, porcelain, glass, acidproof earthenware, stellite, carbon, plastic, stainless steel and hastelloy C | |
| Hydrochloric acid | Hastelloy ABC, porcelain, glass, acidproof earthenware, carbon and thermosetting plastic | |
| Caustic soda | Stainless steel, hastelloy ABC, monel metal, copper, nickel alloy, nickel, Ni-resist, carbon, plastic, rubber and iron | |

(2) Kinds and Usage of Pumps Used in Thailand (From Report prepared for DIP, MOI by RDR)

1) Kinds and usage of pumps are as follows:

① Kinds and usage of pumps

a. For domestic water supply . . . . . Imported

b. Centrifugal pump for agriculture . . . . . Domestic

c. For mine and other industries . . . . . Domestic

d. For special industries . . . . . Imported

2) The quantity of production of pumps in Thailand is shown in Table 4.4.2-4.

Table 4.4.2-4 Number of Production of Pumps in Thailand (1978)

| Type of pump | Number |
|---|---|
| Centrifugal pump | 52,600 |
| Reciprocating pump | 18,100 |
| Hand pump | 4,400 |
| Turbine pump | 350 |
| Other pump | 2,520 |
| Total | 77,970 |

Source: MOI Study

3) The number of import of pumps in Thailand is shown in Table 4.4.2-5.

Table 4.4.2-5 Number of Units of Import of Pumps

| Year | Number of units |
|---|---|
| 1974 | 168,524 |
| 1975 | 149,021 |
| 1976 | 208,101 |
| 1977 | 202,101 |
| 1978 | 258,369 |
| 1979 | 281,668 |

Source: Department of Customs

(3) Kinds and Characteristics of Valve Products

1) Valves are installed by way of the piping or to the apparatur, and are necessary for, transporting the liquid, gas, at times powder. As kinds of valves there are sluice valve, globe valve, check valve, ball valve, butterfly valve, diaphragm valve, etc.
And, valves used at home for hot water and water are separately classified from the above as water supply and drainage cock.

2) There are the following kinds as materials used in valves:

① Bronze
② Cast iron
③ Cast steel
④ Special steel
⑤ Nonmetal

(4) Actual Condition on the Manufacture of Pump/Valve Products in Thailand

With the purpose to seize the actual situation of the manufacture of products of pump/valve, investigation with questionnaires was effectuated. According to the answers to the question (Q 52-2): How do you manufacture Pump/Valve in the Part 3: For Small & Medium Scale Manufacturing Industries: General of the Questionnaires, 10 companies are manufacturing Pump/Valve, and by analyzing the data of these 10 companies, it was known that these 10 were not the makers specialized in Pump/Valve but were manufacturing Pump/Valve as side business.

Though investigation was made with questionnaires (Q 450, Q 550) on the Pump/Valve products, but as the makers are doing the manufacture of Pump/Valve as side business, the questionnaires were answered as foundry industry or machinery industry, and the individual answers as Pump/Valve makers could not obtained.

It is considered difficult to generalize the condition on Pump/Valve products in Thailand only with the data of 10 companies. However, it seems that a tendency can be found. By intending the orientation against problems and the grasp of actual condition on these Pump/Valve product enterprises, we wish to make an aid of metalworking industry promotion. As orientation for such a purpose the relation between the characteristic factor diagram (Fig. 4.4.2-49) and the questionnaire code (Q No.) is desired as index to the solution.

1) Enterprise Scale

① Enterprise Career (Q 01)

As enterprise career enterprises of more than 21 years occupy 50%, followed by 40% of 6 to 20 years. When considering from these enterprise careers it is understood that they have a considerable experience. The enterprise career is shown in Fig. 4.4.2-1.

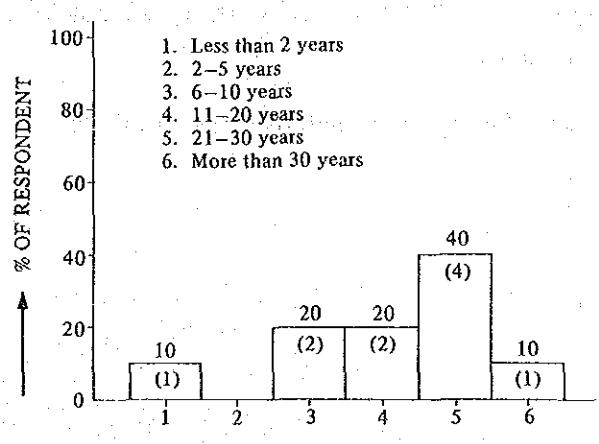



Fig. 4.4.2-1 Age of the firm (Q01)

② Capital (Q 01-1) and Sales (Q 01-2)

Seeing from the constitution by capital enterprises of ฿250,000 occupy the greater part as 50%, then enterprises in the range of ฿250,001 to 1,000,000 occupy 30%, and among them enterprises of ฿16,000,000 to 100,000,000 also occupy 10%.

Fig. 4.4.2-2 shows the constitution by capital of enterprises.

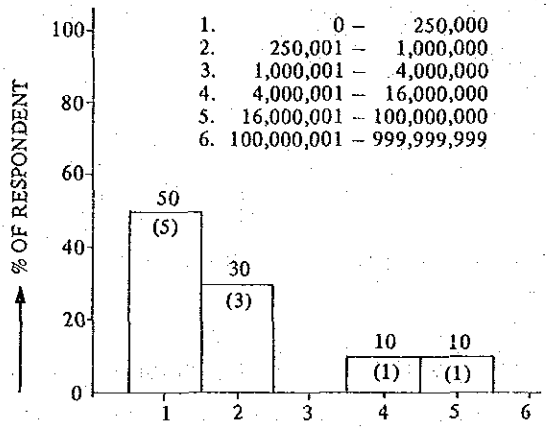



Fig. 4.4.2-2 Capital of Enterprise (Q 01-1)

Fig. 4.4.2-3 shows the sales of enterprises, factories of ฿1,000,000 to 4,000,000 of sales occupy 40%, then enterprises of ฿250,000 occupy 30%, and there is 1 enterprise of ฿16,000,000 to 100,000,000 of sales.

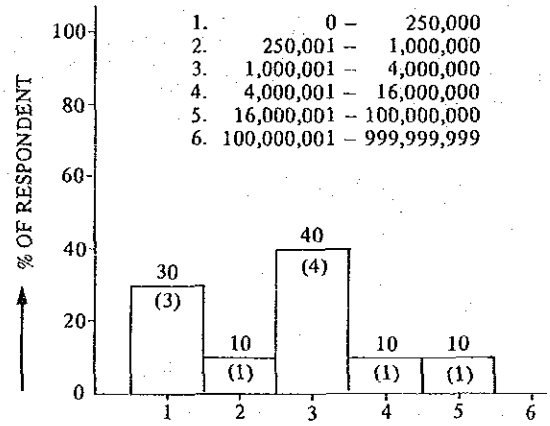



Fig. 4.4.2-3 Sales (Q01-2)

③ Number of Employees (Q 10)

For employees 30 persons to 49 persons occupy 40% and then 10 persons to 29 persons occupy 20%.

On the other hand there are 3 enterprises of more than 100 persons.

Fig. 4.4.2-4 shows the number of employees of enterprises.

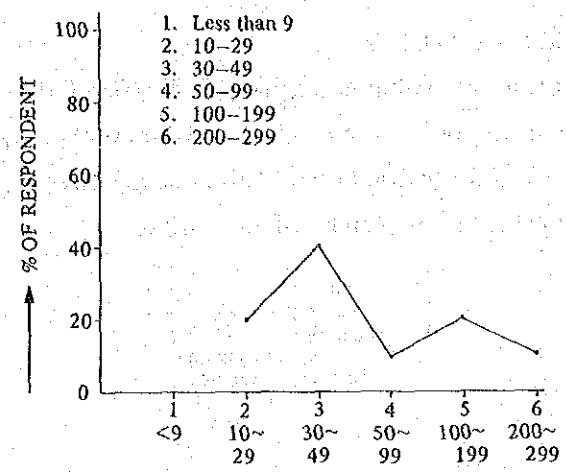



Fig. 4.4.2-4 Number of Employees (Q10)

④ Enterprise Form (Q 07)

Saying that how about is the enterprise form, family enterprises occupy 50%, company organizations 30%, and enterprises of joint management 20%. Fig. 4.4.2-5 shows the enterprise form.

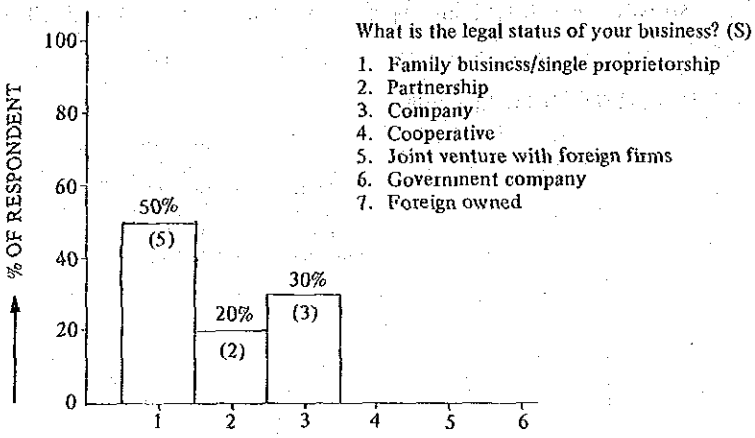



Fig. 4.4.2-5 Enterprise Form

⑤ Degree of Speciality (Q 05-1), (Q05)

Table 4.4.2-6 and Table 4.4.2-7 show what kinds of business are 10 Pump/Valve manufacturing enterprises and are they manufacturing other products including pumps. Also we can find from these table that cast iron products businesses are most many businesses and that casting products and other than pumps are being manufactured.

Table 4.4.2-6 Business Content by Manufacturer

| Enterprise | Casting | Forging | Sheet-work | Plating | Machine Ass. | Machin-ing | Press-work | Preci-sion machine | Heat treat-ment |
|---|---|---|---|---|---|---|---|---|---|
| A | | | | | | | | O | O |
| B | O | | | | | | | | |
| C | O | | | | | | | | |
| D | O | | O | | O | O | | O | O |
| E | O | | O | | | O | | | |
| F | O | | | | | O | | | |
| G | O | | | | | | | | |
| H | O | | | | | O | | | |
| I | | | O | | O | O | | | |
| J | O | | | | | | | | |

Table 4.4.2-7 Product Content by Manufacturer

| Enter-prise | Pump | Hand tool | Farm-machinery | Machine tool | Car | Others |
|---|---|---|---|---|---|---|
| A | O | | | | | O |
| B | O | | O | | | O |
| C | O | | | | O | O |
| D | O | | | | | O |
| E | O | O | | O | O | O |
| F | O | | O | O | | O |
| G | O | | | | | O |
| H | O | | | O | | O |
| I | O | | | O | | O |
| J | O | | O | | O | O |

2) Condition of Subcontracting Enterprises

① Kinds of subcontracting products (Q 05)

Fig. 4.4.2-6 shows kinds of subcontracting products, and according to this table the percentage that industrial machines occupy is highest, followed by farm-machinery. Pump/valve products only occupy 40% and a fraction.

Seeing from these conditions, even if they manufacture pumps in terms of content industrial machines and farm-machinery products are main, and as to the casting material production it is being considered that it becomes the similar trend. These facts are considered that seeing from the condition that the quantity of import of pumps shown in item (2) 3) is increasing year by year the quality, etc. of pump now under manufacture are influenced against the demand.

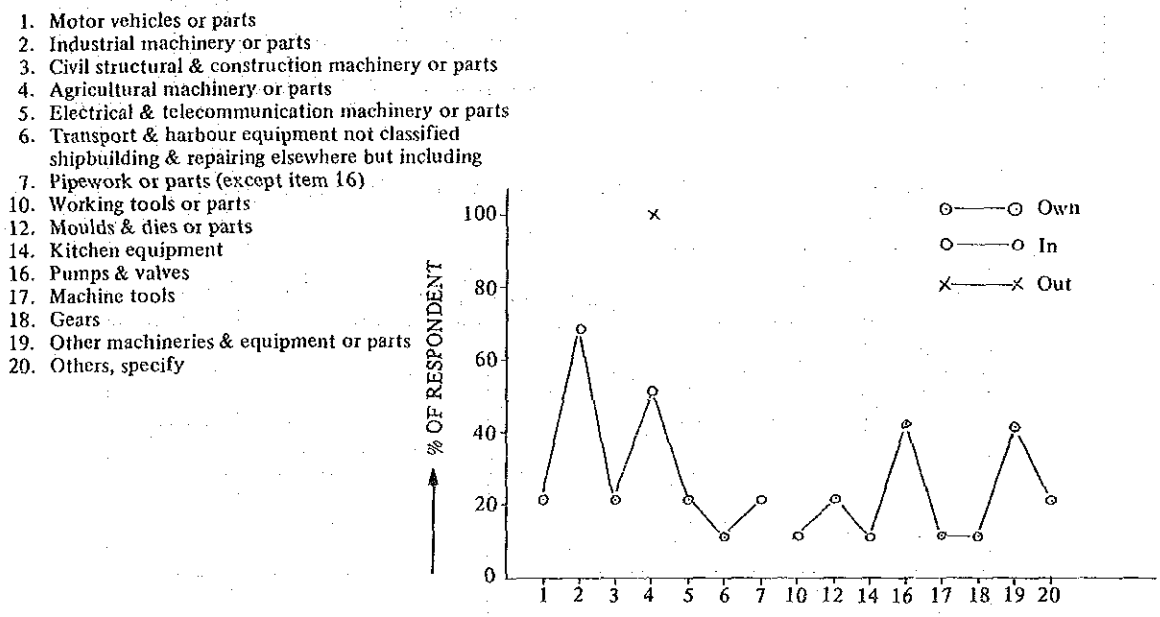



Fig. 4.4.2-6 Kinds of Subcontracting Products

② Order booking condition of subcontracting works (Q 70)

As shown in Fig. 4.4.2-7 the order booking condition of subcontracting works is constand, being 70%, others are rare, and it becomes 10%, respectively, from time to time. As for the quantity of work to submit to the subcontracting it is divided into nothing and 50% from time to time.

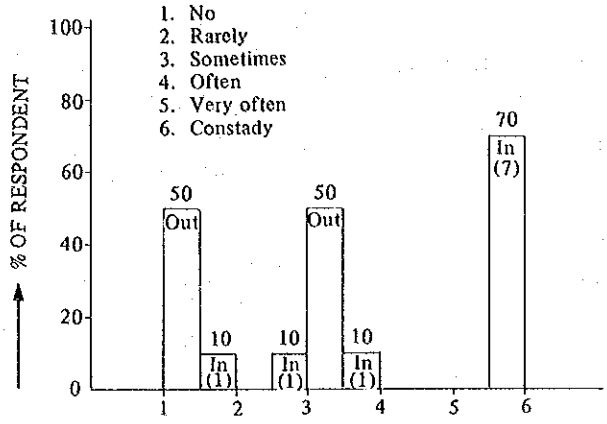



Fig. 4.4.2-7 Order Booking Condition of Subcontracting Works (Q 70)

③ As kinds of enterprises by ordering of subcontracting works those of awarding orders from the scale of similar degree are 30%. There are enterprises of awarding orders from large enterprises recording 20%.

The ordering from public organizations is being composed of 10%.

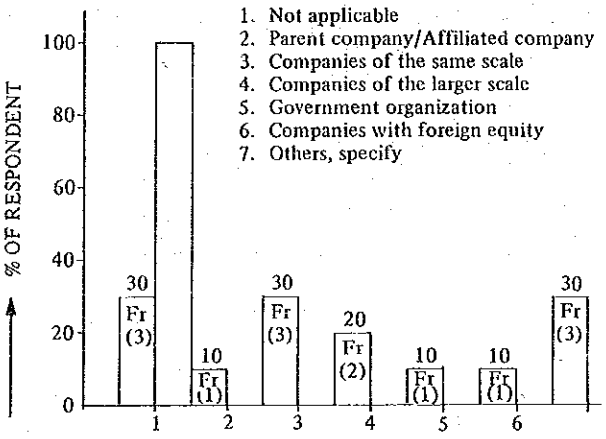



Fig. 4.4.2-8 Where do you make your Subcontracting Work to from

④ In Fig. 4.4.2-9 what kinds of assistance are received or supplied as to subcontracting works are shown, and those supplied are of 56% of supply of installations, etc., and 22.2% of engineering service. Then, the capital, loan and dispatch of specialists are of 11%, respectively. On the one hand, for content of assistance given to the subcontracting the engineering service becomes the main subject.

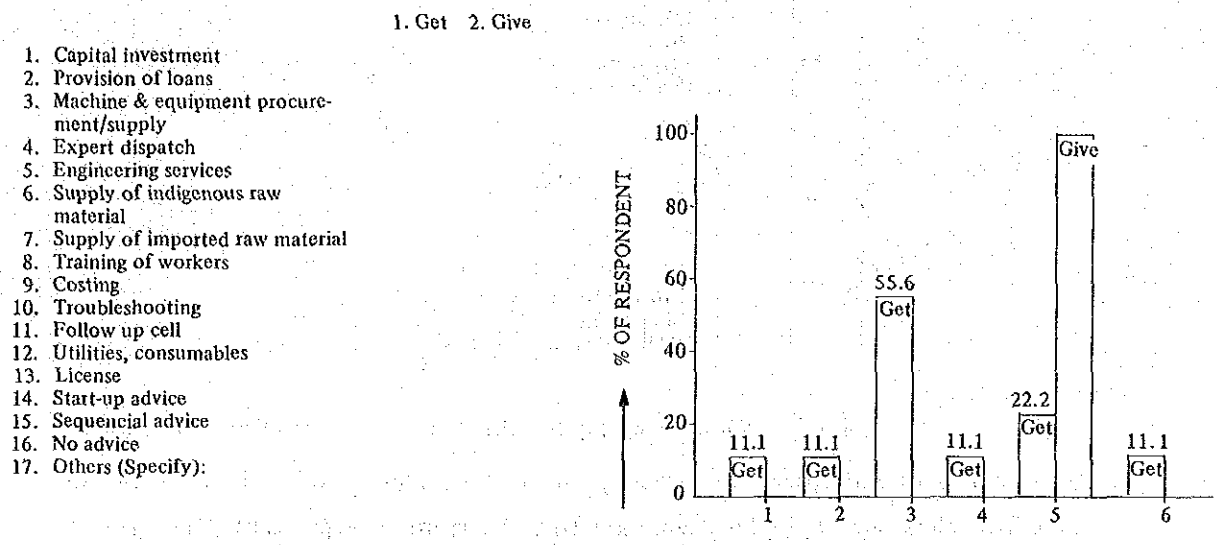



Fig. 4.4.2-9 What kind of assistance are received or supplied to subcontracting works (Q 70-2)

⑤ Evaluation of assistance given to subcontracting works (Q 70-3)

The evaluation on assistance to subcontracting works was recognized as effective in 62.5%, the answer as normally effective recorded 25%, and that as very poor recorded 12.5%.

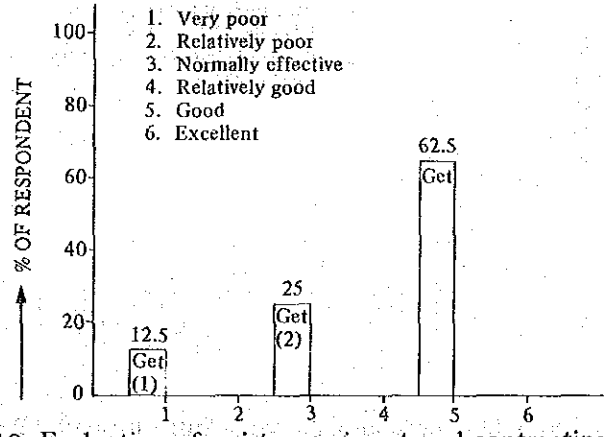



Fig. 4.4.2-10 Evaluation of assistance given to subcontracting work

⑥ Guarantee of products manufactured under subcontracting (Q 70-7)

Fig. 4.4.2-11 shows the condition on quality assurance of product, and enterprises not performing the quality assurance occupy 44%, the assurance at the point of time of delivery is 22.2% and that of less than 3 months is 11.1%. The total of these becomes 77%, which means the factor to be improved on the way of thinking on quality assurance of product.

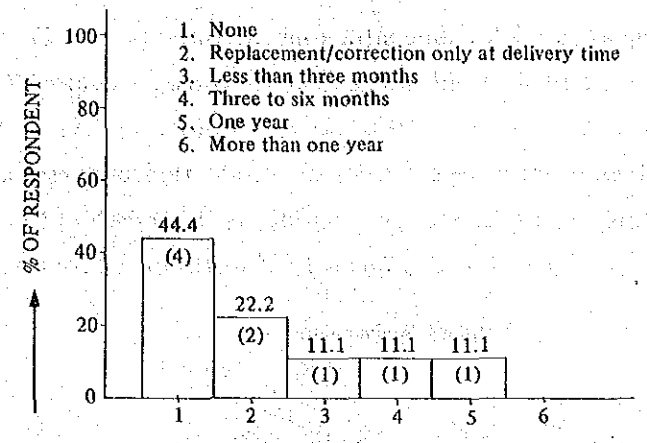



Fig. 4.4.2-11 Guarantee of products manufactured under subcontracting (Q 70-7)

⑦ Claim disposal on products manufactured under subcontracting (Q 70-8)

Fig. 4.4.2-12 shows how is made the claim disposal on products manufactured, and enterprise of 44.1%, nearly the half do not post the person in charge of it.

Against this 33.3% is disposed by the owner, and 22.2% is disposed by the manager, respectively.

The condition that the tackling on claim is not fully made is largely related to the quality control, so the tackling is required.

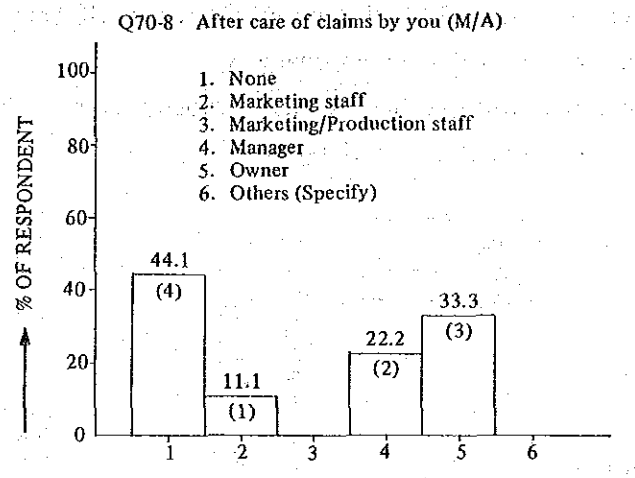



Fig. 4.4.2-12 Claim Disposal of Products Manufactured under Subcontracting (Q 70-8)

⑧ Order booking quantity for subcontracting enterprise (Q 70-12)

The work quantity awarded by subcontracting enterprises occupies 77.8% for that of less than 10 pieces, 11.1% for that of 10 pieces to 50 pieces and 51 to 100 pieces, respectively, and these figures are different from the production business category, but in case the production stability, price, etc. are considered the direction to expand is required. Fig. 4.4.2-13 shows the order booking quantity of works by subcontracting enterprises.

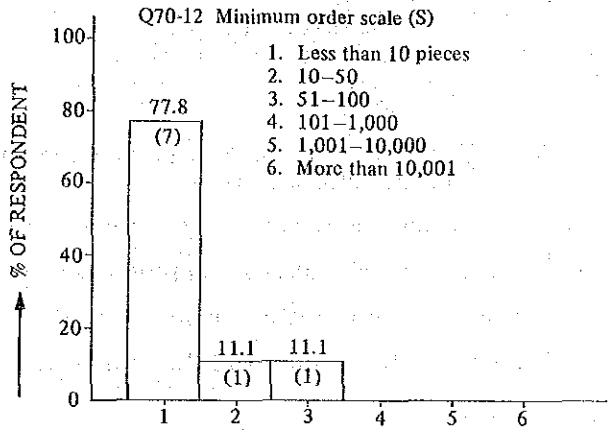



Fig. 4.4.2-13 Order Booking Quantity of Works by Subcontracting Enterprises (Q 70-12)

⑨ Motive to start subcontracting works (Q 70-15)

As shown in Fig. 4.4.2-14 the motive to start subcontracting works is the relation with the owner, manager, etc., being 50%, that improved by himself, being 40%, which means that enterprises make every efforts in their own way.

On the other hand, that forming the secondary subcontracting relation has a characteristic by the introduction of an influential person.

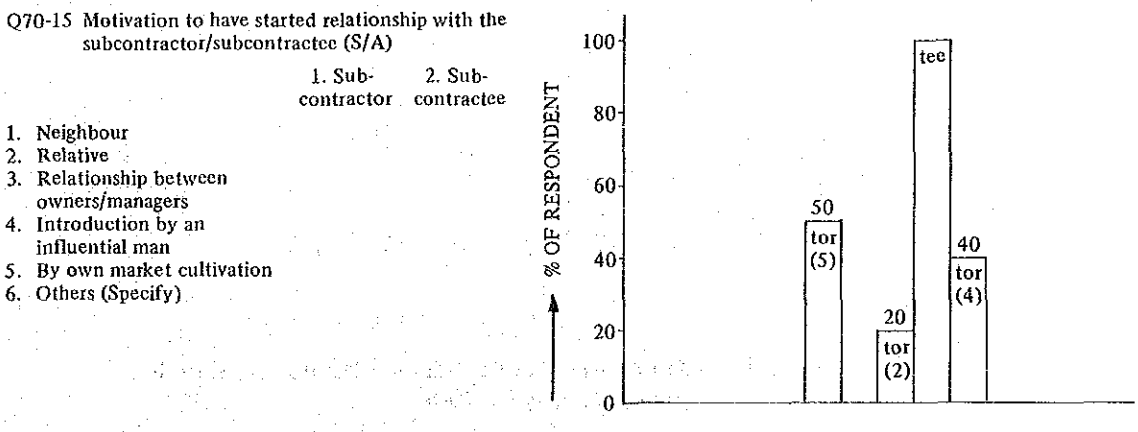



Fig. 4.4.2-14 Motive to Start Subcontracting Works (Q 70-15)

⑩ Distance from the ordering source till the subcontracting (Q 70-11)

Fig. 4.4.2-15 is to show how is positioned from the ordering source till the subcontracting.

From these, enterprises of 33% are within the range of 21 to 40 km, and those of within 20 km are 44%.

On the other hand, enterprises exceeding more than 151 km are also 10%.

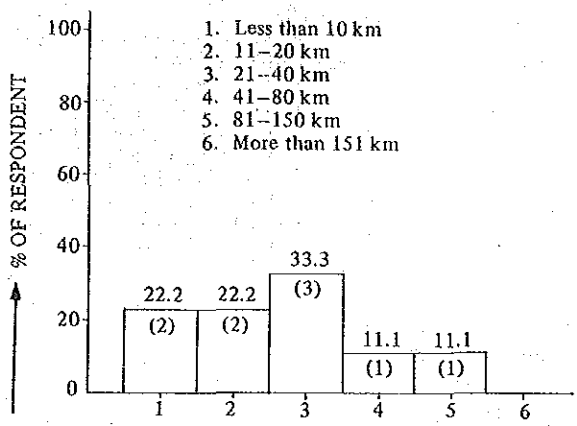



Fig. 4.4.2-15 Distance from the Ordering Source till the Subcontracting (Q 70-11)

⑪ Most favorable subcontractors (Q 70-16)

As shown in Fig. 4.4.2-16, when order booking subcontracting works, most favorable enterprises occupy 40% of those of order booking from the scale of identical degree.

This seems the method near to the cooperation than the subcontracting. Family enterprises occupy 20%, and those from large enterprises occupy 20%.

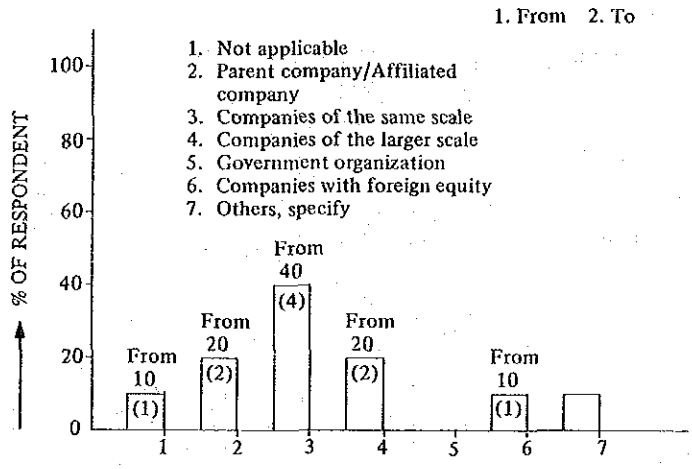



Fig. 4.4.2-16 Most Favorable Subcontractors (Q 70-16)

⑫ Main objects to make subcontracting works (Q 70-10)

The most important object as subcontracting enterprise is to maintain the production, with regard to this point, saying how is the situation, as shown in Fig. 4.4.2-17, enterprises of 70% desire the safety, enterprises of 60% aim at the market expansion, and the technical transfer, special occupation and stable supply of raw materials are 10%, respectively.

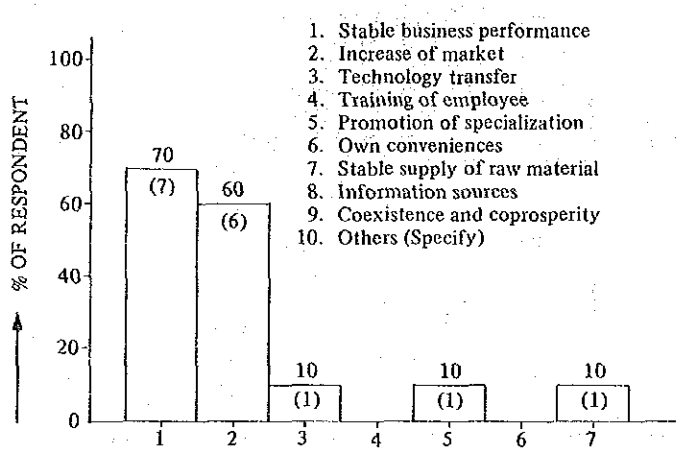



Fig. 4.4.2-17 Main Objects to make Subcontracting Works (Q 70-10)

⑬ Order booking route of subcontracting works (Q 70-13)

Fig. 4.4.2-18 shows the order booking condition of subcontracting works.

As shown in this Table, the main order booking is around 70% of direct trade from the original contractor, and that through the market, broker, etc. is only 10%. The expansion of order booking range is desired.

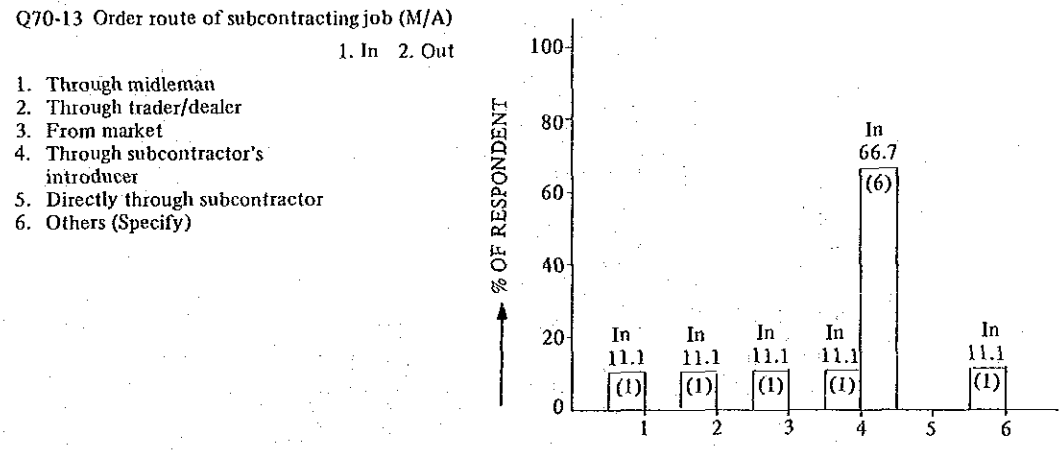



Fig. 4.4.2-18 Order Booking Route of Subcontracting Works (Q 70-13)

⑭ Future orientation as subcontracting enterprise (Q 70-14 and Q 70-9)

As subcontracting enterprise, with regard to the relation with the parent enterprise, as shown in Fig. 4.4.2-19, 20, there is no idea to stop or reduce subcontracting works, 78% of subcontracting enterprises desires the maintenance of the actual condition, wishing to bring to the relation more closely.

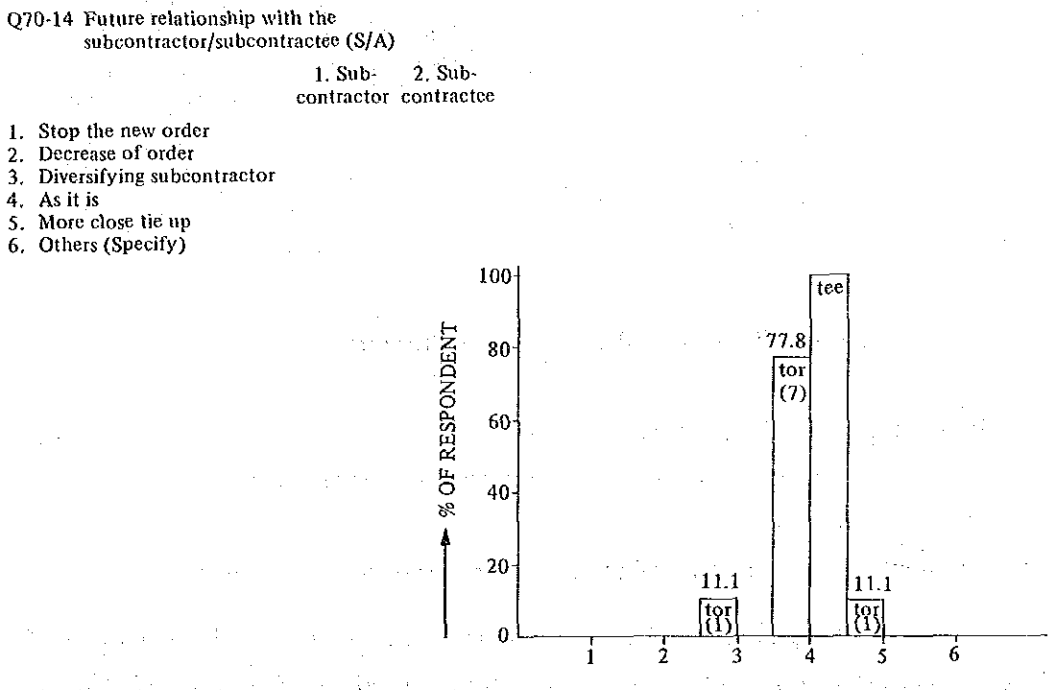



Fig. 4.4.2-19 Relation with Subcontracting Enterprises as Future (Q 70-14)

These are closely related to the improvement on quality and technique, thus it is necessary to promote them.

Concerning the subcontracting work quantity the gradual increase and the maintenance of the actual situation occupy 80%. Contrary to these there are enterprises to desire the reduction, and these show a cross section as subcontracting work.

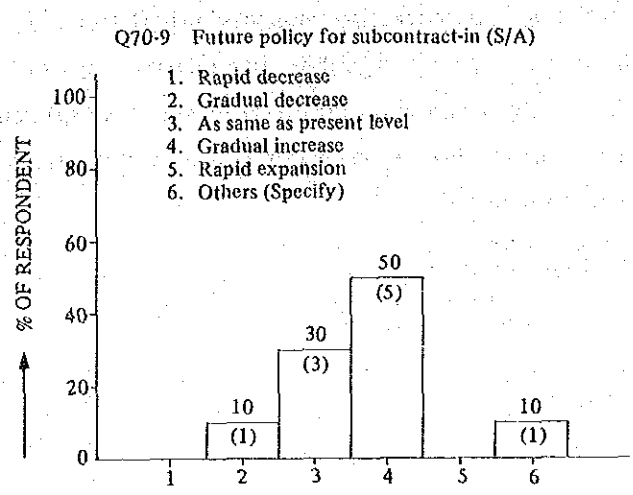



Fig. 4.4.2-20 Future Policy on Subcontracting (Q 70-9)

(5) Production Techniques of Pumps/Valves

1) Kinds of Pumps Produced at the Present Time in Thailand (Study by Means of Questionnaires)

They are mining pump, centrifugal pump, water pump and pump parts.

2) Production Percentage by Material of Pump Products (Q 102, 104). See Fig. 4.4.2-21. Cast iron occupies 86%, followed by 14% of alloy steel. See Fig. 4.4.2-22. Saying how the weight per product is found in the range, that of more than 1,000 kg is 38%, those of 11 to 100 kg and 501 to 1,000 kg of weight per product are 25%, respectively, and seeing from this, 1,000 kg of product weight are main. And, in terms of the production lot number, the production of less than 10 pieces is not found, resulting 100% for that producing more than 11 pieces.

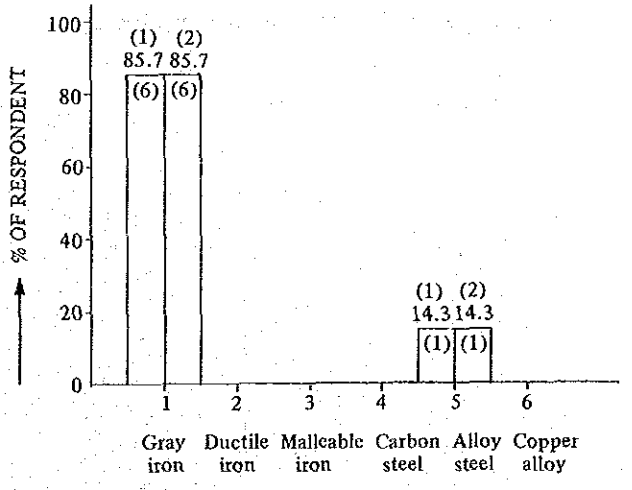



Fig. 4.4.2-21 Production percentage by material (Q102)

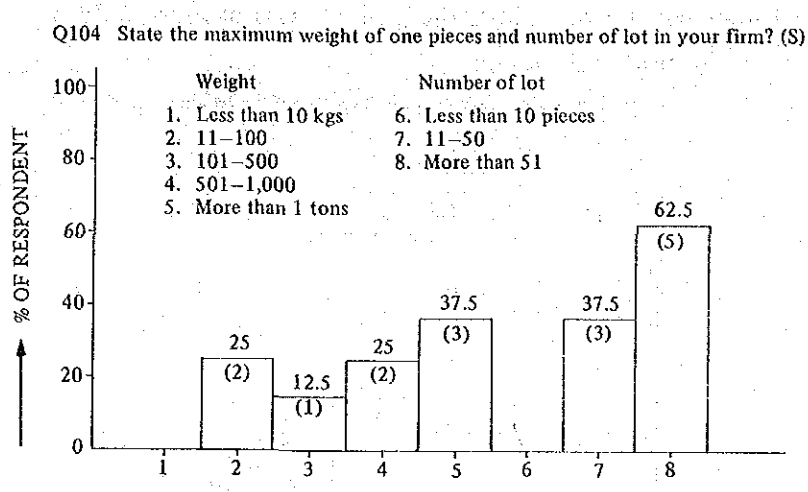



Fig. 4.4.2-22 Production Weight and Lot Number per Piece (Q 104)

3) Possession State of Pattern Manufacturing Shop (Q 105)

In Fig. 4.4.2-23 the possession state of pattern manufacturing shop is shown, but enterprises of 75% do not possess it. However, enterprises of 25% are performing the pattern repair, etc.

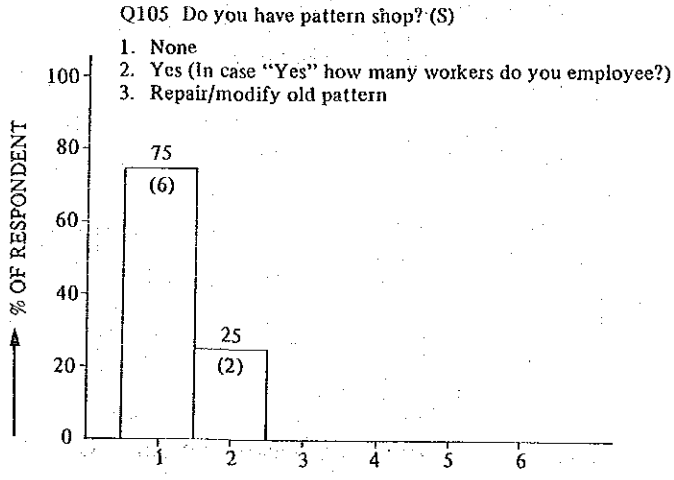



Fig. 4.4.2-23 Existence of Pattern Shop (Q 105)

4) Understanding of Drawings and Casting Design (Q 41 and Q 106)

In order to manufacture the pump/valve, material, it is necessary in the first place to understand drawings. Further more, the gate, number of risers, position, size, etc. should be planned on the basis of drawings.

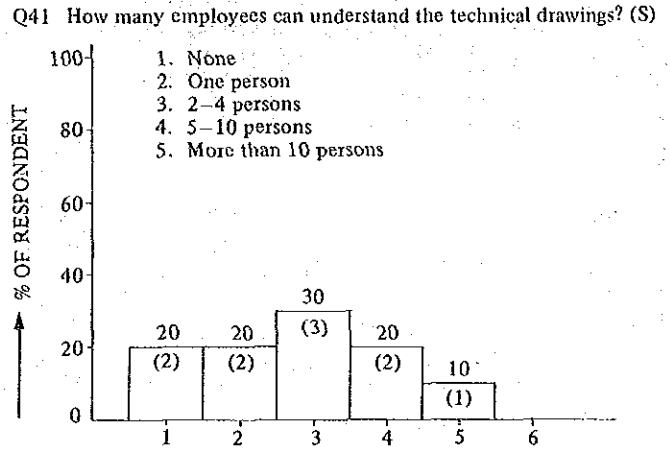



Fig. 4.4.2-24 Persons Who can Understand Drawings (Q 41)

Concerning the degree of understanding of drawings as shown in Fig. 4.4.2-24, enterprises which cannot understand them occupy 20%, and likewise, with regard to the elaboration of casting design in performing them by the worker himself the influence exerted on the quality of product can be considered. In Fig. 4.4.2-25 planners of casting design are shown.

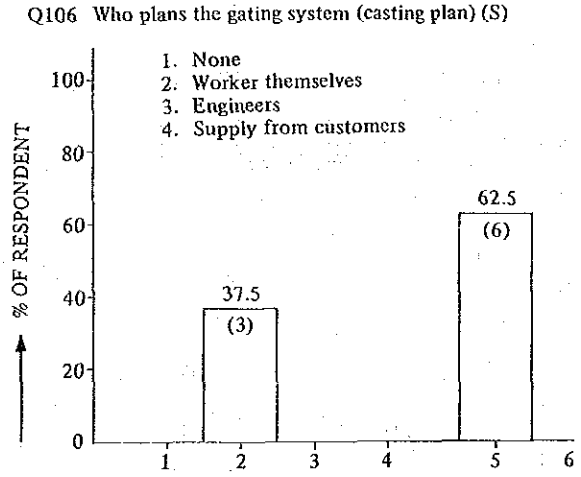



Fig. 4.4.2-25 Who plans casting design? (Q106)

5) Molding and Sand Mixing (Q 111, Q112, Q110 and Q 113)

The molding system of mold is divided into the method by manually operated molding and the method by molding machine each 50%, respectively, and the molding method indicates the mechanization trend. Accompanying with the mechanization, the control of foundry sand used is necessary, and when manufacturing those of the number to some extent the relation with casting design comes to be largely influenced.

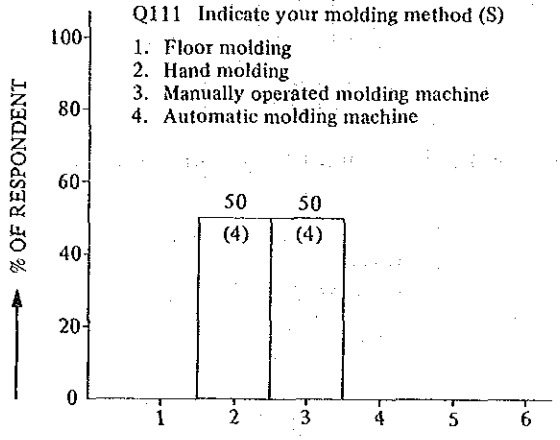



Fig. 4.4.2-26 Molding method (Q111)

Concerning foundry sand the combined use of natural sands and synthetic sands indicates 50%, and natural sand indicates 38%. Seeing the mixing condition of sand the kneading by hand occupies 12%, which comes to the defect occurrence factor against the product.

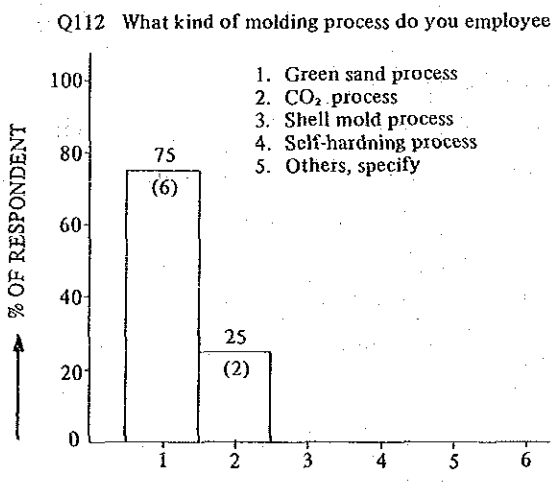



Fig. 4.4.2-27 Molding Process (Q 112)

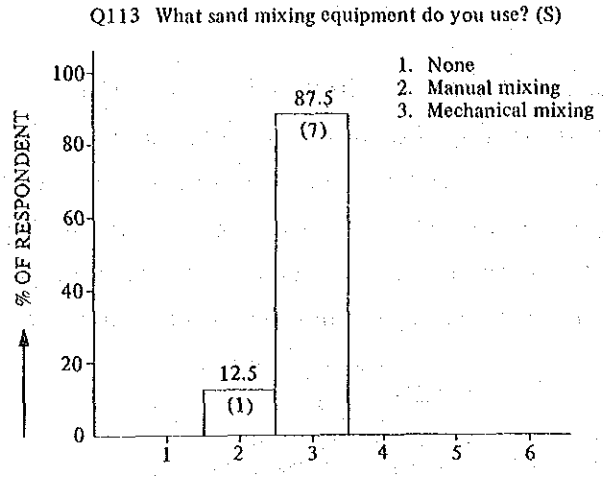



Fig. 4.4.2-28 Sand mixing equipment (Q113)

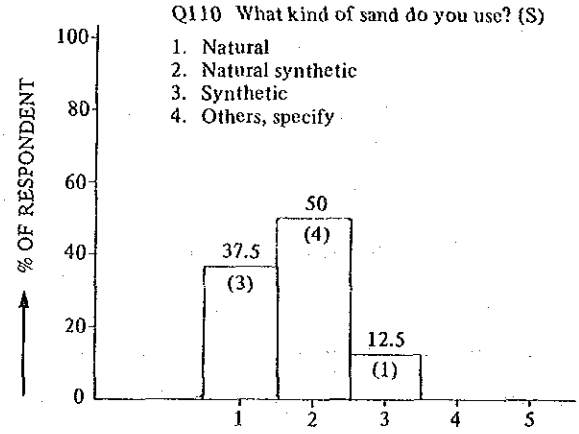



Fig. 4.4.2-29 Kinds of foundry sands (Q110)

6) Melting Method (Q 108 and Q 109)

For the fact that what kind of equipment is being used as melting method of cast iron, as shown in Fig. 4.4.2-30 the standard type is being used in 63%, and partially that of old type is being used.

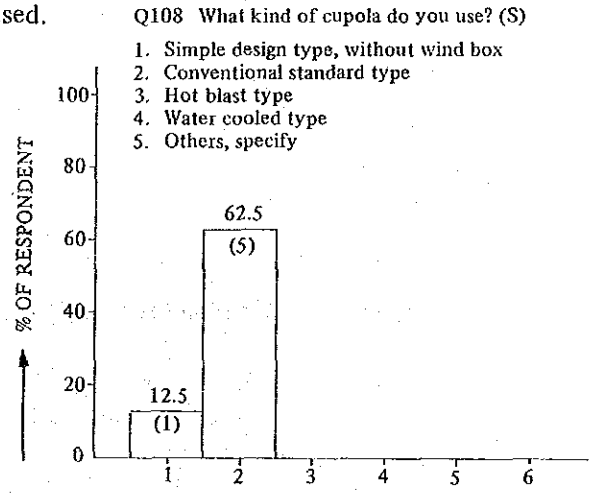



Fig. 4.4.2-30 Kinds of cupolas (Q108)

On the other hand, the composition determination of materials for melting, enterprises of 88% assign it to the worker himself, and it should be considered in terms of the product quality.

In Fig. 4.4.2-31 planners of material composition are shown.

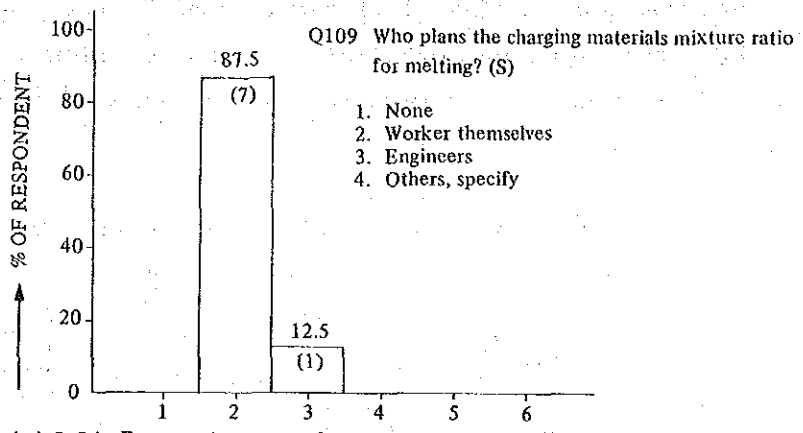



Fig. 4.4.2-31 Determinators of melting material composition rate (Q109)

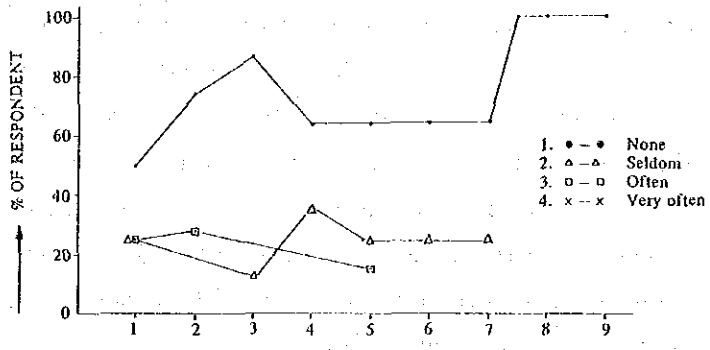
(6) Control

1) Control Condition at Manufacture of Casting Products (Q 114)

In the manufacturing process of casting products there are many processes, and among the items to be controlled in every processes items shown in Fig. 4.4.2-32 shows how the check is made to the extent.

According to this Fig., enterprises which do not carry out the check are low as 50%, and others become that of more than it.

Seeing casting products from the standpoint in terms of the quality it indicates that it is difficult to obtain stable products.




| Sand mixing | Melting Operation | | Metal quality | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 Moisture | 2 Tapping temp. | 3 Quick test | 4 Tensile strength | 5 Hardness | 6 Micro stracture | 7 Chemical comp. | 8 Non-destructive test | 9 Others |

Fig. 4.4.2-32 Check Items in the Manufacturing Process (Q 114)

To intend the quality improvement of casting products it has to be tackled quickly.

2) Defect Occurrence and Its Phenomena (Q 49-9, 49-10, 118, 119-1, 119-2)

Concerning defect phenomena occurring in casting products, as shown in Fig. 4.4.2-33, in casting products they are in order of blowhole, pinhole and sand inclusion, which indicate a high percentage, respectively. These defects as described in the preceding item, seem to contain elements in every processes of foundry sand mixing, molding, casting design, melting, etc.

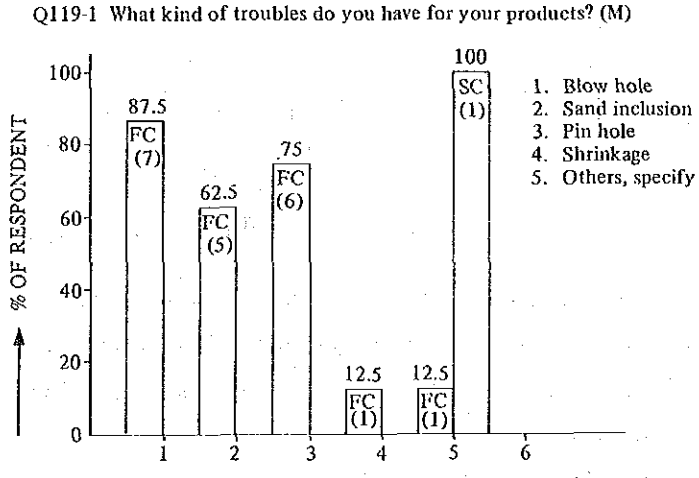



Fig. 4.4.2-33 Kinds of Defects Occurning in Products (Q 119-1)

Concerning the defect occurrence rate as shown in Fig. 4.4.2-34, enterprises of less than 3% of defect occurrence rate are 50%, enterprises of 6 to 10% of defect occurrence rate are 38%, enterprises of 11 to 20% of defect occurrence rate are 13%, and the defect occurrence rate is concentrated in both less than 3% and 6 to 20%. For these numerical values, in the relation with the defect occurring trouble shown in Fig. 4.4.2-35 and the comparison with the defect occurrence rate after shipment shown in Fig. 4.4.2-36, difference is recognized in the product inspection level. As measures against these defects as shown in Fig. 4.4.2-37, that not applicable is 33.3%, and enterprises which dispose at the judgment of the experience are 33.3%.

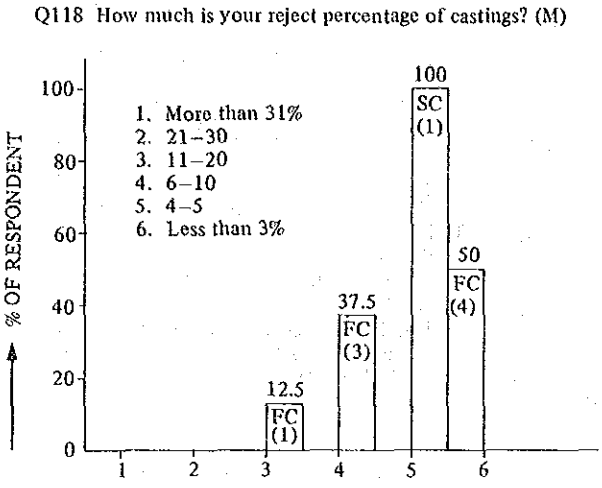



Fig. 4.4.2-34 Defect occurrence rate (Q118)

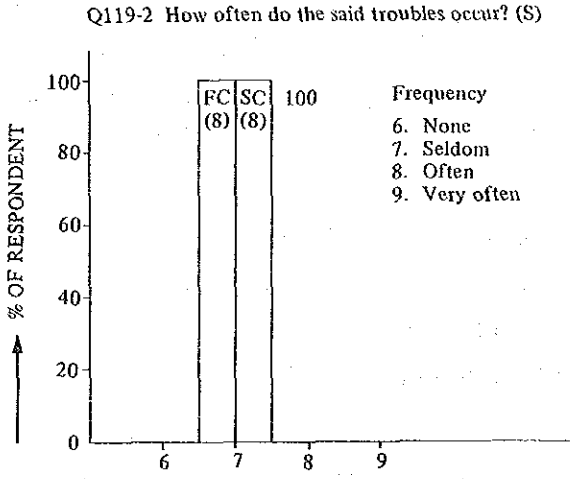



Fig. 4.4.2-35 Defect occurrence trouble (Q119-2)

Fi

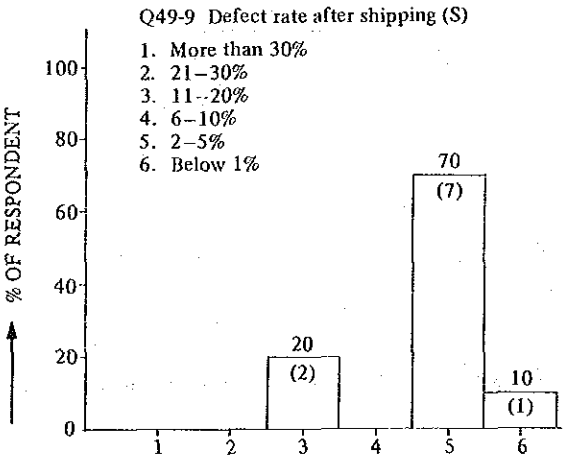



Fig. 4.4.2-36 Defect occurrence rate after shipment (Q49-9)

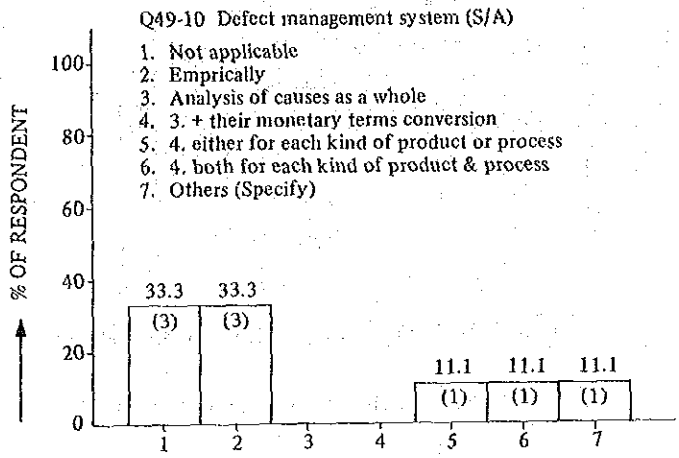



Fig. 4.4.2-37 Measures against the defect (Q49-10)

3) Delivery Time

① Delivery Time Instruction Method (Q 34)

To secure the delivery time is also important in the future production activity.

Fig. 4.4.2-38 shows the delivery time instruction method. Nine of delivery time instruction is 13%, and the verbal instruction is 26%.

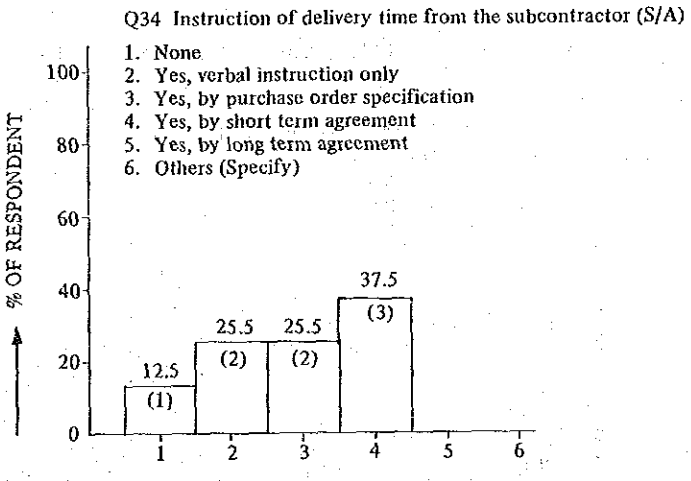



Fig. 4.4.2-38 Delivery time instruction method (Q34)

② Delivery Time Delay (Q 36)

Fig. 4.4.2-39 shows the delivery time delay condition. To delay from time to time occupies the greater part as 44.4%, and not to delay is 22.3%, and to delay a little 22.0%. To delay occasionally is 11.1%.

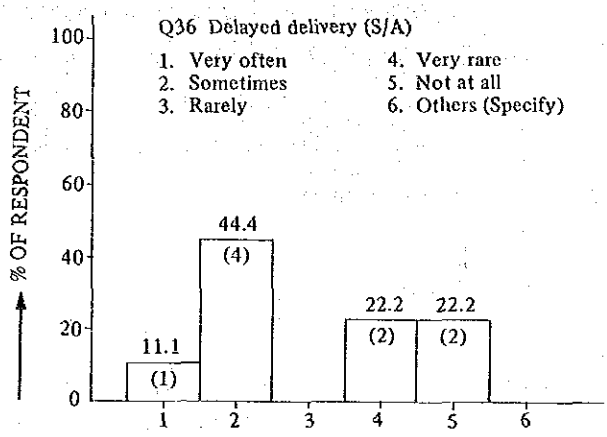



Fig. 4.4.2-39 Delivery time delay condition (Q36)

③ Cause of Delivery Time Delay (Q 39)

The cause of delivery time delay is shown in Fig. 4.4.2-40. The main cause is the labor shortage being 67%, the short delivery time 33.3%, and unskillfulness of process plan and delay of materials 22.2%, respectively.

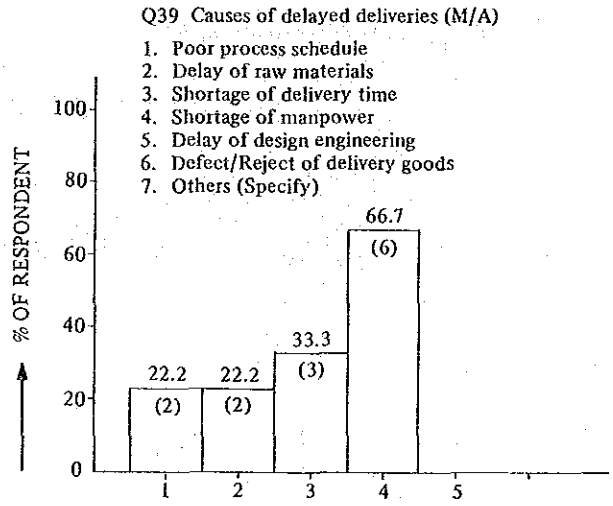



Fig. 4.4.2-40 Cause of delivery time delay (Q39)

④ Measures of Delivery Time Delay (Q 35)

The realization condition of preventive measures of delivery time delay is shown in Fig. 4.4.2-41. According to this enterprises which do not carry out any measure occupy 56%, which means that the training on delivery time, etc. are necessary.

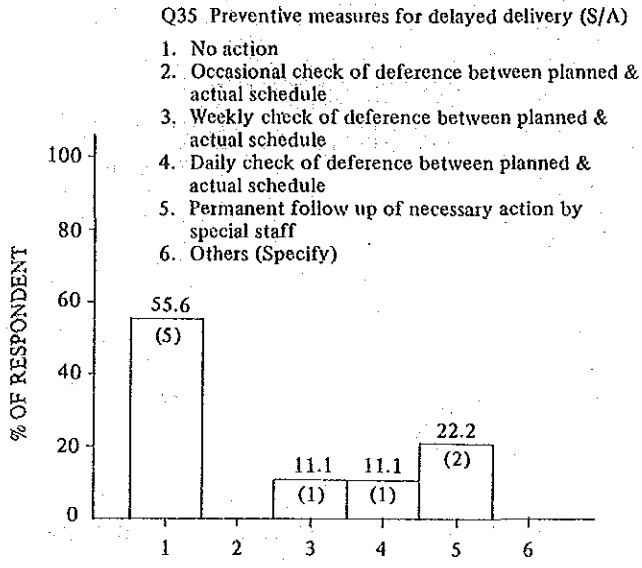



Fig. 4.4.2-41 Measures of Delivery Time Delay (Q35)

(7) Quality and Inspection

1) Quality (Q49-6)

When performing the order booking of casting products Fig. 4.4.2-42 shows how the instruction is made. According to this, that without instruction is 11%, the instruction by verbal way is 44%, and that by the specification is 44%.

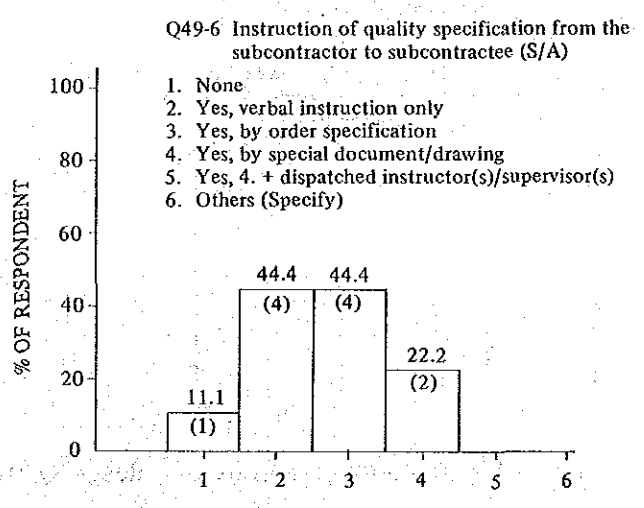



Fig. 4.4.2-42 Instruction of quality specification (Q49-6)

3) Inspection Record (Q49-8)

Fig. 4.4.2-44 shows the actual condition of inspection record, and enterprises without performing the inspection reach to 30%. Enterprises which carry out the visual observation and dimensional inspections are 40%, respectively. From these the difference of opinion against the inspection is considered.

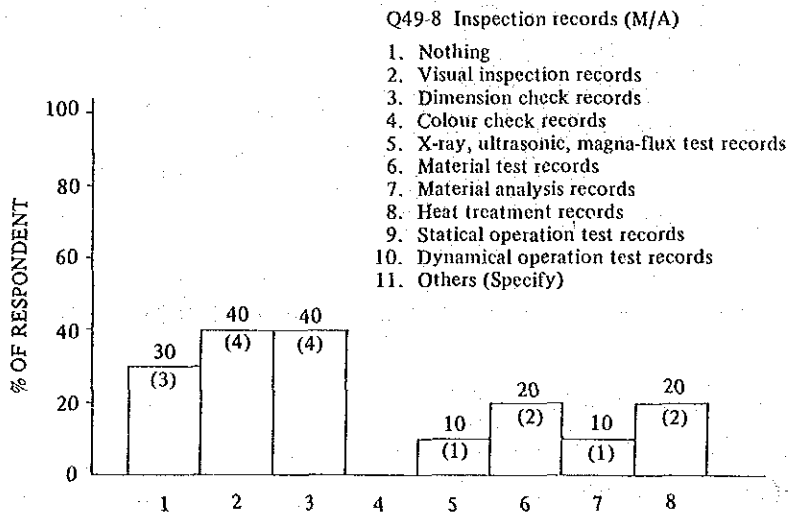



Fig. 4.4.2-44 Inspection Record (Q49-8)

4) Inspection Before Shipment (Q49-7)

Fig. 4.4.2-45 shows that those with inspection carried out by the personnel dispatched from the ordering source before shipment are 50%. On the other hand, enterprises without inspection before shipment are 22%. It is an indispensable item to summarize up on the relation with the inspection system on these.

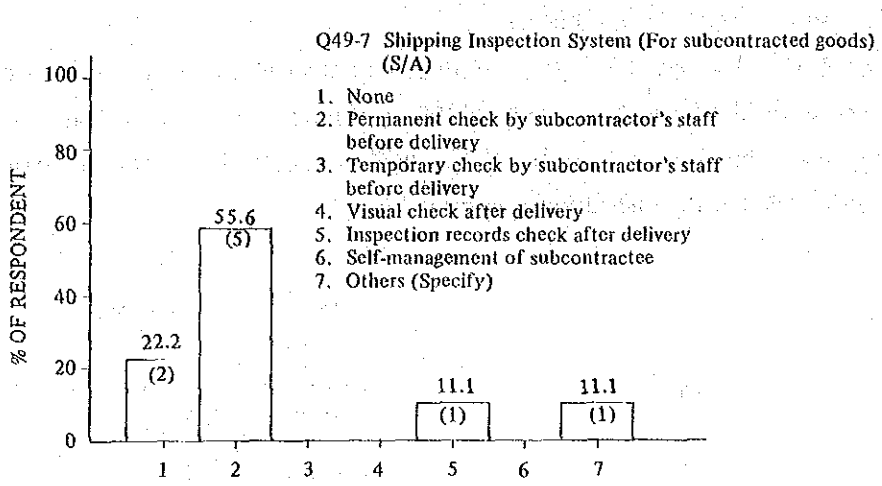



Fig. 4.4.2-45 Inspection Before Shipment (Q49-7)

(8) Education Level of Employees

Education Level of Employee (Q11)

The education level of employees, as shown in Fig. 4.4.2-46, the employees of primary school of 1 and 4 to 6 years higher grade school divided as education level rank make the main current in every enterprises, so the technical guidance is important.

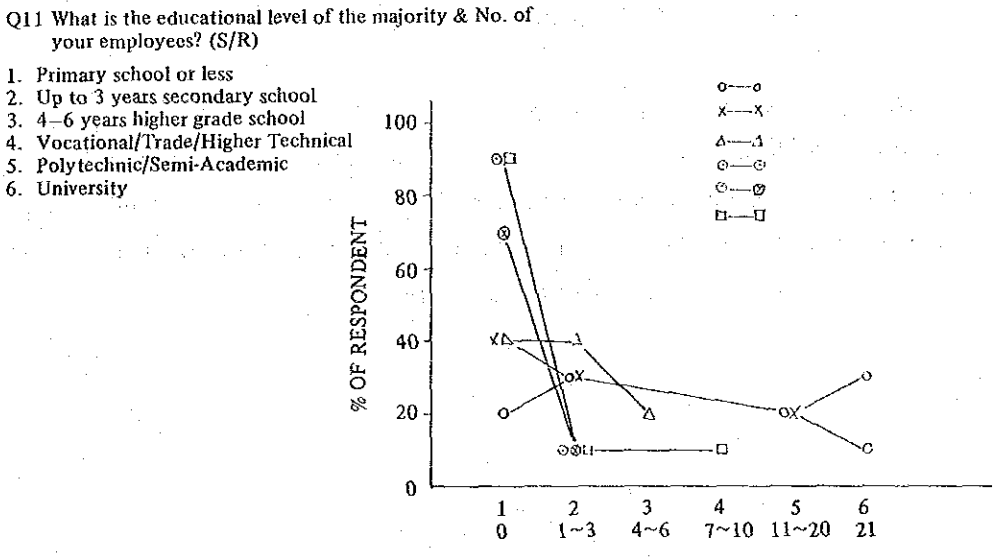



Fig. 4.4.2-46 Education Level of Employee (Q11)

Fig. 4.4.2-47 shows the education training system of employees.

Enterprises without carrying out the education training are 20%. And, there is no enterprise taking part in seminars and training courses carried out by the public organizations. Others are the man-to-man and the training in the enterprise. Such being the case, the guidance of employees is more required to circular guidances, seminars, etc.

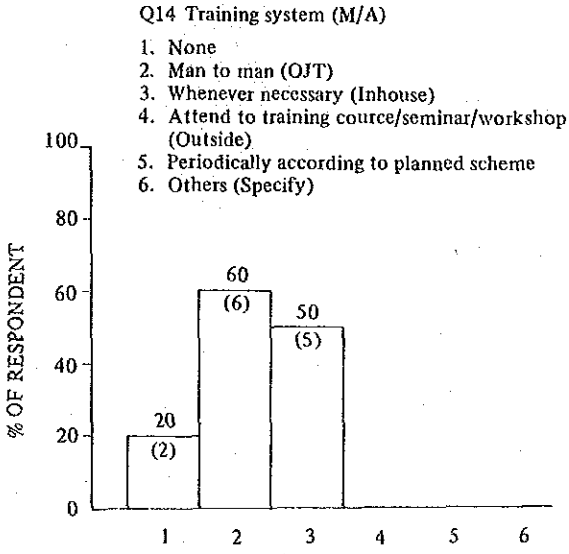



Fig. 4.4.2-47 Training System (Q14)

(9) Environmental Pollution

Various kinds of environmental pollutions are generated in the process of manufacturing casting products which are materials for pump/valve. As kinds of these environmental pollution, there are noise, vibration, air pollution, smell, smoke, water, etc. Fig. 4.4.2-48 is the result obtained from the study on environmental pollution claims.

According to this, the air pollution (smoke) and the air pollution (bad smell), as well as the noise are in the object.

In case the linking with the community is considered it is an important problem, thus the tackling is being urged by incorporating officials and people.