Allocation of personnel to principal departments such as marketing/ selling, cost estimation, design/engineering and inspection is as shown in Table 4.5.5 (15), Q10-01.

Table 4.5.5 (15) Employee's Number by Key Department (Q10-01)

| | 1.01-01 Marketing/ Selling | | 2.01-02 Cost Estimation | | 3.01-03 Inspection/ QC | | 4.01-04 Design/ Engineering | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % |
| 1. None | 17 | 39.5 | 8 | 18.2 | 8 | 17.4 | 13 | 31.6 |
| 2. One person | 15 | 34.9 | 23 | 52.3 | 21 | 45.7 | 15 | 36.6 |
| 3. 2 - 3 persons | 9 | 20.9 | 11 | 25.0 | 11 | 23.9 | 7 | 17.1 |
| 4. 4 - 5 persons | 1 | 2.3 | 1 | 2.3 | - | - | 2 | 4.9 |
| 5. More than 6 persons | 1 | 2.4 | 1 | 2.2 | 6 | 13.0 | 4 | 9.7 |
| Total | 43 | 100.0 | 44 | 100.0 | 46 | 100.0 | 41 | 100.0 |

Attention is given to each department where persons in charge are not specifically allotted. Especially marketing/selling and design/ engineering are weak. In many cases, only one person is allotted to each department.

Moral of Employees:

Self-evaluation is given to the moral of employees, which is relatively low in three firms (5.9%) but is moderate or high in other firms. (Table 4.5.5 (16), Q15-01-01)

Table 4.5.5 (16) Moral of Employees (Q15-01-01)

| | Freq | % |
|---|---|---|
| 1. Very low | - | - |
| 2. Relatively low | 3 | 5.9 |
| 3. Moderate | 27 | 52.9 |
| 4. Relatively high | 16 | 31.4 |
| 5. High | 5 | 9.8 |
| 6. Very high | - | - |
| Total | 51 | 100.0 |

Educational Level of Employees:

Table 4.5.5 (17), Q11-00 summarizes the educational level of the employees of 51 firms taken as the object of present survey classified by the finally graduated school (six levels such as primary school or below, secondary school, higher grade school, vocational school, polytechnic school and university) and by the number of persons.

Approximate 2/3 of the firms answered that they have no university graduates. Those having university graduates are classified into "1-3 persons" (23.5%, 12 firms) and "4-6 persons" (2%, one firm). In addition, there are two large firms (3.9%) having "7-10 persons" and "11-20 persons" respectively.

Approximate 3/4 of the firms have no graduates from polytechnic school. Those having polytechnic school graduates are classified into "1-3 persons" (11.8%, 6 firms) and "4-6 persons" (2%, one firm) and, therefore, the number of such graduates are as small as that of university graduates.

Table 4.5.5 (17) Educational Level of Employees
(Q11-00)

| Level / Number | 00-01 Primary school or less | | 00-02 Up to 3 years secondary school | | 00-03 4-6 yrs higher grade school | | 00-04 Vocational/Trade/ Higher Technical | | 00-05 Polytechnic/ Semi-academic | | 00-06 University | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % |
| 1. 0 | 11 | 21.6 | 13 | 25.5 | 19 | 37.3 | 32 | 62.7 | 40 | 78.4 | 34 | 66.7 |
| 2. 1-3 | 3 | 5.9 | 14 | 27.5 | 12 | 23.5 | 8 | 15.7 | 6 | 11.8 | 12 | 23.5 |
| 3. 4-6 | 7 | 13.7 | 6 | 11.8 | 7 | 13.7 | 6 | 11.8 | 1 | 2.0 | 1 | 2.0 |
| 4. 7-10 | 9 | 17.6 | 4 | 7.8 | 10 | 19.6 | 1 | 2.0 | - | - | - | - |
| 5. 11-20 | 7 | 13.7 | 8 | 15.7 | 1 | 2.0 | 2 | 3.9 | 3 | 5.9 | 2 | 3.9 |
| 6. More than 21 | 14 | 27.5 | 6 | 11.7 | 2 | 3.9 | 2 | 3.9 | 1 | 1.9 | 2 | 3.9 |
| Total | 51 | 100.0 | 51 | 100.0 | 51 | 100.0 | 51 | 100.0 | 51 | 100.0 | 51 | 100.0 |

v. Subcontract:

a) Subcontracting Job In/Out

Firms receiving subcontract orders are classified into 13.6% "constantly", 43.2% "sometimes" and 16.2% "often".

Firms placing subcontract orders, though not constantly, is classified into 45.5% "sometimes" and 40.9% "often", and it appears that order-receiving activities are carried out under lateral connections. (Table 4.5.5 (18), Q70-00)

Table 4.5.5 (18) Subcontracting Job
(Q70-00)

| | 00-01 In | | 00-02 Out | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. No | 8 | 21.6 | 1 | 4.5 |
| 2. Rarely | 1 | 2.7 | 2 | 9.1 |
| 3. Sometimes | 16 | 43.2 | 10 | 45.5 |
| 4. Often | 6 | 16.2 | 9 | 40.9 |
| 5. Very often | 1 | 2.7 | - | - |
| 6. Constantly | 5 | 13.6 | - | - |
| Total | 37 | 100.0 | 22 | 100.0 |

Regarding subcontracted in/out processes, the subcontracted-in process is classified into "machine assembly" (80.5%), "machining" (61.0%), "sheet work and welding" (29.3%), etc., while the subcontracted-out process is classified into "heat treatment (80%, overwhelming), "casting" (28%), "machining" (16%) and others such as "press work" and "precision machining". (Table 4.5.5 (19), Q02-01).

Table 4.5.5 (19) Category of Subcontracting In/Out (Q02-01)

| | 01-01 Own | | 01-02 In | | 01-03 Out | |
|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % |
| 1. Casting | - | - | 3 | 7.3 | 7 | 28.0 |
| 2. Forging | 1 | 2.9 | 7 | 2.4 | - | - |
| 3. Sheetwork & Welding | 21 | 60.0 | 12 | 29.3 | 1 | 4.0 |
| 4. Plating | - | - | 1 | 2.4 | 2 | 8.0 |
| 5. Machine Assembly | 24 | 68.6 | 33 | 80.5 | 3 | 12.0 |
| 6. Machining | 21 | 60.0 | 25 | 61.0 | 4 | 16.0 |
| 7. Presswork | 10 | 28.6 | 4 | 9.8 | 3 | 12.0 |
| 8. Precision Machining (Mold & Die, Gear, etc) | 7 | 20.0 | 7 | 17.1 | 3 | 12.0 |
| 9. Heat Treatment | 2 | 5.7 | 1 | 2.4 | 20 | 80.0 |
| Total | 35 | 245.8 | 41 | 212.2 | 25 | 172.0 |

Table 4.5.5 (20) Own Use/Subcontracting Job In/Out (Q04-01)

| | 01-01 Own | | 01-02 In | | 01-03 Out | |
|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % |
| 1. Service & Repair only | 13 | 48.1 | 11 | 26.8 | 3 | 23.1 |
| 2. Auxiliary materials | 2 | 7.4 | 1 | 2.4 | 6 | 46.2 |
| 3. Basic materials | 5 | 18.5 | 3 | 7.3 | 2 | 15.4 |
| 4. Standard component/ parts | 10 | 37.0 | 19 | 46.3 | 2 | 15.4 |
| 5. Fabricated goods | 4 | 14.8 | 7 | 17.1 | - | - |
| 6. Assembled goods | 5 | 18.5 | 14 | 34.1 | - | - |
| 7. Integrated goods (Fabricated & Assembled goods) | 2 | 7.4 | 15 | 36.6 | - | - |
| 8. Others (Specify) | - | - | 2 | 4.9 | 2 | 15.4 |
| Total | 27 | 151.7 | 41 | 175.5 | 13 | 115.5 |

Subcontracted-in goods are classified into "standard component/ parts" (46.3%), "integrated goods" (36.6%), "service and repair only" (26.8%), etc., while subcontracting-out goods are classified into "auxiliary materials", "service and repair only", etc. (Table 4.5.5 (20), Q04-01)

b) Subcontracting In/Out by Product

Subcontracting-in of automobile-related components, industrial machinery components, agricultural machinery components, railway equipment, etc. is carried out by most of the firms, eight firms of which answered that they place subcontract orders with outside firms mainly for automobile-related and industrial machinery-related components. (Table 4.5.5 (21), Q05-00)

Table 4.5.5 (21) Kind of Products
(Q05-00)

| | 00-01 Own | | 00-02 In | | 00-03 Out | |
|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % |
| 1. Motor vehicles or parts | 4 | 18.2 | 44 | 122.2 | 9 | 112.5 |
| 2. Industrial machinery or parts | 6 | 27.3 | 28 | 77.8 | 5 | 62.5 |
| 3. Civil, structural & construction machinery or parts | 1 | 4.5 | 6 | 16.7 | - | - |
| 4. Agricultural machinery or parts | 5 | 22.7 | 12 | 33.3 | 1 | 12.5 |
| 5. Electrical & telecommunication machinery or parts | 2 | 9.1 | 1 | 2.8 | 1 | 12.5 |
| 6. Transport & harbour equipment not classified elsewhere but including shipbuilding & repairing | 1 | 4.5 | 5 | 13.9 | 1 | 12.5 |
| 7. Pipework or parts (except item 16) | - | - | 2 | 5.6 | - | - |
| 8. Architectural/ carpentry & bldg works or parts | - | - | - | - | 1 | 12.5 |
| 9. Railway equipment & carriage parts | - | - | 7 | 19.4 | 1 | 12.5 |
| 10. Working tools or parts | 1 | 4.5 | - | - | - | - |
| 11. Metalworking machinery or parts (except item 17) | 2 | 9.1 | - | - | - | - |
| 12. Moulds & dies or parts | 3 | 13.6 | - | - | - | - |
| 13. Tableware/utensils or parts | - | - | - | - | - | - |
| 14. Kitchen equipment | - | - | - | - | - | - |
| 15. Engines & turbines | - | - | - | - | - | - |
| 16. Pumps & valves | 1 | 4.5 | - | - | - | - |
| 17. Machine tools | 2 | 9.1 | - | - | - | - |
| 18. Gears | - | - | - | - | - | - |
| 19. Other machineries & equipment or parts | 2 | 9.1 | - | - | - | - |
| 20. Others, specify ____ | 2 | 9.1 | - | - | - | - |
| Total | 22 | 145.3 | 36 | 291.7 | 8 | 237.5 |

c) Number of Subcontractors

In Table 4.5.5 (22), Q31-01 where a question is raised as to the number of subcontractors one firm each (2% each) raised "1-3" and "4-6" respectively as the number of subcontractors for complete products, while "1-3 as the number of subcontractors for parts, components and processing, raised by firms, is classified into "machining" (9.8%, 5 firms), "casting" (3.9%, 2 firms), "heat treatment" (5.9%, 3 firms), "sheetwork/pressing" (5.9%, 3 firms), "plating" and "welding" (2%

each, 1 firm each). For the total number of subcontractors, one firm each (2% each) raised "4-6" and "7-10" respectively, the fact of which is especially remarkable among such other answers as "0" subcontractor.

Table 4.5.5 (22) Number of Subcontractors by Process (Q31-01)

| Number of sub-contractors / Products | (1) 0 | | (2) 1-3 | | (3) 4-6 | | (4) 7-10 | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % |
| 01-01 Complete products | 48 | 94.1 | 1 | 2.0 | 1 | 2.0 | - | - |
| Parts, component & processing | | | | | | | | |
| 01-02 Machining | 46 | 90.2 | 5 | 9.8 | - | - | - | - |
| 01-03 Casting | 49 | 96.1 | 2 | 3.9 | - | - | - | - |
| 01-04 Forging | 51 | 100.0 | - | - | - | - | - | - |
| 01-05 Heat Treatment | 48 | 94.1 | 3 | 5.9 | - | - | - | - |
| 01-06 Plating | 51 | 100.0 | - | - | - | - | - | - |
| 01-07 Painting | 50 | 98.0 | 1 | 2.0 | - | - | - | - |
| 01-08 Welding | 50 | 98.0 | 1 | 2.0 | - | - | - | - |
| 01-09 Sheet Work/Pressing | 47 | 92.2 | 3 | 5.9 | - | - | - | - |
| 01-10 TOTAL: | 49 | 96.1 | - | - | 1 | 2.0 | 1 | 1.9 |

2) Technological Aspect

i. Design and Engineering:

Table 4.5.5 (23), Q49-03 shows the results of survey on the source of design and engineering on stage-by-stage basis. Design and engineering on the upstream side such as conceptual design, etc. are mainly provided by the client (40-56%) and detailed design, production engineering, procurement of materials, etc. are likely to be performed by their own technology.

Table 4.5.5 (23) Source of Design and Engineering
(Q49-03)

| Engineering Source / Items | (1) None | | (2) Copying | | (3) Buying from outside | | (4) Supply from customer | | (5) Supply from licencer | | (6) Self-engineering occasionally | | (7) Self-engineering partially | | (8) Self engineering fully own | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % |
| 03-01. None | 4 | 100.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4 | 100.0 |
| 03-02. Conceptional design | 1 | 5.3 | 7 | 36.8 | 1 | 5.3 | 10 | 52.6 | 3 | 15.8 | - | - | 4 | 21.1 | 1 | 5.3 | 19 | 142.2 |
| 03-03. Specification | - | - | 1 | 4.0 | 1 | 4.0 | 14 | 56.0 | 3 | 12.0 | 4 | 16.0 | 2 | 8.0 | 4 | 16.0 | 25 | 116.0 |
| 03-04. Basic design | 1 | 3.2 | 8 | 25.8 | 1 | 3.2 | 13 | 41.9 | - | - | 3 | 9.7 | 6 | 19.4 | 6 | 19.4 | 31 | 122.6 |
| 03-05. Functional design | 1 | 3.6 | 7 | 25.0 | 3 | 10.7 | 7 | 25.0 | 2 | 7.1 | 2 | 7.1 | 4 | 14.3 | 6 | 21.4 | 28 | 114.2 |
| 03-06. Structural design | - | - | 5 | 18.5 | 4 | 14.8 | 12 | 44.4 | 2 | 7.4 | 1 | 3.7 | 2 | 7.4 | 7 | 25.9 | 27 | 122.1 |
| 03-07. Detail design | 2 | 6.7 | 12 | 40.0 | 1 | 3.3 | 7 | 23.3 | 2 | 6.7 | 3 | 10.0 | 5 | 16.7 | 5 | 16.7 | 30 | 123.4 |
| 03-08. Production engrg | 3 | 12.0 | 7 | 28.0 | 2 | 8.0 | 2 | 8.0 | 2 | 8.0 | 2 | 8.0 | 1 | 4.0 | 7 | 28.0 | 25 | 104.0 |
| 03-09. Procurement engrg | 4 | 20.0 | 3 | 15.0 | 1 | 5.0 | 2 | 10.0 | 1 | 5.0 | 2 | 10.0 | 2 | 10.0 | 7 | 35.0 | 20 | 110.0 |
| 03-10. Selection of mat. | 1 | 3.3 | 6 | 20.0 | 8 | 26.7 | 9 | 30.0 | 1 | 3.3 | 5 | 16.7 | 3 | 10.0 | 6 | 20.0 | 30 | 130.0 |
| 03-11. Material flow plan | 1 | 20.0 | 1 | 6.7 | - | - | - | - | 2 | 13.3 | - | - | 1 | 6.7 | 9 | 60.0 | 15 | 106.7 |
| 03-12. Team engrg | 3 | 20.0 | - | - | - | - | - | - | - | - | - | - | 3 | 20.0 | 10 | 66.7 | 15 | 106.7 |

Copying of preceding products, raised by a relatively large number of firms, is playing an important role in such stages as conceptual design, structural design and functional design. It should be noted that coping was raised by 12 firms regarding the item of detail design and by eight firms regarding the item of selection of materials and that fully copied products are likely to be produced.

Although firms own industrial standards, answers to a question whether "owned but not in use" or "owned and actually in use" are as shown in Table 4.5.5 (25), Q44-01-01.

Unexpectedly, such international standards as ANSI, ASTM, SAE, DIN and BS are put to use by few firms. Most of the firms use customer's standard (62%) and company standard (26%) as well as JIS (26%) and TIS (32%).

Table 4.5.5 (24)
Industrial Standards
(Q44-01-01)

| Name of Std. | Owned, not in use | | Actually in use | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| ANSI | - | - | 1 | 2.0 |
| ASTM | - | - | 3 | 6.0 |
| SAE | - | - | 1 | 2.0 |
| BS | - | - | 3 | 6.0 |
| JIS | 2 | 4.0 | 13 | 26.0 |
| DIN | - | - | 4 | 8.0 |
| TIS (Thai Ind. Std.) | 2 | 4.0 | 16 | 32.0 |
| Customer's Std. | - | - | 31 | 62.0 |
| Company Std. | - | - | 13 | 26.0 |
| Total | Freq: 50, %: 178 | | | |

Table 4.5.5 (25)
Instruction of Quality Specification from Contractors to Subcontractor
(Q49-06)

| | 06-01 From | | 06-02 To | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. None | 6 | 16.2 | 2 | 18.2 |
| 2. Yes, verbal instruction only | 11 | 29.7 | 2 | 18.2 |
| 3. Yes, by order specification | 17 | 45.9 | 5 | 45.5 |
| 4. Yes, by special document/drawing | 12 | 32.4 | 2 | 18.2 |
| 5. Yes, 4.+ dispatched instructor(s)/ supervisor(s) | 2 | 5.4 | - | - |
| 6. Others (Specify) | - | - | - | - |
| Total | 37 | 129.6 | 11 | 100.0 |

Instruction of quality specification from contractors is classified into "by order specification" (45.9%), "verbal instruction only" (29.7%), "by special document/drawing" (32.4%), and others, while that to subcontractor is also given "by order specification" in many cases.

It should be noted that there were such answers as "none" from contractor (6 firms) and "non" to subcontractor (2 firms). Besides the above, two firms answered that they receive "dispatching instructor/supervisor" from the contractor.

ii. Production:

Monthly production takes place under both small-quantity production such as "less than 10 pieces" (33.3%) and "11-150 pieces" (23.5%), and mass production such as "more than 1,500 pieces" (21.6%).

Table 4.5.5 (26) Monthly Production
(Q30-01-01)

| | Freq | % |
|---|---|---|
| 1. Less than 10 pieces/month | 17 | 33.3 |
| 2. 11 - 150 pieces | 12 | 23.5 |
| 3. 151 - 300 pieces | 3 | 5.9 |
| 4. 301 - 600 pieces | 3 | 5.9 |
| 5. 601 - 1,500 pieces | 5 | 9.8 |
| 6. More than 1,500 pieces | 11 | 21.6 |
| Total | 51 | 100.0 |

There are firms (45.2%) not utilizing used or second-hand parts as components of their products, but some firms are putting to reuse materials including steel plate and such precision and costly components as gears, bearings, bushes and motors. (Table 4.5.5 (27), Q50-01-01)

Table 4.5.5 (27) Used/Second-hand Parts and Raw Materials
(Q50-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 19 | 45.2 |
| 2. Gears | 7 | 16.7 |
| 3. Bearings | 8 | 19.0 |
| 4. Bushers | 5 | 11.9 |
| 5. Motors | 5 | 11.9 |
| 6. Steel plates | 9 | 21.4 |
| 7. Raw materials | 14 | 33.3 |
| 8. Others (Specify): | 2 | 4.8 |
| Total | 42 | 164.2 |

Table 4.5.5 (28) shows answers to a question on the number of employees who can understand the technical drawings. Firms that gave the answer "none" are amounting to 15.7%.

Table 4.5.5 (28) Number of Employees Who Can Understand Technical Drawings
(Q41-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 8 | 15.7 |
| 2. One person | 10 | 19.6 |
| 3. 2 - 4 persons | 16 | 31.4 |
| 4. 5 - 10 persons | 10 | 19.6 |
| 5. More than 10 persons | 7 | 13.7 |
| Total | 51 | 100.0 |

As defect management system, firms are taking measures against defective products through trouble-shooting (45.2%) and role of thumb (23.8%) (Table 4.5.5 (29), Q49-01-01). For answers to a question on the defect rate after shipping, the majority gave "below 1%" but 37% firms gave "2-5%" and some firms gave as high as "6-10%". (Table 4.5.5 (30), Q49-09-01)

Table 4.5.5 (29)
Defect Management
(Q49-10-01)

| | Freq | % |
|---|---|---|
| 1. Not applicable | 9 | 21.4 |
| 2. Emprically | 10 | 23.8 |
| 3. Analysis of causes as a whole | 19 | 45.2 |
| 4. 3. + their monetary terms conversion | - | - |
| 5. 4. either for each kind of product or process | 2 | 4.8 |
| 6. 4. both for each kind of product & process | 2 | 4.8 |
| 7. Others (Specify) | - | - |
| Total | 42 | 100.0 |

Table 4.5.5 (30)
Defect Rate after Shipping
(Q49-09-01)

| | Freq | % |
|---|---|---|
| 1. More than 30% | - | - |
| 2. 21 - 30% | - | - |
| 3. 11 - 20% | - | - |
| 4. 6 - 10% | 4 | 8.7 |
| 5. 2 - 5% | 17 | 37.0 |
| 6. Below 1% | 25 | 54.3 |
| Total | 46 | 100.0 |

Answers "10 mm" (8.2%) and "1 mm" (36.7%) were given to a question on dimensional tolerance for principal products as in Table 4.5.5 (31), Q43-01-01. The highest frequency centered on "1/10 mm" (67.3%), followed by "1/100 mm" (49.0%) and there was even such high precision machining as "less than 1/100 mm" (12.2%).

Table 4.5.5 (31) Tolerance of Main Products
(Q43-01-01)

| | Freq | % |
|---|---|---|
| 1. 100 mm or rough estimate | - | - |
| 2. 10 mm | 4 | 8.2 |
| 3. 1 mm | 18 | 36.7 |
| 4. 1/10 mm | 33 | 67.3 |
| 5. 1/100 mm | 24 | 49.0 |
| 6. Less than 1/100 mm | 6 | 12.2 |
| Total | 49 | 173.4 |

It is understood from these figures that large steel structures and repair parts applied on a field-adjustment basis, that are not called for a high accuracy, are coexisting with products called for "less than 1/100 mm" tolerance.

Instructions given to workers are mostly by means of "sample/ rough sketch/verbal instruction" (66.7%), followed by "technical drawing" (25.0%). (Table 4.5.5 (32), Q47-01-01)

Table 4.5.5 (32) Instruction ot the Workers
(Q47-01-01)

| | Freq | % |
|---|---|---|
| 1. Sample/rough sketch/verbal instruction | 32 | 66.7 |
| 2. Technical drawing | 12 | 25.0 |
| 3. Own design technical drawing | 4 | 8.3 |
| 4. Others, specify _____ | - | - |
| Total | 48 | 100.0 |

Interviewer's Assessment of Technical Level:

Interviewer's assessment after visiting firms is classified into "normal/average" (55.0%) and "relatively low" (5.0%) in addition to "relatively high" (25.0%) and "high" (12.5%), implying that not a few firms are highly evaluated. One of the firms is found to have reached "exportable level".

Table 4.5.5 (33) Evaluation of Technical Level by the Interviewer (Q49-13-01)

| | Freq | % |
|---|---|---|
| 1. Very low (Primitive level) | - | - |
| 2. Relatively low (Traditional level) | 2 | 5.0 |
| 3. Normal/Average (Local level) | 22 | 55.0 |
| 4. Relatively high (National level) | 10 | 25.0 |
| 5. High (International level) | 5 | 12.5 |
| 6. Extremely high (Exportable level) | 1 | 2.5 |
| Total | 40 | 100.0 |

Accordingly, this survey is considered to have covered a wider range of enterprises from extremely high to relatively low technical levels.

3) Production Facilities and Measuring instruments:

The cost and quality of product greatly depend upon the efficiency and accuracy of production facilities.

Since checks on dimensions, angles, profile and surface conditions (roughness, hardness) during or after processing are an important point to improve the accuracy of products, it is interesting to know the kind of measuring instruments being put to use.

i. Production Facilities:

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

ii. Measuring Instruments:

The maintenance state of measuring instruments in each firm is shown together with the frequency of answers in Table 4.5.5 (34). (Q42-01-01)

Length and Flatness:

Most of the firms keep tape measures, straight edges, calipers, etc. and possession of micrometers (65.3%), dial gauges (28.6%), etc. belongs to a relatively satisfactory side from the viewpoint of the industrial level of Thailand. Some firms use, though small in number, such instruments as cylinder gauges (10.2%), precision levels (6.1%), depth meters (10.2%), thickness gauges (10.2%) and others, that are indispensable for highly accurate measurement.

In particular, there are two firms keeping special purpose gauges (jigs). They appear to have been ranked as international class under the interviewer's assessment of technical level.

Angle, Squareness and Parallelism:

Measuring instruments for this purpose cover squares, angle plates, combination square sets, etc. up to high-precision ones, through small in number.

Profile:

Not many firms keep screw pitch gauges (20.4%), radius and taper gauges (10.2% each), gear tooth and drill gauges (6.1% each) and the like.

Temperature:

All the answers given were only "thermo-electric thermometer" (8.2%), "temperature recorder" (6.1%), "etched-stem thermometer" and "resistance thermometer" (2% each). This fact clarifies that temperature is hardly included in the object of measurement.

Surface Hardness:

In view of the status of "Rockwell tester" (10.2%), "Brinell tester", "Vickers tester" (4.1% each) and "Shore tester" (2.0%), surface hardness check does not appear to be conducted sufficiently.

Table 4.5.5 (34) Measuring Instrument

(Q42-01-01)

| | Freq | % |
|---|---|---|
| Length/Flatness | | |
| 1. Tape measure | 35 | 71.4 |
| 2. Carpenter ruler | 21 | 42.9 |
| 3. Steel ruler | 45 | 91.8 |
| 4. Caliper | 36 | 73.5 |
| 5. Varier Caliper | 37 | 75.5 |
| 6. Micrometer | 32 | 65.3 |
| 7. Depth meter | 5 | 10.2 |
| 8. Dial gauge | 14 | 28.6 |
| 9. Cylinder gauge | 4 | 8.2 |
| 10. Optimeter | 1 | 2.0 |
| 11. Microscope | 2 | 4.1 |
| 12. Thickness caliper | 6 | 12.2 |
| 13. Precision level | 3 | 6.1 |
| 14. Special purpose gauge (jig) | 2 | 4.1 |
| 15. Thickness gauge | 5 | 10.2 |
| Angle/Squareness/Parallelism | | |
| 21. Angle plate | 18 | 36.7 |
| 22. Steel protoractor | 10 | 20.4 |
| 23. Universal benel protoractor | 5 | 10.2 |
| 24. Square | 22 | 44.9 |
| 25. Straight edge | 2 | 4.1 |
| 26. Combination square set | 6 | 12.2 |
| 27. Micro protoractor | 1 | 2.0 |
| 28. Optical protoractor | 1 | 2.0 |
| 29. Iron level | - | - |
| 30. Precision level | 1 | 2.0 |
| 31. Box precision level | 1 | 2.0 |
| Profile | | |
| 32. Radius gauge | 5 | 10.2 |
| 33. Screw pitch gauge | 10 | 20.4 |
| 34. Taper gauge | 5 | 10.2 |
| 35. Drill gauge | 3 | 6.1 |
| 36. Gear tooth gauge | 3 | 6.1 |
| 37. Projector | 1 | 2.0 |
| 38. Roundness tester | 1 | 2.0 |
| Temperature | | |
| 41. Etched-stem thermometer | 1 | 2.0 |
| 42. Thermo-electric thermometer | 4 | 8.2 |
| 43. Registance thermometer | 1 | 2.0 |
| 44. Optical pyrometer | - | - |
| 45. Surface thermometer | - | - |
| 46. Temperature recorder | 3 | 6.1 |
| 47. Immersion pyrometer | - | - |

| | Freq | % |
|---|---|---|
| Hardness | | |
| 51. Brinell tester | 2 | 4.1 |
| 52. Vickers tester | 2 | 4.1 |
| 53. Rockwell tester | 5 | 10.2 |
| 54. Shore tester | 1 | 2.0 |
| 55. Harnester | 2 | 4.1 |
| Machined surface roughness | | |
| 61. Standard piece for surface roughness (Surface roughness scale) | 2 | 4.1 |
| 62. Optical roughness tester | 1 | 2.0 |
| 63. Electrical roughness tester | - | - |
| 64. Interference roughness tester | - | - |
| 65. Surface measuring instrument | - | - |
| Electric performance testing | | |
| 71. Wattmeter | 8 | 16.3 |
| 72. Voltmeter | 17 | 34.7 |
| 73. Ammeter | 18 | 36.7 |
| 74. Power-factor meter | 2 | 4.1 |
| 75. Torque meter | 1 | 2.0 |
| 76. Insulation resistance meter | 3 | 6.1 |
| Testing | | |
| 81. Colour checker | 2 | 4.1 |
| 82. Magna flux tester | - | - |
| 83. Ultra-sonic tester | 1 | 2.0 |
| 84. Tensile strength tester | 1 | 2.0 |
| 85. Chemical analyser | 1 | 2.0 |
| 86. Tachometer | - | - |
| 87. Stop watch | 2 | 4.1 |
| 88. Dynamometer | 1 | 2.0 |
| 89. Noise meter | - | - |
| 90. Vibrometer | - | - |
| 91. Stroboscope | - | - |
| Miscellaneous | | |
| 95. Surface plate | 6 | 12.2 |
| 96. V-block | 8 | 16.3 |
| 97. Magnetic V-block | 2 | 4.1 |
| 98. Surface gauge | 4 | 8.2 |
| Total | 49 | 907.4 |

Surface Roughness:

In view of the status of "surface roughness scale" and "optical roughness tester" (3 firms in total), it can be safely said that no surface roughness control takes place.

Electric Performance Testing:

Instruments being kept for this purpose are classified into "ammeter" (36.7%), "voltmeter" (34.7%), "wattmeter" (16.3%) and a small quantity of power factor meter, torque meter, insulation resistance meter, etc.

Testing and Inspection:

Answers consist of "colour checker", "stop watch" (2 firms each), "ultrasonic tester", "tensile strength tester", "chemical analyzer" and "dynamometer" (1 firm each).

Others:

Answers consist of "surface plate" (12.2%), "V-block" (16.3%) and "magnetic V-block" (2.1%).

From the above results, measurement of length, flatness, angle, etc. can be made to a relatively high accuracy, but checks for surface hardness and roughness, that are indispensable for precision components, are insufficient.

Though temperature measuring and electric performance testing instruments depend upon products to be manufactured, it is considered that testing and inspection instruments should be further supplemented. Quantity of surface plate and jigs for manufacturing and inspection is small through being adopted by a part of firms. As these offer a relatively higher effect than the amount of investment, it is desirable to conduct guidance to their application positively.

4) Product Inspection and Quality Control

Table 4.5.5 (35) shows answers to questions on quality control system including inspection systems, inspectors, checking items and feedback of the result, which were raised to grasp the situation of product inspection. (Q46-01-01)

Table 4.5.5 (35) Inspection System and Feed Back System (Q46-01-01)

| | Freq | % |
|---|---|---|
| The inspection system is (are): | | |
| 1. Systematic inspections are not available, "When trouble occurs check" | 12 | 25.0 |
| 2. First articles inspection | 3 | 6.3 |
| 3. Single sampling inspection | 4 | 8.3 |
| 4. Multiple sampling inspection | 13 | 27.1 |
| 5. Sequantial sampling inspection | 2 | 4.2 |
| 6. Total (100%) inspection | 21 | 43.8 |
| 7. Without acceptance or purchasing inspection | - | - |
| 8. With acceptance or purchasing inspection by standard inspection documents | - | - |
| Whom is it inspected by? | | |
| 11. Workers themselves | 26 | 54.2 |
| 12. Manager or the owner | 23 | 47.9 |
| 13. Professional staff, patrol | 7 | 14.6 |
| 14. Professional staff, stationary | 4 | 8.3 |
| Checking methods and items are: | | |
| 21. Visual check | 31 | 64.6 |
| 22. Sensory check | 5 | 10.4 |
| 23. Dimensional check | 32 | 66.7 |
| 24. Clearance check for moving parts | 21 | 43.8 |
| 25. Hardness check | 7 | 14.6 |
| 26. Surface roughness check | 4 | 8.3 |
| 27. Colour check | 3 | 6.3 |
| 28. X-ray check | - | - |
| 29. Magna flux check | - | - |
| 30. Noise check | 2 | 4.2 |
| 31. Vibration check | 4 | 8.3 |
| 32. Life test/running test | 4 | 8.3 |
| Feedbackd of the results of inspection is: | | |
| 41. Only in file, no feed back | 7 | 14.6 |
| 42. Notice on the boad | 5 | 10.4 |
| 43. Circulating notice or inspection record to workers/managers | 20 | 41.7 |
| 44. Establishing counter measures by workers/managers | 6 | 12.5 |
| 45. Establishing counter measures by professional staff, statistical quality control system | 2 | 4.2 |
| Total | 48 | 558.6 |

Product Inspection System:

Product inspection system is classified into "total inspection" (43.8%), "when trouble occurs check" (25%), "multiple sampling inspection" (27.1%), "single sampling inspection" (8.3%), etc.

Inspectors:

Inspectors are classified into "workers themselves" (54.2%, about a half of the firms), followed by "manager or the owner" (47.9%).

In addition, there were such answers as "full-time inspection staff, patrol" (14.6%) and "full-time inspection staff, stationary" (8.3%).

Checking Items and Methods:

Checks conducted are classified into "dimensional check" (66.7%), "clearance check for moving parts" (43.8%), "hardness check" (14.6%), "surface roughness check" (8.3%), etc. Though some firms are conducting "life test/running test", there are no firms conducting X-ray check and magna flux check for internal defects of materials. Inspection by "visual check" (64.6%) and "sensory check" (10.4%) is also conducted generally.

Feedback of Inspection Results:

The majority gave such answers as "circulating notice or inspection record to workers/managers" (41.7%) and "notice on the board" (7.7%), but a relatively large number of firms also answered "only in file, no feedback" (14.6%).

When establishing countermeasures some firms rely upon "workers/ managers" (12.5%) and "full-time staff" (4.2%) and attention is drawn, in particular, to the latter, though small in number.

Inspection Records:

About 1/3 of the firms keep "nothing" (34.0%) but those who keep inspection records are classified into mainly "dimension check records" (51.1%), "visual inspection records" (42.6%), "material test records" (17.0%), etc. There are some firms though small in number, who keep "material analysis records" (8.5%), "heat treatment records" (8.5%), "statical test records" (10.6%), "dynamic test records" (6.4%), etc. These firms belong to a relatively high grade side from the viewpoint of the current technical level of Thailand.

Table 4.5.5 (36)
Inspection Record
(Q49-08-01)

| | Freq | % |
|---|---|---|
| 1. Nothing | 16 | 34.0 |
| 2. Visual inspection records | 20 | 42.6 |
| 3. Dimension check records | 24 | 51.1 |
| 4. Colour check records | 3 | 6.4 |
| 5. X-ray, ultrasonic, magna-flux test records | - | - |
| 6. Material test records | 8 | 17.0 |
| 7. Material analysis records | 4 | 8.5 |
| 8. Heat treatment records | 4 | 8.5 |
| 9. Statical operation test records | 5 | 10.6 |
| 10. Dynamical operation test records | 3 | 6.4 |
| 11. Others (Specify) | 1 | 2.1 |
| Total | 47 | 187.2 |

Table 4.5.5 (37)
Shipping Inspection for
Subcontracted Products
(Q49-07-01)

| | Freq | % |
|---|---|---|
| 1. None | 12 | 27.9 |
| 2. Permanent check by subcontractor's staff before delivery | 15 | 34.9 |
| 3. Temporary check by subcontractor's staff before delivery | 5 | 11.6 |
| 4. Visual check after delivery | 2 | 4.7 |
| 5. Inspection records check after delivery | 6 | 14.0 |
| 6. Self-management of subcontractee | 3 | 6.9 |
| 7. Others (Specify) | - | - |
| Total | 43 | 100.0 |

Shipping Inspection System for Subcontracted Goods:

Answers to this question is classified into "permanent check by contractor's staff before delivery" (34.9%), "temporary check" (11.6%), "inspection records check after delivery" (14%), etc., but about 1/4 of the firms answered "none".

A few firms rely on "self-management of subcontractor" (6.9%).

5) Price and Delivery

i. Price:

As price is decided "after comparing market price" (48.9%), price level is equal to "market price" (64.0%) or "1-10% higher" (12%).

Some firms answered "11-20% higher" (10%) and "31% and above higher" (one firm) than market price under such price systems as short term agreement, self-estimation, cost accounting, etc. Another answer was "less than market price" given by some firms (12%). (Table 4.5.5 (38), Q27-01-01, Table 4.5.5 (39), Q24-01-01)

Table 4.5.5 (38)
Decision Making of
Price (Q27-01-01)

| | Freq | % |
|---|---|---|
| 1. Same as quotation/estimation of subcontractee | 7 | 14.9 |
| 2. After comparing with self-estimation (target price) | 9 | 19.1 |
| 3. After comparing market price | 23 | 48.9 |
| 4. Short term agreement of price (Less than 6 months) | 7 | 14.9 |
| 5. Long term agreement of price (More than 6 months) | 1 | 2.2 |
| 6. Others (Specify) | - | - |
| Total | 47 | 100.0 |

Table 4.5.5 (39)
Assessment of Price
(Q24-01-01)

| | Freq | % |
|---|---|---|
| 1. 31% and above higher | 1 | 2.0 |
| 2. 21% - 30% higher | - | - |
| 3. 11% - 20% higher | 5 | 10.0 |
| 4. 1% - 10% higher | 6 | 12.0 |
| 5. Market price | 32 | 64.0 |
| 6. Less than market price | 6 | 12.0 |
| Total | 50 | 100.0 |

ii. Delivery:

Instruction of delivery time from the contractor is classified into "verbal instruction only" (47.6%), followed by" by purchase order specification" (33.3%) and "by short term agreement" (11.9%).

A couple of firms answered "none" (4.8%). (Table 4.5.5 (40), Q34-01-01)

Table 4.5.5 (40) Instruction of Delivery Time from the Contractor (Q34-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 2 | 4.8 |
| 2. Yes, verbal instruction only | 20 | 47.6 |
| 3. Yes, by purchase order specification | 14 | 33.3 |
| 4. Yes, by short term agreement | 5 | 11.9 |
| 5. Yes, by long term agreement | 1 | 2.4 |
| 6. Others (Specify) | - | - |
| Total | 42 | 100.0 |

Frequency of delayed delivery is classified into "sometimes" (51.2%), "rarely" (16.3%), "very rare" (11.6%) and "not at all" (13.9%) (Table 4.5.5 (41), Q36-01-01), while average term of delayed delivery is "four days to one week" (53.7%), "less than three days" (26.8%) and "two to four weeks" (19.5%). There is no delay of "more than one month". (Table 4.5.5 (42), Q37-01-01)

Table 4.5.5 (41)
Delayed Delivery
(Q36-01-01)

| | Freq | % |
|---|---|---|
| 1. Very often | 3 | 7.0 |
| 2. Sometimes | 22 | 51.2 |
| 3. Rarely | 7 | 16.3 |
| 4. Very rare | 5 | 11.6 |
| 5. Not at all | 6 | 13.9 |
| 6. Others (Specify) | - | - |
| Total | 43 | 100.0 |

Table 4.5.5 (42)
Term of Delayed Delivery
(Q37-01-01)

| | Freq | % |
|---|---|---|
| 1. Less than 3 days | 11 | 26.8 |
| 2. 4 days to one week | 22 | 53.7 |
| 3. 2 to 4 weeks | 8 | 19.5 |
| 4. 1 month to 2 months | - | - |
| 5. 3 months to 4 months | - | - |
| 6. More than 5 months | - | - |
| Total | 41 | 100.0 |

Cause of delayed delivery is classified into "poor process schedule" (31.6%), "delay of raw materials", "shortage of manpower" (28.9% each), "delay of design engineering" (10.5%), "shortage of delivery time" (21.1%), etc. (Table 4.5.5 (43), Q39-01-01)

Table 4.5.5 (43)
Causes of Delayed Delivery
(Q39-01-01)

| | Freq | % |
|---|---|---|
| 1. Poor process schedule | 12 | 31.6 |
| 2. Delay of raw materials | 11 | 28.9 |
| 3. Shortage of delivery time | 8 | 21.1 |
| 4. Shortage of manpower | 11 | 28.9 |
| 5. Delay of design engineering | 4 | 10.5 |
| 6. Defect/Reject of delivery goods | - | - |
| 7. Others (Specify) | 2 | 5.3 |
| Total | 38 | 126.3 |

Table 4.5.5 (44)
Preventive Measures for
Delayed Delivery
(Q35-01-01)

| | Freq | % |
|---|---|---|
| 1. No action | 10 | 24.4 |
| 2. Occasional check of deference between planned & actual schedule | 15 | 36.6 |
| 3. Weekly check of deference between planned & actual schedule | 3 | 7.3 |
| 4. Daily check of deference between planned & actual schedule | 9 | 22.0 |
| 5. Permanent follow up of necessary action by special staff | 4 | 9.7 |
| 6. Others (Specify) | - | - |
| Total | 41 | 100.0 |

Preventive measures for delayed delivery are classified into "occasional check of difference between planned and actual schedule" (36.6%), "daily check of difference between planned and actual schedule" (22.0%) and "no action" (24.4%).

Another answer was "permanent follow up of necessary action by special staff" (9.7%). (Table 4.5.5 (44), Q35-01-01)

6) Managerial Aspect

i. Management:

Profit management system is classified into "check as a whole business" (44.7%), "profit and loss account" (23.4%), "every business for each product" (21.3%), etc. There was also "break even point" (31.9%). (Table 4.5.5 (45), Q71-01-01)

Table 4.5.5 (45)
Profit Management
(Q71-01-01)

| | Freq | % |
|---|---|---|
| 1. Check as a whole business | 21 | 44.7 |
| 2. Every business for main products | 8 | 17.0 |
| 3. Every business for each products | 10 | 21.3 |
| 4. Deference between standard cost & actual cost | 7 | 14.9 |
| 5. Break even point | 15 | 31.9 |
| 6. Profit & loss calculation/ account | 11 | 23.4 |
| 7. Others (Specify) | - | - |
| Total | 47 | 153.2 |

Table 4.5.5 (46)
Terms of Profit Management
(Q72-01-01)

| | Freq | % |
|---|---|---|
| 1. Annually | 34 | 70.8 |
| 2. Every six months | 7 | 14.6 |
| 3. Monthly | 4 | 8.3 |
| 4. Weekly | - | - |
| 5. Daily | 2 | 4.2 |
| 6. Others (Specify) | 1 | 2.1 |
| Total | 48 | 100.0 |

Profit management is carried out overwhelmingly "annually" (70.8%), "every six months" (14.6%) and "monthly" (8.3%).

It is also carried out "daily" by two firms (4.2%). (Table 4.5.5 (46), Q72-01-01)

While it is natural that great importance is attached to direct cost such as material cost, labor cost, etc. (41.7%, 47.9% respectively), cost accounting is carried out for each product in terms of overhead, profit, depreciation, etc.

However, not many firms raised "sales charge" and "fixed cost" (10.4% and 4.2% respectively). (Table 4.5.5 (48), Q73-01-01)

Table 4.5.5 (47)
Breakdown of Accounting System (Q23-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 10 | 20.8 |
| 2. Every kinds of products | 13 | 27.1 |
| 3. Every kinds of parts & compartments | 14 | 29.2 |
| 4. Material cost | 20 | 41.7 |
| 5. Labour cost | 23 | 47.9 |
| 6. Direct cost/Indirect cost | 12 | 25.0 |
| 7. Overhead | 10 | 20.8 |
| 8. Sales charge | 5 | 10.4 |
| 9. Profit | 7 | 14.6 |
| 10. Depreciation | 9 | 18.8 |
| 11. Fixed cost | 2 | 4.2 |
| 12. Variable cost | 4 | 8.3 |
| 13. Others (Specify) | 1 | 2.1 |
| Total | 48 | 270.9 |

Table 4.5.5 (48)
Management Policy to be Developed (Q73-01-01)

| | Freq | % |
|---|---|---|
| 1. R & D of product | 24 | 52.2 |
| 2. R & D of technology | 28 | 60.9 |
| 3. Productivity | 21 | 45.7 |
| 4. Expansion of market share | 20 | 43.5 |
| 5. Upgrading qualification | 7 | 15.2 |
| 6. Diversification of products | 4 | 8.7 |
| 7. Own capital | 7 | 15.2 |
| 8. Labour cost | 10 | 21.7 |
| 9. Material cost | 14 | 30.4 |
| 10. Capital cost | 4 | 8.7 |
| 11. Overhead cost | 7 | 15.2 |
| 12. Production control | 10 | 21.7 |
| 13. Process control | 4 | 8.7 |
| 14. Design engineering | 8 | 17.4 |
| 15. Cost control | 11 | 23.9 |
| 16. Quality control | 18 | 39.1 |
| 17. Human resources | 5 | 10.9 |
| 18. Training of workers | 10 | 21.7 |
| 19. Others (Specify) | - | - |
| Total | 46 | 460.8 |

Main management policy to be developed is classified into business expansion by positive measures such as "R&D of technology" (60.9%), "R & D of product" (52.2%), "improving productivity" (45.7%), "increase of market share" (43.5%), etc. and steady improvement in basic sector such as "quality control" (39.1%), "material cost" reduction (30.4%), "cost control" (23.9%), etc. (Table 4.5.5 (48), Q73-01-01)

Answers to question on organization chart were not given by specifically written documents but are mainly classified into "verbal function only" (27.5%) and "verbal job classification only" (33.3%). Firms having organization chart are classified into "chart with line function" (11.8%) and "chart with line function and job classification". (Table 4.5.5 (49), Q12-01-01)

There were a few answers "none" (7.8%).

Table 4.5.5 (49) Organization Chart
(Q12-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 4 | 7.8 |
| 2. Verbal function only | 14 | 27.5 |
| 3. Verbal job classification only | 17 | 33.3 |
| 4. Chart with line function | 6 | 11.8 |
| 5. Chart with job | 4 | 7.8 |
| 6. Chart with line function and job classification | 6 | 11.8 |
| 7. Others (Specify) | - | - |
| Total | 51 | 100.0 |

Training system for employees is classified into "man to man (OJT)" (49.0%), "whenever necessary (inhouse)" (43.1%), etc. A few firms gave such answers as "attend to training course/seminar/ workshop (outside)" (7.8%) and "periodically according to planned scheme" (5.8%).

It is the current situation in Thailand that the training system for employees, though its importance is recognized, is not put into practice generally due to a high turn-over rate.

Table 4.5.5 (50)
Training System
(Q14-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 9 | 17.6 |
| 2. Man to man (OJT) | 25 | 49.0 |
| 3. Whenever necessary (Inhouse) | 22 | 43.1 |
| 4. Attend to training course/ seminar/workshop (Outside) | 4 | 7.8 |
| 5. Periodically according to planned scheme | 3 | 5.9 |
| 6. Others (Specify) | - | - |
| Total | 51 | 123.4 |

Table 4.5.5 (51)
Market Survey
(Q29-01-01)

| | Freq | % |
|---|---|---|
| Market tendency | | |
| 1. Competitors | 10 | 27.0 |
| 2. Selling prices | 19 | 51.4 |
| 3. Purchasing prices, raw materials, key parts/component | 15 | 40.5 |
| 4. Quality | 20 | 54.1 |
| 5. Subcontractors | 4 | 10.8 |
| 6. New technology | 8 | 21.6 |
| Demand situation | | |
| 7. Total demand | 1 | 2.7 |
| 8. Domestic output/Export | 1 | 2.7 |
| 9. Import | 1 | 2.7 |
| Total | 37 | 213.5 |

Out of 51 firms, 37 firms gave the answer "yes" to the question "whether or not market survey has so far been made".

Breakdown of all answers is given in Table 4.5.5 (51), Q29-01-01, which is classified into "quality" of competitive products (54.1%), "selling prices" (51.4%), "purchasing prices, raw materials, key parts/component" (40.5%), "competitors" (27.0%), "new technology" and "subcontractors".

For demand situation, only one firm each raised "total demand", "domestic output/export" and "import" respectively.

ii. Subcontractor/Contractor:

a) Purpose of Getting Subcontract Job

Main purposes to get subcontracting job are classified mainly into "stable business performance" (62.5%), "increase of market" (37.5%) and "own conveniences" (27.5%). Some firms raised "technology transfer" (12.5%), "coexistence and coprosperity" (10.0%), "promotion of specialization" (7.5%), etc. (Table 4.5.5 (52), Q70-01-01)

Table 4.5.5 (52) Main Proposes to Get Subcontracting Job (Q70-10-01)

| | Freq | % |
|---|---|---|
| 1. Stable business performance | 25 | 62.5 |
| 2. Increase of market | 15 | 37.5 |
| 3. Technology transfer | 3 | 12.5 |
| 4. Training of employee | - | - |
| 5. Promotion of specialization | 3 | 7.5 |
| 6. Own conveniences | 11 | 27.5 |
| 7. Stable supply of raw materials | 2 | 5.0 |
| 8. Information sources | 2 | 5.0 |
| 9. Coexistence and coprosperity | 4 | 10.0 |
| 10. Others (Specify) | - | - |
| Total | 40 | 167.5 |

b) Subcontracting Job from Contractor to Subcontractor

Contractor is classified into "companies of the larger scale" (55.8%), "companies of the same scale" (18.6%), "parent company/affiliated company" (27.9%), "government organization" (25%), etc.

Out of 16 firms that gave answers to a question on subcontractor, six firms (37.5%), five firms (31.3%) and four firms (25%) raised "companies of the same scale", "parent company/affiliated company" and "companies of the larger scale" respectively. (Table 4.5.5 (53), Q70-01)

Distance up to contractors falls within a relatively short range such as "less than 10 km " (24.4%), "11-20 km " (29.3%) and "21-40 km" (14.6%), namely, the total share of "less than 40 km" is amounting to 68.3%.

Some firms answered "more than 151 km" (14.6%). (Table 4.5.5 (54), Q70-11-01)

Table 4.5.5 (53)
Sub-contracting Job To/From
(Q70-01-01)

| | 01-01 From | | 01-02 To | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Not applicable | 4 | 9.3 | 2 | 12.5 |
| 2. Parent company/Affiliated company | 12 | 27.9 | 5 | 31.3 |
| 3. Companies of the same scale | 8 | 18.6 | 6 | 37.5 |
| 4. Companies of the larger scale | 24 | 55.8 | 4 | 25.0 |
| 5. Government organization | 11 | 25.6 | - | - |
| 6. Companies with foreign equity | 4 | 9.3 | - | - |
| 7. Others, specify _____ | 4 | 9.3 | 1 | 6.3 |
| Total | 43 | 155.8 | 16 | 112.6 |

Table 4.5.5 (54)
Distance up to the Contractor
(Q70-11-01)

| | Freq | % |
|---|---|---|
| 1. Less than 10 km | 10 | 24.4 |
| 2. 11 - 20 km | 12 | 29.3 |
| 3. 21 - 40 km | 6 | 14.6 |
| 4. 41 - 80 km | 4 | 9.8 |
| 5. 81 - 150 km | 3 | 7.3 |
| 6. More than 151 km | 6 | 14.6 |
| Total | 41 | 100.0 |

c) Minimum Order Scale and Payment Terms

Minimum order scale is mostly as small as "less than 10 pieces" (70.7%) and "10-50 pieces" (12.2%). (Table 4.5.5 (55), Q70-12-01)

Payment terms are classified into "credit (two to three months)" (40.8%), "cash and credit" (34.7%), "cash on delivery" (12.2%), etc. and only one firm raised "credit (four to six months)".

Table 4.5.5 (55)
Minimum Order Scale
(Q70-12-01)

| | Freq | % |
|---|---|---|
| 1. Less than 10 pieces | 29 | 70.7 |
| 2. 10 - 50 pieces | 5 | 12.2 |
| 3. 51 - 100 pieces | 2 | 4.9 |
| 4. 101 - 1,000 pcs | 2 | 4.9 |
| 5. 1,001 - 10,000 pcs | 3 | 7.3 |
| 6. More than 10,001 | - | - |
| Total | 41 | 100.0 |

Table 4.5.5 (56)
Payment Products
(Q26-01-01)

| | Freq | % |
|---|---|---|
| 1. Cash on delivery | 6 | 12.2 |
| 2. Cash + Credit | 17 | 34.7 |
| 3. Credit (Less than 1 month) | 5 | 10.2 |
| 4. Credit (2 to 3 months) | 20 | 40.8 |
| 5. Credit (4 to 6 months) | 1 | 2.1 |
| 6. Others (Specify) | - | - |
| Total | 49 | 100.0 |

d) Motivation of Receiving Orders for and Order Route of Subcontracting Job

Motivation of receiving orders for subcontracting job in classified into "relationship between owners/managers" (55.9%), "by own market cultivation" (26.5%), "introduction by an influential man" (14.7%), etc. Some firms raised "neighbour" and "relatives". (Table 4.5.5 (57), Q70-15). Order route of subcontracting job is mainly "directly through contractor" (83.3%), so that middlemen and traders/dealers are not much involved in the order route. (Table 4.5.5 (58), Q70-13)

Table 4.5.5 (57)
Motivation to the Initial Stage with the Contractor/ Sub- (Q70-15)

| | 15-01 Sub-contractor | | 15-02 Sub-contractee | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Neighbour | 2 | 5.9 | 2 | 8.3 |
| 2. Realtives | 2 | 5.9 | 2 | 8.3 |
| 3. Relationship between owners/managers | 19 | 55.9 | 16 | 66.7 |
| 4. Introduction by an influential man | 5 | 14.7 | 2 | 8.3 |
| 5. By own market cultivation | 9 | 26.5 | 2 | 8.3 |
| 6. Others (Specify) | 2 | 5.9 | 1 | 4.2 |
| Total | 34 | 114.8 | 24 | 104.1 |

Table 4.5.5 (58)
Order Route of Sub-contracting Job (Q70-13)

| | 13-01 In | | 13-02 Out | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Through middleman | 5 | 13.2 | 1 | 5.6 |
| 2. Through trader/dealer | 4 | 10.5 | 1 | 5.6 |
| 3. From market | 9 | 23.7 | 1 | 5.6 |
| 4. Through subcontractor's introducer | 1 | 2.6 | 1 | 5.6 |
| 5. Directly through sub-contractor | 30 | 78.9 | 15 | 83.3 |
| 6. Others (Specify) | 2 | 5.3 | - | - |
| Total | 38 | 134.2 | 18 | 105.7 |

e) Description of Assistance from Contractor to Subcontractor

Description of assistance received from contractor is classified into "capital investment", "engineering services", "supply of raw material", "provision of loans", "start-up advice", etc. Some firms, though small in number, raised "trouble shooting", "sequential advice", "expert dispatch", etc. "No advice" is also amounting to 41.4%. (Table 4.5.5 (59), Q70-02)

On the other hand, description of assistance given to subcontractor is classified into "engineering services" (15.8%), "trouble shooting" (21.1%), "supply of indigenous raw material" (10.5%), etc. together with "no advice" which is as high as 52.6%.

Answers to a question as to whether these items of assistance have been valid are shown in Table 4.5.5 (60), Q70-03.

Regarding the assistance received, there are a number of affirmative answers such as "normally effective" (37.5%), "relatively good" (20.8%), and "good" (29.2%). Regarding the various kind of assistance extended to subcontractors, it is natural that self-assessment centered on "normally effective", "relatively good" and "good", instead of "relatively poor" and "very poor".

Table 4.5.5 (59)
Assistance, Get/Give for Subcontracting Job (Q70-02)

| | 02-01 Get | | 02-02 Give | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Capital investment | 4 | 13.8 | 2 | 10.5 |
| 2. Provision of loans | 3 | 10.3 | - | - |
| 3. Machine & equipment procurement/supply | - | - | 1 | 5.3 |
| 4. Expert dispatch | 1 | 3.4 | 1 | 5.3 |
| 5. Engineering services | 4 | 13.8 | 3 | 15.8 |
| 6. Supply of indigenous raw material | 4 | 13.8 | 2 | 10.5 |
| 7. Supply of imported raw material | 1 | 3.4 | 1 | 5.3 |
| 8. Training of workers | - | - | 1 | 5.3 |
| 9. Costing | 1 | 3.4 | - | - |
| 10. Trouble shooting | 2 | 6.9 | 4 | 21.1 |
| 11. Follow up cell | 1 | 3.4 | 2 | 10.5 |
| 12. Utilities, consumables | - | - | - | - |
| 13. License | - | - | - | - |
| 14. Start-up advice | 3 | 10.3 | 1 | 5.3 |
| 15. Sequencial advice | 1 | 3.4 | 2 | 10.5 |
| 16. No advice | 12 | 41.4 | 10 | 52.6 |
| 17. Others (Specify): ____ | 1 | 3.4 | - | - |
| Total | 29 | 130.7 | 19 | 158.0 |

Table 4.5.5 (60)
Asssessment after Assistance Gotten Given (Q70-03)

| | 03-01 Gotten | | 03-02 Given | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Very poor | 2 | 8.3 | - | - |
| 2. Relatively poor | 1 | 4.2 | - | - |
| 3. Normally effective | 9 | 37.5 | 4 | 36.4 |
| 4. Relatively good | 5 | 20.8 | 5 | 45.5 |
| 5. Good | 7 | 29.2 | 2 | 18.1 |
| 6. Excellent | - | - | - | - |
| 7. Others | - | - | - | - |
| Total | 24 | 100.0 | 11 | 100.0 |

f) Guaranty of Subcontracted Products

Guaranty of subcontracted products is classified into "none" (41.5%), the highest figure), "replacement only at delivery" (29.3%), "less than three months" (7.3%), "3~6 months" (9.8%), "one year" (9.8%) and "more than one year" (2.3%), (Table 4.5.5 (61), Q60-07-01). These figures clarify the fact that no guaranty is applied or any guaranty, even if applied, is limited to an extremely short period in this country.

Aftercare of claims is classified into "by manager" (26.8%), "by owner" (19.5%), "by marketing/production staff" (14.6%), etc. The answer "none" is amounting to as high as 39%. (Table 4.5.5 (62), Q70-08-01)

Table 4.5.5 (61)
Guaranty of Subcontracted Products (Q70-07-01)

| | Freq | % |
|---|---|---|
| 1. None | 17 | 41.5 |
| 2. Replacement/correction only at delivery time | 12 | 29.3 |
| 3. Less than three months | 3 | 7.3 |
| 4. Three to six months | 4 | 9.8 |
| 5. One year | 4 | 9.8 |
| 6. More than one year | 1 | 2.3 |
| Total | 13 | 100.0 |

Table 4.5.5 (62)
Aftercare of Claims (Q70-08-01)

| | Freq | % |
|---|---|---|
| 1. None | 16 | 39.0 |
| 2. Marketing staff | 2 | 4.9 |
| 3. Marketing/Production staff | 6 | 14.6 |
| 4. Manager | 11 | 26.8 |
| 5. Owner | 8 | 19.5 |
| 6. Others (Specify) | 1 | 2.4 |
| Total | 41 | 107.2 |

g) Preferable Relationship with Contractor and Subcontractor

Preferable contractor from the viewpoint of subcontractor is classified into "companies of the larger scale" (61.5%), "government organization" (23.1%), "companies with foreign equity" (15.4%), "companies of the same scale" (12.8%), etc. (Table 4.5.5 (63), Q70-16)

On the other hand, preferable subcontractor from the viewpoint of contractor is classified into "companies of the larger scale", "companies of the same scale" (25% each) and "parent company/affiliated company" (18.8%).

Table 4.5.5 (63) Preferable Subcontracting Job From/To (Q70-16)

| | 16-01 From | | 16-02 To | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Not applicable | 3 | 7.7 | 3 | 18.8 |
| 2. Parent company/ Affiliated company | 4 | 10.3 | 3 | 18.8 |
| 3. Companies of the same scale | 5 | 12.8 | 4 | 25.0 |
| 4. Companies of the larger scale | 24 | 61.5 | 4 | 25.0 |
| 5. Government organisation | 9 | 23.1 | 1 | 6.3 |
| 6. Companies with foreign equity | 6 | 15.4 | 1 | 6.3 |
| 7. Others, specify _____ | - | - | 1 | 6.3 |
| Total | 39 | 130.8 | 16 | 106.5 |

For future policy for receiving subcontracting job order, most of the answers are "as same as present level" (53.8%), but there are also two opposing opinions such as "gradual increase" (25.6%) and "gradual decrease" (17.9%).

The firms that gave the answer "gradual decrease" are considered that they wish to uplift their abilities so as to quit subcontractor's business. (Table 4.5.5 (64), Q70-09-01, Table 4.5.5 (65), Q70-14)

Table 4.5.5 (64)
Future Plan for Subcontract in (Q70-09-01)

| | Freq | % |
|---|---|---|
| 1. Rapid decrease | - | - |
| 2. Gradual decrease | 7 | 17.9 |
| 3. As same as present level | 21 | 53.8 |
| 4. Gradual increase | 10 | 25.6 |
| 5. Rapid expansion | - | - |
| 6. Others (Specify) | 1 | 2.7 |
| Total | 39 | 100.0 |

Table 4.5.5 (65)
Future Relationship with the Constractors/Sub-contractors (Q70-14)

| | 14-01 Sub-contractor | | 14-02 Sub-contractee | |
|---|---|---|---|---|
| | Freq | % | Freq | % |
| 1. Stop the new order | - | - | - | - |
| 2. Decrease of order | 4 | 11.8 | 4 | 15.4 |
| 3. Diversifying sub-contractor | 5 | 14.7 | 3 | 11.5 |
| 4. As it is | 19 | 55.9 | 17 | 65.4 |
| 5. More close tie up | 6 | 17.6 | 2 | 7.7 |
| 6. Others (Specify) | 1 | 2.9 | - | - |
| Total | 34 | 102.9 | 26 | 100.0 |

iii. Sources of Technical Informations:

For information sources, answers are classified in the order of those given at a higher percentage into "magazine (foreign)" (40.8%), "workshop" (36.7%), "exhibition" (34.7%), "magazine (local)" (30.6%), "consultant" (28.6%), "human network" (28.6%), etc. (Table 4.5.5 (66), Q49-04-01)

As for information sources, no great importance is attached to such organizations as Industrial Service Institute (ISI), university/college, etc.

According to the above results, it appears that the firms, object of survey, give attention to information from various foreign countries and participate even in seminar/society for scientific research/ exhibition positively.

Table 4.5.5 (66) Technical Information Sources
(Q49-04-01)

| | Freq | % |
|---|---|---|
| 1. Newspaper | 11 | 22.4 |
| 2. Magazine (Local) | 15 | 30.6 |
| 3. Magazine (Foreign) | 20 | 40.8 |
| 4. Seminar | 9 | 18.4 |
| 5. Workshop | 18 | 36.7 |
| 6. Exhibition | 17 | 34.7 |
| 7. Consultant | 14 | 28.6 |
| 8. Extension officer | 4 | 8.2 |
| 9. Circular | 4 | 8.2 |
| 10. Corporative | 6 | 12.2 |
| 11. Industrial Service Institute (ISI) of DIP | 3 | 6.1 |
| 12. Human network | 14 | 28.6 |
| 13. Subcontractor | 9 | 18.4 |
| 14. Other firms | 12 | 24.5 |
| 15. University/college | 2 | 4.1 |
| 16. Others (Specify) | 3 | 6.1 |
| Total | 49 | 328.6 |

7) Financial Aspect

Stock period of raw materials is relatively short such as "up to seven days" (26.1%), "8-30 days" (34.8%) and "1-2 months" (21.7%). Also, some firms gave "2-3 months" and "more than three months" (8.7% each). (Table 4.5.5 (58), Q60-00-01)

Those which take a long delivery time, such as imported materials, also take a long stock period.

It should be noted that there were three firms (6.5%) that have utilized the governmental low-interest credit assistance program. (Table 4.5.5 (68), Q60-01-01)

Table 4.5.5 (67)
Stock of Raw Material
(Q60-00-01)

| | Freq | % |
|---|---|---|
| 1. Up to 7 days | 12 | 26.1 |
| 2. 8 - 30 days | 16 | 34.8 |
| 3. 1 - 2 months | 10 | 21.7 |
| 4. 2 - 3 months | 4 | 8.7 |
| 5. More than 3 months | 4 | 8.7 |
| Total | 46 | 100.0 |

Table 4.5.5 (68)
Experience of the
Government Fund
(Q60-01-01)

| | Freq | % |
|---|---|---|
| 1. Yes | 3 | 6.5 |
| 2. No | 43 | 93.5 |
| Total | 46 | 100.0 |

Trend in Capital Investment:

Although several questions were raised as to the results of capital investment in the past five years classified by production facilities, machinery, estate, building structure (new acquirement or extension/remodeling), etc., most of the firms refrain from answering to these questions and it is difficult to grasp the trend. Judging from the status of firms at the time of visiting them, no brisk investment takes place. (Q61-02)

Investment in Research and Development:

Investment in research and development to sales is classified into "less than 0.5%" (14.9%), "0.6-1%" (10.6%), "1.1-2%" (17.0%), "2.1-3%" (4.3%) and "more than 3%" 27.7%.

On the other hand, about 1/4 of the firms gave the answer "none" to the question on investment in research and development.

Table 4.5.5 (69) Expence to the R & D Program to the Total Sales
(Q45-01-01)

| | Freq | % |
|---|---|---|
| 1. None | 12 | 25.5 |
| 2. Less than 0.5% | 7 | 14.9 |
| 3. 0.6% - 1% | 5 | 10.6 |
| 4. 1.1% - 2% | 8 | 17.0 |
| 5. 2.1% - 3% | 2 | 4.3 |
| 6. More than 3% | 13 | 27.7 |
| Total | 47 | 100.0 |

8) Preferable Government Assistances and Assessment of Existing Ones

Table 4.5.5 (70), Q72-01 shows the results of a questionnaire survey on the above subject.

Table 4.5.5 (70) Preferable government Assistance and Assessment of Existing Ones

(Q-74)

| | 1. Not useful | | 2. Useful | | 3. Very useful | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Freq | % | Freq | % | Freq | % | Freq | % |
| Development of infrastructure | | | | | | | | |
| 01-01. Access road | 1 | 7.1 | 2 | 14.3 | 11 | 78.6 | 14 | 100.0 |
| 01-02. Telecommunication | 2 | 12.5 | 5 | 31.3 | 9 | 56.2 | 16 | 100.0 |
| 01-03. Electric supply | 1 | 9.1 | 5 | 45.5 | 5 | 45.4 | 11 | 100.0 |
| 01-04. Water supply | 1 | 10.0 | 6 | 60.0 | 3 | 30.0 | 10 | 100.0 |
| 01-05. Central sewerage treating | 2 | 33.3 | 1 | 16.7 | 3 | 50.0 | 6 | 100.0 |
| 01-06. Pollution control | 1 | 11.1 | 4 | 44.4 | 4 | 44.5 | 9 | 100.0 |
| Technical/information services by public organization | | | | | | | | |
| 01-11. Training services | - | - | 7 | 36.8 | 12 | 63.2 | 19 | 100.0 |
| 01-12. Consultancy services | - | - | 4 | 28.6 | 10 | 71.4 | 14 | 100.0 |
| 01-13. Information services | - | - | 6 | 31.6 | 13 | 68.4 | 19 | 100.0 |
| 01-14. Testing services | - | - | 5 | 29.4 | 12 | 70.6 | 17 | 100.0 |
| 01-15. Laboratory | - | - | 3 | 33.3 | 6 | 66.7 | 9 | 100.0 |
| 01-16. Standardization | - | - | 6 | 54.5 | 5 | 45.5 | 11 | 100.0 |
| 01-17. Quality control | - | - | 4 | 26.7 | 11 | 73.3 | 15 | 100.0 |
| 01-18. Seminer/symposium | - | - | 5 | 62.5 | 3 | 37.5 | 8 | 100.0 |
| Financial/Marketing support Encouraging investment | | | | | | | | |
| 01-21. Tax rebate and tax exemption | - | - | 8 | 29.6 | 19 | 70.4 | 27 | 100.0 |
| 01-22. Credit assistance | - | - | 7 | 43.8 | 9 | 56.2 | 16 | 100.0 |
| 01-23. Subsidy | - | - | 2 | 50.0 | 2 | 50.0 | 4 | 100.0 |
| 01-24. Marketing | - | - | 8 | 33.3 | 16 | 66.7 | 24 | 100.0 |
| Protection of domestic products | | | | | | | | |
| 01-31. Import surcharge | 2 | 33.3 | 2 | 33.3 | 2 | 33.3 | 6 | 100.0 |
| 01-32. Import restriction | 2 | 18.2 | 3 | 27.3 | 6 | 54.5 | 11 | 100.0 |
| 01-33. Export promotion | | | | | | | | |

Regarding the development of infrastructure, the majority of answers to questions on access road, telecommunication, electrical supply, water supply, central sewerage treating, and pollution control gave "useful" and "very useful", but there was "not useful" given by the minority of answers.

Regarding the technical/information services by public organization, expectation centers on such services as training, consultancy, information, testing, quality control, etc. Unexpectedly, seminar/symposium and standardization are popular.

Regarding the financial/marketing support, answers to questions on tax rebate or tax exemption, low interest credit assistance, market activation, etc. gave "very useful" but there was "subsidy" given by the minority of answers. It appears that there are some problems such as a smaller amount of subsidy as against troublesome formalities.

Regarding the protection of domestic products, opinions that import surcharge, import restriction, etc. are "not useful" were formed and only a few firms gave "useful" answer.

Since import surcharge and import restriction will lead to a high cost (especially on production machinery and industrial machinery), they should not be carried into effect unless fully domestic production becomes prospective. Commencement of enforcement, target items, etc. should be decided after careful examination into the technical level of the country.

### (3) Problems and Countermeasures

1) Problems

As described at the outset of section 4.5.5.1, machine assembly is one part of the machine production process and, therefore, it is different in character from such sectors as casting and machining industries, the production process of which composes independent industry.

Namely, every aspect including design technology, production technology, manufacturing facilities, equipment and materials, distribution channels (clients, method of sale), etc. becomes different in the case of machine assembly depending upon the feature of final products.

Accordingly, the machine assembly industry does not exist nor is generally recognized independently, though casting and machining industries are in existence. It is therefore more appropriate to handle the "machine assembly" as a industry classified by product.

The products of the 51 firms dealt with in this chapter can be reclassified into those which are dealt with in other chapters such as agricultural machinery, industrial machinery, machine tools, vehicles, etc. and those which belong to other sectors.

Dealing with them on the same basis does make problems more complicate than advantageous.

In view of the above, examination is to be started from the origination of problems and countermeasures classified by product.

2) Countermeasures

Refer to the section of countermeasures classified by product.

4.4.1 Agricultural Machinery
4.4.5 Machine Tools
4.4.6 Automotive Vehicle-Related Equipment

Since 48 firms out of the 51 firms, object of survey, are dealt with in the chapter of machining, reference can be made to the information contained therein.

4.5.4 Machining

4.5.6 Pressworks

(1) General

Some 330 firms which are engaged in metalworks in Bangkok and its sorrounding areas have been surveyed mainly through the questionnaires. Among them, 52 firms engage in pressworks and only three firms or 10% of them are specialized in pressworks, which is considerably low ratio in comparison with the ratio, 65% of the plating industry. About two thirds of the firms were established within 10 years. The demands for press-working industry in the country have been expanding along with the progress of industrialization. Regarding the firm size from the viewpoint of the number of employees, 18 firms or 35% of the firms surveyed have 17 to 40 employees and 30% have 16 or less. In another word, about two thirds of the firms are belong to the small scale industry with employees less than 40. Three firms with more than 250 employees were also surveyed, but they are engaged not only in pressworks, but also in other jobs. On the other hand, the sales amount of approximately 40% of firms is below 250 thousand Baht. It is assumed that the sales of presswork job are far less.

Only 19 answers were gathered to the question about the industrial fields and kinds of pressworked products, therefore the findings from these answers cannot be generalized. Most of the firms mainly produce motor vehicle and motorcycle components through pressworking, followed by furniture and construction elements, farming and mining machinery components etc. Most of these products can be manufactured in a simple and basic process such as punching, blanking, shearing and bending. Drawing and compound pressworks seem to be done still very scarcely.

Most of the products, moreover, are within an accuracy range of 0.05 to 0.5 mm, which can be measured by such measuring instruments as verniers and calipers. Some 60% of the enterprises do not provide their presses with any safety devices. It seems that they do not fully recognize the importance of safety.

From a technical point of view, many enterprises are using steel plate as raw material. Nevertheless, approximately one-third of the enterprises also use non-ferrous metal sheet. The dies, which are important for pressworks, are designed and fabricated in house by about two thirds of the firms. Most of these dies are simple blanking dies made of ordinary carbon steel, carbon tool steel and special steel alley.

The most popular press in Thailand is crank press (employed by approximately 74% of the enterprises). It seems that hydraulic presses, mechanical presses and manual presses are also employed in many firms. The capacity of presses employed are within a wide range of 10 to 300 tons. The largest capacity of press owned by the firms generally ranges from 100 to 300 tons. As compared with the previous survey, it seems that the maximum capacity of the presses employed in Thailand have remarkably increased. The average number of presses owned by one enterprise is approximately 10.

The number of engineers per firm may be considered to indirectly represent an overall technological level of the firms. The firms surveyed have a very small number of engineers per company. Besides, because many enterprises are not engaged only in pressworks but also in other processes the engineers engaged in pressworks seem to be considerably limited.

The technological level of each enterprise has been evaluated, based on the number of those workers who can understand technical drawings. Approximately one-fifth of the firms surveyed, do not have any workmen able to understand technical drawings. Such enterprises, including those which have only one workman able to read drawings, reach approximately 40%. As a result, instructions are forced to be given to workers verbally and by means of sketches and samples.

Production process is standardized in large number of the firms or 50%, and followed by inspection and prices.

The most popular method of inspection is sampling check by workmen or by the manager, and visual and dimensional inspections are mostly applied.

Approximately 50% of the enterprises answered defect ratio of 1% or less, and 2 to 10%, respectively. It is problem however, that about 15% of the enterprises show defect ratio of more than 5% in the simple blanking pressworks.

Approximately 40% of the enterprises surveyed exist in industrial areas and nearly 30% are located in residential areas. They seem to have caused pollution problems in the past relating to noise and vibrations.

The highest percentage of customers instruct a delivery date verbally, reaching approximately 40%, followed by those instructing it in specifications (34%) and in a short-term delivery agreement (14%). The largest number of the enterprises have answered that a delivery is delayed "sometimes" to an extent of 4 to 7 days.

The reasons for delay of delivery are pointed out by many enterprises that raw materials are not provided in time, production control is poor and workmen are lacking.

The general aspects of pressworking industry existing around Bangkok in Thailand could be outlined as referred to the above, based on the findings obtained through the survey. On the other hand, the fact that there are many firms who produce pressmachines, has been proven through the field survey apart from the survey by the questionnaire. They produce press machines ranging from small-sized manual types to large ones with a capacity of more than 300 tons.

(2) Anslysis of Actual Trends

As referred to in the previous article "General," the enterprises engaged in pressworks have amounted to 52 companies of all the enterprises surveyed. However, answers to the questionnaire relating to pressworks could be given by only 17 firms of which three are specialized in pressworks. Therefore, the results of analysis decribed hereinafter should be grasped as the actual trends of those enterprises which are conducting on various lines of business, including pressworks. Since a small number of answers have been given in relation to the questions concerning pressworks, the statistical significance is considered to be lowered and the generalization of the trends is not applicable. It is necessary to keep in mind that the analysis results are limited to the enterprises actually surveyed.

1) General Items

① Firm age (52 valid answers)

The firm age of the enterprises which are engaged in pressworks is shown in Table 4.5.6-1.

Table 4.5.6-1 Firm age

| Firm age | Frequency | Percentage |
|---|---|---|
| Less than 2 yers | 2 | 3.8 |
| 2 to 5 years | 10 | 19.2 |
| 6 to 10 years | 21 | 40.4 |
| 11 to 20 years | 14 | 26.7 |
| 21 to 30 years | 5 | 9.7 |
| Total | 52 | 100.0 |

As shown in the table, the enterprises which were established within 10 years account for 33 (about 63%) of the 52 firms. Thus, the progress of Thai industries for the past decade can be clearly seen in the pressworking industry too. Besides, twelve companies or 23% have been established after the "previous survey" (see note).

NOTE: The term, the "previous survey", means the "Comparative study on Small and Medium scale Metal Working Industry among Asian Countries" made by the Japan International Cooperation Agency and Technonet Asia in 1978. This survey was intended to quantitatively grasp the technological levels of small and medium scale industries in seven Asian countries, i.e. the Philippines, Indonesia, Malaysia, Singapore, Sri Lanka and Bangladesh, focusing on the metalworking industry. In the first year, the survey was conducted in Thailand and in the Philippines.

② Number of employees

The number of employees of the firms surveyed is shown in Table 4.5.6-2. Nine firms or 17% have a workforce of more than 100 persons, however about two thirds are small scale industry with 40 or less employees. Moreover, most of the firms are engaged in other jobs as well as in pressworks. Therefore, all of the employees shown in the table are not engaged in only pressworks.

Table 4.5.6-2 Number of employees

| No. employees | Frequency | Percentage |
|---|---|---|
| 1 to 6 | 5 | 9.0 |
| 7 to 16 | 11 | 21.2 |
| 17 to 40 | 18 | 34.6 |
| 41 to 100 | 9 | 17.3 |
| 101 to 250 | 6 | 11.5 |
| 251 to 630 | 3 | 5.8 |
| Total | 52 | 100.0 |

③ Capital of firms

The capital of the firms can be classified as shown in Table 4.5.6-3

Table 4.5.6-3 Capital of the firms

| Capital in million Baht | Frequency | Percentage |
|---|---|---|
| Less than 0.25 | 21 | 40.4 |
| 0.25 to 1.00 | 16 | 30.8 |
| 1.00 to 4.00 | 7 | 13.5 |
| 4.00 to 16.00 | 5 | 9.6 |
| 16.00 to 100.0 | 3 | 5.7 |
| Total | 52 | 100.0 |

About 70% or 37 of the firms are small capitalized enterprises with capital of one million Baht or less.

④ Sales amount

Annual sales of the fimrs surveyed are classified as shown in Table 4.5.6-4

Table 4.5.6-4 Annual sales

| Annual sales in million Baht | Frequency | Percentage |
|---|---|---|
| Less than 0.25 | 21 | 40.4 |
| 0.25 to 1.00 | 6 | 11.5 |
| 1.00 to 4.00 | 10 | 19.2 |
| 4.00 to 16.00 | 8 | 14.5 |
| 16.00 to 100.0 | 5 | 9.6 |
| Over 100.0 | 2 | 3.9 |
| Total | 52 | 100.0 |

Although the sales shown in the table include sales of other job orders as well as press-works, about 40% or 21 firms sell less 0.25 million Baht.

⑤ Types of pressworks (19 valid answers)

Type of prcssworks undertaken in the firms surveyed are shown in Table 4.5.6-5. Simple blanking and punching works are conducted in most of the firms, and also shearing and bending are conducted in some 60% of the firms. These pressworks do not need highly sophisticated technologies and dies thereof are also very simple and fundamental. On the other hand, drawing and combined pressworks, which require quite advanced technologies, are undertaken in a few firms.

Table 4.5.6-5 Type of presswork

| Type of presswork | Frequency | Percentage |
|---|---|---|
| Sheering | 13 | 68.4 |
| Bending | 11 | 57.9 |
| Blanking/Punching | 18 | 94.7 |
| Drawing | 4 | 21.1 |
| Combined | 2 | 10.5 |
| Others | 1 | 5.3 |

⑥ Markets by industrial sector. (19 valid answers)

Table 4.5.6-6 shows the industrial sectors in which products pressed by the 19 companies surveyed are sold, including their quantitative percentages. Since a small number of samples were taken up, figures involved can not be simply reckoned as the general trends of the press machining industry in Thailand. Many enterprises produce motor vehicle and motorcycle components followed by furniture, construction elements, farming and mining machinery parts, electrical appliances and ornaments, etc. The specialization are rather advanced in the fields of vehicle components, furniture and construction materials.

Table 4.5.6-6 Industrial fields of presswork products

| Industrial Fields | Share of sales (%) | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 1 – 20 | 21 – 40 | 41 – 60 | 61 – 80 | 81 – 100 |
| Components, automobile and motorcycle | 10 | 4 | | | 1 | 4 |
| Components of farm, forti and mining machinery | 13 | 3 | | | | 2 |
| Components, industrial machinery | 19 | | | | | |
| Electric machinery components | 19 | | | | | |
| Electric appliances | 14 | 4 | | | | 1 |
| Kitchen and tableware | 19 | | | | | |
| Furnitures and construction materials | 12 | 4 | | | | 3 |
| Stationeries and office equipment | 19 | | | | | |
| Decorations and ornaments | 14 | 4 | | | | 1 |
| Tools | 19 | | | | | |
| Others | 16 | | | | | 3 |

⑦ Category of customers

Since only 6 answers were given to the question, the data cannot be generalized. As far as the firms who gave answers, none of them produce pressworked products for in house use, three firms do business mainly with small and medium scale firms and theree with large scale firms. Numbers of customers per firm are 3 to 4 in average.

2) Technologies and Facilities

① Materials used (18 valid answers)

Steel plate is most popularly used in the firms surveyed; 12 firms or 67% of them. Such nonferrous metals as aluminium and copper are also used in 6 firms or 33% of them. Scraps, stainless steel or alloy steel and non-metallic materials are used in a firm, respectively. Regarding the thickness of sheet metal used, 17 firms gave answers. These are shown in comparison with the previous survey in Table 4.5.6-7

Table 4.5.6-7 Thickness of sheetmetal

| | Present survey | | Previous survey |
|---|---|---|---|
| Thickness | Frequency | % | % |
| Less than 0.7mm | 1 | 5.9 | 0 |
| 0.8 to 2.0 | 6 | 35.5 | 3.6 |
| 2.1 to 4.0 | 4 | 23.5 | 12.0 |
| Over 4.0 | 6 | 35.3 | 84.3 |

Thus, the thickness of sheetmetals used are considerably diversified comparing with the previous survey.

② Types and raw materials of press dies

Types and raw materials of press dies are shown comparing with the findings of the previous survey in Table 4.5.6-8 and 4.5.6-9 respectively.

Table 4.5.6-8 Type of press dies

| | Present survey | | Previous survey |
|---|---|---|---|
| Type | Frequency | Percentage | Percentage |
| Not use dies | 2 | 10.5 | 4.8 |
| Simple blanking or punching die | 13 | 68.4 | 84.8 |
| Compound die | 2 | 10.5 | 4.8 |
| Progressing die | 4 | 21.1 | 4.8 |
| Transfer die | 1 | 5.3 | – |
| Others | 1 | 5.3 | 1.2 |

Table 4.5.6-9 Raw material of press die

| | Present survey | | Previous survey |
|---|---|---|---|
| | Frequency | Percentage | Percentage |
| Carbon steel | 7 | 36.8 | 34.9 |
| Tool alloy steel and special steel alloy | 9 | 47.4 | 57.8 |
| Sintered alloy steel | 1 | 5.3 | 6.0 |
| Others | 2 | 10.5 | – |

As shown in the tables, compound and progress dies have increased since the previous survey, however raw materials used are almost same as those of the previous survey.

③ Designs and production of press dies

About 63% or 12 firms of the surveyed firms conduct designs of die by themselves for in-house use, two firms by customers, 3 firms by subcontractors and one firm by engineering company.

Production of dies is compared with the previous survey as follows:

Table 4.5.6-10 Production of press dies

| | Present survey | | Previous survey |
|---|---|---|---|
| Producers | Frequency | Percentage | Percentage |
| In-house manufacture | 13 | 68.4 | 62.7 |
| Furnished by customers | 1 | 5.3 | 37.3 |
| Subcontractor | 5 | 26.3 | |

In comperison with the previous survey, the present one shows a little increase in percentage of the dies internally fabricated but apparently without a significant difference.

④ Type of press machines

Crank type presses are the most pupolar in Thailand, which are used by 74% of the enterprises. Hydraulic presses and mechanical presses are also popularized considerably, which are used by 42% and 32% of the enterprises, respectively. On the other hand, manual presses are still used jointly. For a small quantity of small-sized products, it is convenient to jointly employ manual presses, therefore they could not be disused so easily.

Findings of both present and previous surveys are given below. In the present survey, multiple answers have been allowed while a single answer was permitted in the previous survey. It is impossible, therefore, to simply compare numerals, but it will be possible to make a comparison of trends.

Table 4.5.6-11 Type of press machines

| | Present (multi answer) | | Previous (single answer) |
|---|---|---|---|
| | Frequency | Percentage | Percentage |
| Manual press | 6 | 31.4 | 8.4 |
| Screw press | 2 | 10.5 | 2.4 |
| Crank press | 14 | 73.7 | 71.1 |
| Mechanical press | 6 | 31.6 | |
| Hydraulic press | 8 | 42.1 | 18.1 |

Considering the answers given in Item ②, it can be clearly proven that hydraulic presses have considerably increased.

⑤ Capacity and average quantity of press machines in use

Answers were given by 17 firms and they are broken down by capacity as follows;

Table 4.5.6-12 Number of presses by capacity

| Capacity | Number of press in 17 firms |
|---|---|
| 11 to 50 | 58 |
| 51 to 100 | 48 |
| 101 to 300 | 26 |
| Over 300 | 2 |
| Total | 176 |

Thus, one firm are equiped with 10.4 machines on the average. On the other hand, the firms can be stratified by number of press machines in use as follows.

Table 4.5.6-13 Number or pressed per firm

| No. of presses | Frequency | Percentage |
|---|---|---|
| 1 to 5 machines | 7 | 41.2 |
| 6 to 10 | 2 | 11.8 |
| 11 to 20 | 6 | 35.3 |
| 21 to 30 | 2 | 11.8 |

Thus, to be interesting, the firms can be roughly classified into two categories; that is, one is the firms who have one to five machines and the other is those who have 11 to 20. The maximum capacity of press owned by each firm can be compared with the findings of the previous survey as follows:

Table 4.5.6-14 Maximum capacity of press

| | Present survey | | Previous survey |
|---|---|---|---|
| Max. capacity | Frequency | Percentage | Percentage |
| Under 10 tons | 2 | 11.8 | 41.0 |
| 11 to 50 | 1 | 5.6 | 25.3 |
| 51 to 100 | 4 | 23.5 | 15.7 |
| 101 to 300 | 8 | 47.1 | 14.4 |
| Over 300 | 2 | 11.8 | 3.6 |

As seen obviously in the table, the maximum capacity of press machine owned by each firm has been remarkably increased since the previous survey.

⑥ Setting and feeding devices

Most of the firms set up and feed works manually, and it seems that automation technology with mechanical or hydraulic devices are far behind. However, automatic setting and feeding devices have slightly increased in comparison with the previous survey.

Table 4.5.6-15 Setting and feeding device of press

| | Present survey | | Previous survey |
|---|---|---|---|
| | Frequency | Percentage | Percentage |
| Simple manual | 16 | 84.2 | 95.2 |
| Mechanical | 2 | 10.5 | 3.6 |
| Hydraulic | 1 | 5.3 | 1.2 |

⑦ Safety devices on machines

Nearly 60% of the firms surveyed do not provide safety devices on their press machines. It seems that they are lacking of the responsibility to protect their workmen from accidents. Incidentally the safety device on press machines are mandatory to be equipped in Japan.

Table 4.5.6-16 Safety devices on machines

| | Frequency | Percentage |
|---|---|---|
| No device | 11 | 57.9 |
| Guard plate | 1 | 5.3 |
| Both hands operation | 5 | 26.3 |
| Photoelectric tube | 1 | 5.3 |
| Pullout | 1 | 5.3 |

⑧ Number of engineers

Those who have completed the courses in a high school of technology, a technological college and a university of science and engineering are to be herein defined as "engineers." The number of "engineers" who are actively working as the technical backbone of an enterprise after completed the courses in such educational organizations may be considered to indirectly indicate a technological level of the enterprise.

Table 4.5.6-17a shows the findings of the survey with a sample number of 52 companies. From these findings, however, the details of an enterprise with 0 thru 6 engineers can not be clearly analyzed. Therefore, an analysis of the 15 companies who have answered to the questionaire relating to presses has resulted in Table 4.5.6-17b.

As clearly shown in Table 4.5.6-17b, four of the 15 companies do not have any engineers and most of the enterprises have 1 to 4 engineers.

Analyzing the enterprises with 0 to 6 engineers based on Table 4.5.6-17b allows us to analogize that more than half the enterprises have no engineer. Besides, since most of the enterprises conduct on some lines of business other than pressworking, it seems that the number of engineers engaged exclusively in pressworking is far smaller.

Table 4.5.6-17a Number of engineers per firm

| | Frequency | | | |
|---|---|---|---|---|
| Level of education | 0 to 6 | 7 to 16 | 17 to 40 | 41 to 100 |
| Tech. high schools or vocational training sch. | 46 | 4 | 2 | 0 |
| Polylechniques | 47 | 2 | 3 | 0 |
| College or university | 49 | 1 | 1 | 0 |

Table 4.5.6-17b Detail of number of engineers

| | Frequency | | | |
|---|---|---|---|---|
| Level of education | 0 | 1 to 4 | 5 to 10 | Over 10 |
| Tech. high school or vocational training sch. | 7 | 6 | 1 | 1 |
| Poly techniques | 11 | 3 | 0 | 1 |
| College or university | 11 | 2 | 1 | 1 |
| Total* | 4 | 8 | 1 | 2 |

*Total in this case does not mean the sum of each column, but means the number of firms which have engineers graduated from any educational level.

⑨ Workmens' ability to understand technical drawings and Instructing method of jobs to them.

It is very difficult to evaluate the technology level of workmen in the firms only through the questionnaire. As an indirect measures to evaluate it, the ability to understand technical drawings was surveyed, of which results are shown in Table 4.5.6-18.

Table 4.5.6-18 Workmen's ability to understand technical drawings

| No. of workmen able to understand tech. dwgs. | 0 | 1 | 2 to 4 | 5 to 10 | Over 10 |
|---|---|---|---|---|---|
| Frequency | 10 | 12 | 18 | 4 | 8 |
| Percentage | 19.2 | 23.1 | 34.6 | 7.7 | 15.4 |

About one fifth of the firms surveyed have no workmen able to understand technical drawings, and most of them have 1 to 4 workmen.

Consequently technical drawings can not be used to instruct daily jobs to workmen, but it is inevitable to instruct verbally by means of simple sketches or samples. This will be sufficient as far as simple jobs are concerned, however it seems that complicated jobs can not be accurately transmitted without technical drawings.

Table 4.5.6-19 Instruction of jobs

| | Frequency | Percentage |
|---|---|---|
| Verbal, sketch or sample | 33 | 67.3 |
| Technical drawings | 16 | 32.7 |

⑩ Process standardized in ordinary business activities
(multiple answers, 44 valid answers)

Which processes are standardized in the daily activities of an enterprise has been surveyed. The jobs standardized are enumerated in the order of popularity as follows:

Table 4.5.6-20 Standardized jobs in daily jobs

| Jobs | Frequency | Percentage |
|---|---|---|
| Production works | 24 | 54.5 |
| Inspection, tasting | 19 | 43.2 |
| Quality control | 17 | 38.6 |
| Price | 14 | 31.8 |
| Process | 13 | 29.5 |
| Design | 12 | 27.3 |
| Quarantee | 12 | 27.3 |
| Costing | 11 | 25.0 |
| Others | 39 | |

The frequency per firm accounts for 3.66; that is, three to four items are standardized on the average. It seems that the standardization has considerably progressed, however what has been standardized to what extent and how they are applied are important. But they are not proven clearly in this survey.

⑪ Inspection and feedback system

The findings of the survey concerning inspection are shown in Tables 4.5.6-21a, -21b, -21c and -21d.

Table 4.5.6-21a Inspection method

| Methods | Frequency | Percentage |
|---|---|---|
| Check only when trouble occurs | 6 | 11.8 |
| First product inspection | 16 | 31.4 |
| Single sampling inspection | 15 | 29.4 |
| Multiple sampling inspection | 22 | 43.2 |
| Total inspection | 16 | 35.3 |

Table 4.5.6-21b Inspector in charge

| | Frequency | Percentage |
|---|---|---|
| Workmen | 24 | 47.1 |
| Manager/owner | 26 | 51.0 |
| Staff specialized | 17 | 33.4 |

Table 4.5.6-21c Kinds of inspection

| | Frequency | Percentage |
|---|---|---|
| Visual check | 37 | 72.5 |
| Dimensional check | 33 | 64.7 |
| Clearance check for movable parts | 16 | 31.4 |
| Hardness check | 12 | 23.5 |
| Sensory check | 7 | 13.7 |
| Roughness check | 5 | 9.8 |
| Colour check | 2 | 3.9 |
| Noise, vibration check | 4 | 5.8 |
| Running test | 1 | 2.0 |

Table 4.5.6-21d Feedback system of inspection

| | Frequency | Percentage |
|---|---|---|
| Circulating notice or inspection record | 18 | 35.3 |
| Notice on the board | 9 | 17.6 |
| Countermeasure by manager and workmen | 9 | 17.6 |
| Countermeasures by staff in chage | 4 | 7.8 |
| No feedback | 7 | 13.7 |

It should be noted, however, that the inspections include not only those relating to pressworks but also to other processes like machining and assembly. The sampling inspection by a worker himself or by a namager/employer is most popularly conducted with visual and dimensional checks moreover, the measuring instruments used for dimensional inspection are enumerated in the order of popularity as follows:

Table 4.5.6-22 Measuring instruments in use

| Instruments | Percentage of firms used in. |
|---|---|
| Verniers | 81 to 100 % |
| Tape measure and steel rulers | 61 to 80 |
| Caliper gauge, micrometer and square | 41 to 60 |
| Carpenter's ruler, dial gauge protractor and angle plate | 21 to 40 |
| Depth gauge, thickness gauge | 11 to 20 |
| Hardness tester, roughness tester | |

⑫ Defect ratio and countermeasures

The tables given below show the defect ratio and countermeasures therefor.

Table 4.5.6-23a Defect ratio

| Defect ratio | 11 to 20% | 6 to 10% | 2 to 5% | Less 1% |
|---|---|---|---|---|
| Frequency | 1 | 6 | 16 | 21 |
| Percentage | 2.3 | 13.6 | 36.4 | 47.7 |

Table 4.5.6-23b Countermeasure against defects

| | Frequency |
|---|---|
| Not applicable | 8 |
| Emprically | 10 |
| Analysis of causes as a whole | 21 |
| Analysis by product and process | 3 |

It is considerable that almost half of the firms show a defect ratio of 2 to 10%. It can not be proven whether the defect ratios have taken place in the process of pressworks or in other processes.

Many enterprises, moreover, have answered that an overall analysis is made to clarify the causes of defective products. Since the question was ambiguous, however, it is impossible to know what action has been actually taken.

3) Markets, accounting financial affairs and others

① Scope of markets

Most of the firms surveyed extend their markets throughout the country, and a few of them, moreover export a part of their products to the developing countries and the NICs. The fact that most of them sell their products throughout the country may means that there are few pressworking industries in the rural areas and most of them are existent in Bangkok areas. The scope of their markets are shown in Table 4.5.6-18.

Table 4.5.6-24 Scope of markets

| | Frequency | Percentage |
|---|---|---|
| Region/district | 18 | 35.3 |
| Province/state | 21 | 41.2 |
| Country | 41 | 82.4 |
| Developing country | 2 | 3.9 |
| NICs | 1 | 2.0 |
| Developed country | 2 | 3.9 |

② Methods of pricing

Prices are often determined in comparison with market prices with answers from 27 firms or 59%. Four or 9% of the firm make a price agreement with their customers.

Table 4.5.6-25 Method of pricing

| | Frequency | Percentage |
|---|---|---|
| According to customer's inquiry | 7 | 15.2 |
| Estination by themselves | 7 | 15.2 |
| According to marked price | 27 | 58.7 |
| Short-term agreement | 4 | 8.7 |
| Others | 1 | 2.2 |

③ Instruction of delivery time

In 44% or 22 firms, delivery time is verbally instructed by customers, and instructed in specifications in 17 firms or 34%

Table 4.5.6-26 Instruction of delivery time

| | Frequency | Percentage |
|---|---|---|
| Not instructed | 2 | 4 |
| Verbally instructed | 22 | 44 |
| Instructed in spec. | 17 | 34 |
| Short-term agreement | 7 | 14 |
| Long-term agreement | 2 | 4 |

④ Delay of delivery, causes and measures thereof

The answers regarding the delay of delivery are shown in Table 4.5.6-27a to 4.5.6-27d.

Table 4.5.6-27a Frequency of delay

| | Frequency | Percentage |
|---|---|---|
| Often | 0 | 0 |
| Sometimes | 22 | 44 |
| Rarely | 13 | 26 |
| Seldom | 4 | 8 |
| Never | 11 | 22 |

Table 4.5.6-27b Extent of delay

| | Frequency | Percentage |
|---|---|---|
| Within 3 days | 19 | 44.2 |
| 3 days to 1 week | 18 | 41.9 |
| 2 to 4 weeks | 6 | 13.9 |

Table 4.5.6-27c Causes of delay

| | Frequency | Percentage |
|---|---|---|
| Poor process schedule | 11 | 27.5 |
| Delay of raw material | 15 | 37.5 |
| Short delivery time | 8 | 20.0 |
| Shortage of manpower | 12 | 30.0 |
| Delay of designs | 2 | 5.0 |
| Defector reject of products | 2 | 5.0 |
| Others | 5 | 12.5 |

Table 4.5.6-27d Actions to keep delivery time

| | Frequency | Percentage |
|---|---|---|
| No action | 11 | 23.4 |
| Occasional check of plan and actual | 11 | 23.4 |
| Weekly check of plan and actual | 5 | 10.6 |
| Daily check of plan and actual | 11 | 23.4 |
| Permanent check by speckal controller | 8 | 17.0 |
| Others | 1 | 2.2 |

Nearly 37% of them have answered "due to a delay of materials." The fact that the "delay of materials" is ranked at the top as the cause of delays seems to indicate a poor situation of raw materials in Thailand.

⑤ Labour productivity, capital equipment ratio and capital productivity, etc.

Among from the firms engaged in pressworks, 40 firms who gave answers to the questions concerning the above items have been analyzed. The results involved are shown as follows. These 40 enterprises, however, are not only engaged in the business of pressworks but also in other lines of business. Thus, their data include the figures in the lines other than that of pressworks. The numerical values given below, therefore, naturally cover other lines of business, too.

The 40 companies, meanwhile, are broken down as follows:

| | |
|---|---|
| Firms specialized in pressworks | 3 firms |
| Pressworks plus 1 process | 6 |
| plus 2 processes | 11 |
| plus 3 processes | 10 |
| plus 4 processes | 5 |
| plus 5 processes | 3 |
| not identified | 2 |

On the average, one firm is engaged in 3.5 lines of business.

Sum of employees of 39 firms = 2619 persons

Average of employees per firm = 67.2 persons

Sum of sales of 30 firms = 639.8 million Baht

Average of sales per firm = 21.33 million Baht

Sum of fixed asset of 37 firms = 223.2 million Baht

Average of fixed asset per firm = 6.03 million Baht

Sales per employee (labour productivity) = 317.4 thousand Baht

Fixed asset per employee (capital equipment productivity) = 87.8 thousand Baht

Sales per fixed asset (capital productivity) = 3.53

In comparison with the previous survey, these items are summarized as follows with use the exchange rate 23 Baht for one US dollar.

| | Present survey | Previous survey |
|---|---|---|
| Labor productivity | US$ 13800 | US$7798 |
| Capital equipment ratio | US$ 3815 | US$ 5951 |
| Capital productivity | 3.53 | 1.31 |

In the previous survey the answers were given by 20 firms who were mainly engaged in pressworks, therefore they can not be compared strictly with those of the present survey. Roughly speaking, however, the labour productivity has increased by 1.8 times, the capital equipment ratio by 1.56 times and the capital productivity by 2.7 times in comparison with those of the previous survey, respectively. Thus, it can be proven from these numerals that the pressworking industry in Thailand has grown considerably for these several years.

⑥ Location of firms and pollution problems

The firms surveyed are located at the various areas in Bangkok or its surrounding areas as follows:

Table 4.5.6-28 Location of factories

| Location | Frequency | Percentage |
|---|---|---|
| Industrial district | 19 | 42.2 |
| Industrial district in custom or export free zone | 4 | 8.9 |
| Commercial areas | 1 | 2.2 |
| Residential district | 14 | 31.1 |
| Not defined | 7 | 15.6 |

About half of the firms are located in the industrial district while one third are located in the residential districts.

On the other hand approximately one-third (13 companies or 31.7%) of the enterprises have received complaints relating to pollution so far. These complaints can be broken down into 9 for noise, 1 for vibration, 4 for bad smell, 2 for smoke and 3 for waste water. Both noise and vibration pollutions may be considered to be caused by the process of pressing, while the others are assumed to be caused by processes of casting, heat treatment, plating, ect. Though relations of the pollution with factory locations have not been proven clearly, it is assumed that complaints were mainly given to the enterprises existing in the residential areas.

(3) Issues and countermeasures

As shown obviously from the analysis of the actual situations in the previous articles, the Thai pressworking industry has being progressing in many aspects such as number of employees, maximum capacity of press machines, labour and capital productivity since the previous survey. It seems, however, that significant changes have not taken place in firms of software such as number and technological level of engineers, managerial and control technologies. In order to cope with the sophisticated and diversified industrialization in the country for the future, the Thai pressworking industry should upgrade their engineering technologies and modernize their facilities. Furthermore, with these improvements, it is also essential prerequisite to improve and modernize the managerial and control technologies.

On the other hand, standardization and normalization of products, production and inspection processes will bring about significant effects to the industries, particularly it will bring about many profits to the pressworking industry. For example, considerable cost reduction, stable quality and highly effective operating ratio of the equipment will be attained by decreasing jigs, tools and dies, type and quantities of raw materials in stock, etc. The following recommendations are proposed to resolve these issues.

① Education and training of backbone engineers and managerial persons in the firms.

In general in the case of pressworking industry, the upper-stream technologies such as designs, facilities, tools and dies, selection of materials and quality control are more important rather than skills of workmen. These are the responsibility to be undertaken by the leading engineers and managing persons in the firms. They should always persue new and advanced technical informations and technologies and should upgrading their technologies. In reality, however, there are few organizations and opportunities to re-educate and train those who are actively engaged in firm jobs. In addition, they can not easily have time to participate such educational or training courses because they are always busy with actual jobs.

With such conditions taken into account, it is recommended to establish an organization in which they can receive effective training in a short time.

In such an organization, training should not be limited to technologies only but also to such managerial and control techniques as quality control and production control.

② Upgrading production and design of tools and dies

It is not exaggerated to say that pressworks are mostly dependent upon the quality of dies. As products become more complicated and sophisticated for the future, designs and production techniques will be also become difficult.

In the existing technical high schools and vocational training schools, some die making courses should be newly established to be provided with sufficient and effective educational facilities in order to educate and train apprentices.

In the technical high schools, emphasis should be placed on the training of die designs and drawings in addition to teaching fundamental technical knowledgement such as materials, strength of materials heat treatment and machining techniques.

In the vocational training schools, on the other hand, emphasis should be placed on the traing of production technologies such as machining, finishing and assembling and reading technical drawings. In addition, operation skills of special quality machines and measuring instruments such as EDM, jig borer, NC lathe, grinding machine, should be trained.

4.5.7 Plating

(1) General Aspects

In this study conducted on the metalworking industries in Bangkok and its sorrounding areas, some 350 firms were surveyed. Among them, 54 firms or about 15% of the whole are engaged in plating process, and 35 firms are specialized. The previous survey which had been undertaken by JICA and TECHNONET ASIA in 1978 proved that the specialization rate of the Thai plating industry was considerably high. This was also proven through this survey. With firm age, about 60% of the plating firms were established during these ten years. Especially 15 firms were set up after the previous survey in 1978. This fact shows the increase in demand for plating in Thai metalworking industry during these several years. Furthermore, it could be assumed that the kinds of plating will be diversified in the future as Thai industry develops, with the further rise in the demand.

With firm scale, the average number of the employees of the firms specializing in plating is approximately 14, slightly up from the former survey, but less than other industries. Nearly 60% of the firms surveyed undertake plating jobs for motor vehicle components. Their specialization rate is high. However, the customers of most of the firms are mainly small and medium scale enterprises. There are very few firms who undertake jobs for in house use or large enterprises.

With aspects of facilities and technologies, the number of tanks (including cleaning tanks) per firm is approximately 7, which is more than 4 to 5 of the previous survey. However, there are big differences among the firms as will be mentioned later.

With plating tanks, most of the firms use tanks coated with rubber or polyvinyl (PVC). This result is the same as that of the previous survey.

With kinds of plating, nickel plating is most popular, followed by copper-plating and zind-plating. There are few firms doing tin-plating, hard chrome plating, and rare metal plating. The average number of kinds of plating per firm is 2. With DC power source necessary for plating, many of the firms use silicon rectifiers or DC generators.

Surface treatment before plating is an important process because it heavily influences the quality of plating. While most of the plating firms applied degreasing methods such as soap-and-water solution on the previous survey, the treatment methods used by them are diversified on this survey. For example, acid-cleaning, electrolytic degreasing, and cleaning with solvent such as trichloroethylene liquid. With inspections after plating, a visual inspection is made by every firm surveyed, and a film thickness inspection is also made by about 25% of them.

With the defect ratio, about two thirds of the respondents replied as 1% or less. It seems that their plating quality is stable, but it is heavily influenced by the judging criterion. With the kinds of defects, most common kinds are cracking, shortage of luster, and pin-hole. This survey shows that 70% of the firms answered that when defects occured their controllers and workmen would make efforts together to resolve them in accordance with their experiences.

About 50% of the firms replied that they had no engineers who graduated from a technical high school, a polytechnical school, or a technical college, who played the leading roles in the firms. With education and training of employees, about 40% of them have never let their employees receive training outside.

The relation between the plating industry and wastewater pollution has sometimes called into question even in the industrially advanced countries like Japan. Therefore, this survey laid emphasis on the problem.

About 50% of the firms surveyed are located in residential areas. Only less than 10% is located in industrial districts. Eight firms have received protests against their wastewater from their neighbors. Unexpectedly, they are all located outside the residential areas. Approximately 80% of the respondents posses wastewater tanks or septic tanks of organic substances. Only 6 firms discharge their plant effluent into public sewerage, or creek and river. The commonly used wastewater treatment methods are settling, filtration, and neutralization. Only one firm uses a circulating system. These results are entirely different from what has been imagined from the bad reputation saying that Thai plating firms discharge their plant effluent with no treatment.

In the following sections, a quantitative analysis of the actual condition of Thai plating industry will be given, then problems will be extracted from the results of the analysis, and the measures are suggested to meet the problems.

(2) Analysis of Actual Condition

As described before, there are 54 firms doing plating among all the firms surveyed. However, the number of the plating firms that actually gave answers to the questionnaire was 44. Moreover, the number of the firms specializing in plating among them was 35. Therefore, this is the analysis of these 44 respondents. However, as they did not answered to all of the questions, the number of effective responses was varied by question.

2-1 General

A. Firm Age (44 effective responses)

Many of the firms surveyed are relatively new. Ages of about 61% or 27 firms of them are under 10 years. Especially, 34% or 15 firms were established after the previous survey. (Note: It means the comparative study of small and medium scale metalworking industry conducted by JICA and TECHNONET ASIA in 1978. It is called as 'the previous survey' hereafter.) This fact seems to indicate the increase in demand for plating in Thai metalworking industry during these several years.

Table 4.5.7-1 Firm Age

| Firm Age (yrs) | Established | No. firms | Percentage (%) |
|---|---|---|---|
| 0 – 2 | 1984 – 1982 | 3 | 6.8 |
| 3 – 5 | 1981 – 1979 | 12 | 27.3 |
| 6 – 10 | 1978 – 1974 | 12 | 27.3 |
| 11 – 20 | 1973 – 1964 | 9 | 20.4 |
| 21 – 30 | 1963 – 1954 | 3 | 6.8 |
| Over 30 | before 1953 | 5 | 11.4 |
| Total | | 44 | 100.0 |

B. Firm Scale Indicated by the Number of employees (44 effective responses)

Small firms with 10 or less employees represent about 39% or 17 firms of the whole, and those with 11 to 30 employees 36% or 16 firms. In other words, 75% of them are small or medium firms with 30 or less employees. (See Table 4.5.7-2.) Taking only the firms specializing in plating into consideration, 94% of them (32 firms) have 30 or less employees. The average number of employees per firm is 14.1, slightly up from 11.8 on the previous survey. (See Table 4.5.7.2 a.)

Table 4.5.7-2 Number of Employees

| No. Employees | Frequency | Percentage (%) |
|---|---|---|
| 1 – 10 | 17 | 38.6 |
| 11 – 30 | 16 | 36.4 |
| 31 – 100 | 8 | 18.2 |
| 101 – 200 | 2 | 4.5 |
| Over 201 | 1 | 2.3 |
| Total | 44 | 100.0 |

Table 4.5.7-2a Number of Employees; Firms specialized in Plating

| No. Employees | Frequency | Percentage (%) |
|---|---|---|
| 1 – 10 | 17 | 50.0 |
| 11 – 30 | 15 | 44.1 |
| 31 – 100 | 2 | 5.9 |
| Total | 34 | 100.0 |

C. Firm Scale Indicated by Capital (28 effective responses)

Taking only the firms specializing in plating into consideration, there are no firms with capital of 4 million Baht or more. Those with capital of 250 thousand Baht or less represent 39% or 9 firms. Refer to Table 4.5.7-3.

Table 4.5.7-3 Capital of Firms

| Capital (1000 Baht) | No. of firms | |
|---|---|---|
| | Total | Specialized firm |
| Less 250 | 11 | 9 |
| 250 – 1000 | 7 | 7 |
| 1,000 – 4,000 | 8 | 7 |
| 4,000 – 16,000 | 2 | 0 |
| Total | 28 | 23 |

D. Firm Scale Indicated by Sales (22 effective responses)

Taking only the firms specializing in plating into consideration, the annual sales of nearly 70 % of them are 250 thousand to 1 million Baht. Some companies make the sales of 4 million to 16 million Baht. The average sales of these specialized firms are about 1.1 million Baht. Using this figure and the average number of employees described before, the sales per head are 78 thousand Baht. Moreover, the monthly sales per head are 6500 Baht.

Refer to Table 4.5.7-4

Table 4.5.7-4 Annual Sales

| Sales (1000 Baht) | No. of firms | |
|---|---|---|
| | Total | Specialized firm |
| Less 250 | 4 | 4 |
| 250 – 1,000 | 13 | 13 |
| 1,000 – 4,000 | 1 | 1 |
| 4,000 – 16,000 | 4 | 1 |
| Total | 22 | 19 |

E. Kinds of Plating (44 effective responses, multi-responses)

The most common kind of plating done by the firms surveyed is nickel-plating (27 firms or 61%), followed by copper-plating (17 firms or 39%), and zinc-plating (11 firms or 25%). The rarist kinds of plating are lead-plating and cadmium-plating (0 firm each), followed by tin-plating (1 firm), rare metal plating (3 firms), and hard chrome plating (4 firms), etc. Also, 26 firms replied 'others' but the contents were not defined.

With the number of kinds of plating per firm, the firms answering 'one kind' represent 35% of the whole (15 firms), those answering 'two kinds' 35% (15 firms), those answering 'three kinds' 23% (10 firms), and those answering '4 or more kinds' 7%. (3 firms) the most common kind of plating done by those answering 'one kind' is nickel-plating; while common kinds of plating done by those answering '2 or more kinds' are the combination of nickel, copper, and 'others'. In comparison with 14% on the previous survey, the rate of the firms doing 2 or more kinds of plating on this survey indicates the great increase. This may mean the diversification of the demand for plating accompanied by the development of Thai industry. (See Table 4.5.7-5.)

Table 4.5.7-5 Kinds of Plating

| Kinds of plating | Frequency | Percentage(%) |
|---|---|---|
| Zinc plating | 11 | 25.0 |
| Tin | 1 | 2.3 |
| Lead (Pb) | 0 | 0 |
| Cadmium | 0 | 0 |
| Hard chrome | 4 | 9.1 |
| Gold, silver, w. gold. | 3 | 6.8 |
| Copper | 17 | 38.6 |
| Nickel | 27 | 61.3 |
| Others | 26 | 59.1 |

F. Industrial Fields of Plating (42 effective responses, multi-responses)

This is the survey of the industrial fields of plating conducted on the firms surveyed. The most common field is that of motor vehicle components (25 firms or 59%), followed by that of decorating & trinkets (17 firms or 40%), and that of electrical appliances (11 firms or 26%). With the specialization rate, the highly specialized fields are those of motor vehicle components, and decorating & trunkets. Many of the firms doing other industrial fields of plating do not specialize in one industrial field of plating but they are doing several kinds of industrial fields of plating. This seems to indicate the markets of Thai industrial fields except that of motor vehicle components still being small.
See Table 4.5.7-6.

Table 4.5.7-6 Industrial Fields of Plating

| | –20% | 21 –40 | 41 –60 | 61 –80 | 81 –100 | Total | Per-centage |
|---|---|---|---|---|---|---|---|
| 1. Motor vehicle components | 5 | 5 | 4 | 1 | 10 | 25 | 59.5 |
| 2. Agri/miming mack'ry | 1 | – | – | – | – | 1 | 2.4 |
| 3. Mach toole indust'l mack. | 2 | 1 | 1 | – | – | 4 | 9.5 |
| 4. Electric machinery | 1 | 1 | | | | 2 | 4.8 |
| 5. Electrical appliances | 5 | 4 | – | – | 2 | 11 | 26.2 |
| 6. Kitchen, table ware | 2 | 2 | 2 | – | – | 6 | 14.3 |
| 7. Householdware, arch. carp | 4 | 3 | 1 | – | – | 8 | 19.0 |
| 8. Stationery & office equip. | 5 | 1 | 1 | – | – | 7 | 16.7 |
| 9. Decorating & trinkets | 6 | 1 | 1 | – | 9 | 17 | 40.5 |
| 10. Hand & agri tools | 1 | – | – | – | – | 1 | 2.4 |
| 11. Others | 3 | 1 | 1 | 1 | 5 | 11 | 26.2 |
| Total | 35 | 19 | 11 | 2 | 26 | 93 | |

G. Category of Customers (35 effective responses, multi-responses)

With the category of customers based on sales, the main customer is defined as a customer whose purchase represents more than 60% of sales. The number of firms whose main customers are small medium firms is 22, the number of the firms whose main customers are large firms is 4, and the number of those plating mainly for in house use is 3. There are many companies whose main customers are small/medium companies. Other firms conduct plating for in house use and for small/medium firms by 50% each or the plating for small/medium firms and for large firms by 50% each.

Only 8 answers were received to the question about the number of customers. But the typical Thai plating firm seems to deal with 4 to 12 small/medium firms and 1 to 6 large firms. (See Table 4.5.7-7)

Table 4.5.7-7 Category of Customers

| | –20% | 21–40% | 41–60% | 61–80% | 81–100% | Total |
|---|---|---|---|---|---|---|
| In house use | 2 | | 3 | 1 | 2 | 8 |
| Small/medium firms | 3 | 2 | 5 | 5 | 17 | 32 |
| Large firms | 3 | 1 | 2 | 2 | 2 | 10 |

2-2 Facilities and Technology

A. Number of Tanks (44 effective responses, multi-responses)

The numbers of cleaning tanks and plating tanks owned by the 44 surveyed firms are shown in Table 4.5.7-8.

As clearly shown in Table 4.5.7-5, the number of the kinds of plating per firm is about 2.0. Consequently, it can be said that the typical surveyed firm conducts 2 kinds of plating, having about 14 employees, 5 to 6 plating tanks and 2 to 3 cleaning tanks.

Table 4.5.7-8 Number of Tanks

| Volume ($m^3$) | No. of tanks | Total | Mean/firm |
|---|---|---|---|
| Cleaning tank | 118 | 118 | 2.7 |
| Plating tank less 1.0 | 64 | | |
| 1.1 to 3.0 | 88 | | |
| 3.1 to 7.0 | 30 | 201 | 4.6 |
| 7.1 to 10.0 | 18 | | |
| 11 to 20.0 | 1 | | |
| Total | | 319 | 7.3 |

However, microscopic study shows the variety between the surveyed firms. Figure 4.5.7-1 is a graph indicating the relation between the number of tanks per kind of plating and the number of firms. As clearly shown by the graph, there are 25 firms (58%) whose number of cleaning tanks per kind of plating is 0 to 1.0. In other words, they are doing 1 to 4 kinds of plating with one cleaning tank. This fact seems to be the cause of plating defects, along with surface treatment that will be mentioned later.

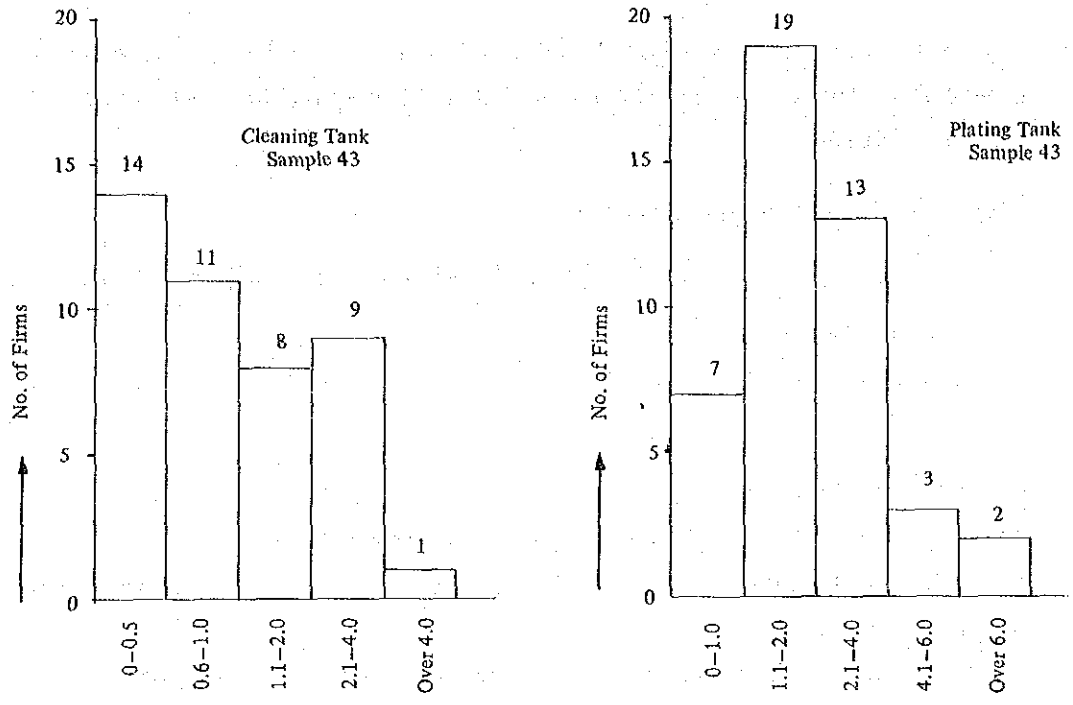



Fig. 4.5.7-1 No. of Tanks per firm

On the other hand, the number of tanks (including cleaning tanks) per firm is 7 to 8 on this survey, up from 4 to 5 on the previous survey.

B. Material for Plating Tank (47 effective responses)

43 firms (91%) are using the plating tanks coated with rubber or polyvinyl (PVC). This result is much the same as that of the previous survey. The number of the firms using the tanks of lead/acidproof brick, and that of the firms using the tanks of FRP/glass fiber are 2 each.

C. Kinds and Capacity of Rectifier (47 effective responses)

26 firms (55%) are using silicon rectifiers, and 19 firms (40%) are using DC generators. Taking together, these two kinds represent 95%. With the capacities of these rectifiers, the number of the rectifiers whose capacities are 500 to 1200 A is 19, and that of the rectifiers whose capacities are over 1200 A is 21.

D. Surface Preparation before Plating (47 effective responses, multi-responses)

Surface treatment before plating (for example, removal of rust, oil, and smut, etc., and of surface roughness) is an important process for upgrading the quality of plating and improving the rate of defects. The most popularly used surface treatment method is acid-cleaning (30 firms or 64%), followed by brushing/grinding with power tool (25 firms or 53%), and electrolytic degreasing (22 firms or 43%). In the most cases they are not used independently but used jointly.

On the previous survey, degreasing method by detergents such as soap-and-water solution was used in approximately 89% firms surveyed. It can be said that one of the characteristics of this survey is the deversification of the treatment methods. Refer to Table 4.5.6-9.

Table 4.5.7-9 Surface preparation before plating

| | Frequency | Percentage |
|---|---|---|
| * Emery/sandpaper, manual brushing or grinding | 13 | 27.7 |
| * Electrical brushing and grinding | 25 | 53.2 |
| * Shot. sand grid blusting | 3 | 6.4 |
| * Barreling and buffing | 9 | 19.1 |
| * Detergent and soap water cleaning | 15 | 31.9 |
| * Gasoline, kerosine, triclene cleaning | 20 | 42.6 |
| * Electrolytic degreasing | 22 | 46.8 |
| * Acid cleaning, pickling etching | 30 | 63.8 |
| * Others | 4 | 8.5 |
| Total | | 300.0 |

E. Kind and frequency of inspection (47 effective responses - multi-response)

Most of the companies (44 companies or 94%) apply visual inspection on plating process, and approximately 25% (11 companies) do film thickness inspection. However quite few companies apply surface hardness check (2 companies) and other inspections. For frequency of inspection, about half of the companies (25 companies, 53%) have a regular inspection system, and 18 companies (38%), 'often inspect', resulting in the fact that 90% or more of the companies inspect in a regular or frequent manner. However, it can be assumed that these methods are not based on the statistical theory, except only one firm who makes the sampling inspection according to the statistical method.

In the previous survey, "first-production inspection", without any specific methods of inspection was most popularly applied.

F. Kind of defects and defect ratio (40 effective responses - multi-responce)

The responses on the defect ratio is as follows:

| | | |
|---|---|---|
| 1% or less | 26 companies | 65% |
| 2 to 5% | 8 " | 20% |
| 6 to 10% | 5 " | 12% |
| 11 to 20% | 1 " | 3% |

Defect ratio of 1% in the plating industry may prove its technical level to be very high. However, defect ratio can vary greatly depending on a standard on which evaluation is made, that is, on quality standards requested by customers. The previous survey, which was not properly graded in questions, had a rough range of 0 to 10%. Therefore comparison of the two surveys on this matter can not make any sense.

Kinds of defects are as shown in Table 4.5.7-10 and Figure 4.5.7-2. The most dominant is cracking on the plated surface (17 firms, 37%), followed by shortage of luster (15 firms, 33%), and then by pin hole (7 firms, 15%) and poor uniformity of thickness and hardness.

Table 4.5.7-10 Defect faced sometimes

| | Frequency | Percentage |
|---|---|---|
| * Pin hole | 7 | 15.2 |
| * Cracking | 17 | 37.0 |
| * Corrosion or rusting | 6 | 13.0 |
| * Shortage or excess of film thickness | 3 | 6.5 |
| * Shortage of hardness | 0 | 0 |
| * Shortage of luster | 15 | 32.6 |
| * Poor uniformity of thickness and hardness | 7 | 15.2 |
| * Others | 15 | 32.6 |

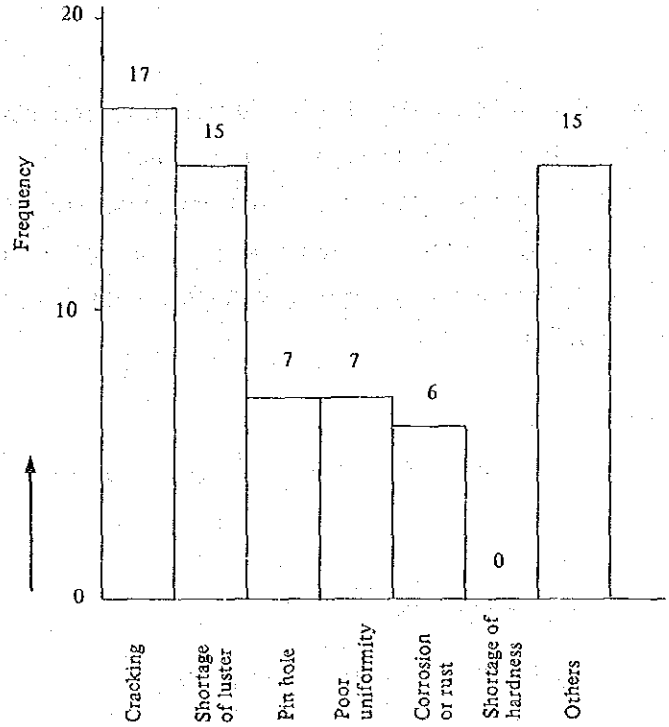



Fig. 4.5.7-2 Kinds of Defects

G. Technical assistance

In response to the question whether or not any external plating technical assistance has been given, the respondents give the replies; 14 (approx. 30%) companies have never had it, two others have had it from other companies in the same line industry, four from their parent companies, and one from the governmental institution. No company has asked private specialists or consultants for assistance. 26 companies chose the item of "others" and the contents of "others" are not clear.

H. Training and education of employees

The question is how often employees or the employer himself have taken the educational or training course outside their company. 18 companies (approx. 38%) have never taken any, 21 (approx. 45%) have participated in it once to three times which is dominant, and three, very few as they are, reply that they take such a course periodically every year.

I. Number of "engineers"

"Engineer" here means graduates of technical high school, polytechnical, or technical college. This item is the research on distribution of the number of "engineers."

It is assumed that the number of "engineers" who graduated from these educational institutions and play a leading role for their company, indirectly shows a technical level of the company. The numbers of companies and engineers working for 43 companies which replied to the item are shown in Table 4.5.7-11.

Table 4.5.7-11 No. of Engineers

| No. of Eng'r | 0 | 1 – 4 | 5 – 10 | 11 – 20 | Over 20 |
|---|---|---|---|---|---|
| No. of Firms | 22 | 13 | 3 | 1 | 3 |

Table 4.5.7-11a No. of Engineers by Education Level

| | 0 | 1 – 4 | 5 – 10 | Over 10 |
|---|---|---|---|---|
| Tech. High School | 29 | 7 | 5 | 2 |
| Polytechnical | 36 | 5 | 1 | 1 |
| University | 31 | 10 | 1 | 2 |

As indicated in the table, 22 companies (approx. 51%) have no "engineers" at all, and 13 companies (approx. 30%) have 1 to 4 "engineers", while all the companies which have 11 or more "engineers" engage in other kinds of production. Table 4.5.7-11a shows the number of "engineers" in relation to education levels in more detailed sorting.

Since the previous survey did not make the same research, it is impossible to compare the two surveys.

J. Capability of understanding technical drawings and job instruction methods.

It can be one of standards for assessing technical level of a company how many workmen are capable of understanding technical drawings. The capability may also determine daily job instruction methods and will affect accuracy and quality of jobs. Table 4.5.7-12 shows the number of workmen capable of understanding technical drawings related to the number of companies.

Table 4.5.7-12 No. of workmen who understand tech. dwg.

| No. of workmen | 0 | 1 | 2 – 4 | 5 – 10 | Over 10 |
|---|---|---|---|---|---|
| No. of firm | 31 | 2 | 9 | 0 | 2 |

As obviously shown in the table, 31 firms or about 70% have not any workmen who can understand technical drawings. As a result, job instruction is given by a sample, a sketch, or oral information in 41 companies (approx. 93%). The figure reaches 100% for the firms which engage only in plating. When standardization of product and operation has been established, plating does not necessarily require technical drawings in routine operation. However, when they begin to deal with a new product, lack of knowledge of technical drawings may cause unexpected defects.

K. Standardization in Production activities

The question is about the kind of job items which have been standardized or normalized in the whole activity of operation process from the planning stage to after-sales-service. The result is; 8 in the production process, 7 in quality control, 6 in production work, 6 in price, 4 in warranty, 3 in design, etc. Thus standardization of operation in the plating industry is very low. It is strongly preferred that in this industry at least production processes such as plating and inspection should be standardized and controlled by written instruction such as a job instruction sheet.

L. Feed back of inspection results and preventive measures against defects

It is a basic of quality control to feed back inspection results to the upper process of production for protective measures against defects. The following are the replies on the methods of feed back.

| | | |
|---|---|---|
| * Notice on a bulletin board, etc. | 4 companies | (13%) |
| * Circulating notice among superintendents and workers | 2 " | ( 7%) |
| * Combined meeting of both superintendents and workers for possible measures | 23 " | (77%) |
| * Statistical control by specialized person | 1 company | ( 3%) |

Thus approximate 80% of the respondents seem to try to take measures against defects with combined efforts of superintendents and workers. However it is not clear whether they take measures against troubles already occurred or for preventive measures.

When a defect occurrs, most companies (28, or 68%) take measures based on their experiences of the past troubles.

Six companies analize the cause of defects from a whole aspect, while five companies take almost no measures against troubles.

2-3 Location of factories and pollution caused by them

The survey laid emphasis on wastewater pollution which is caused by the plating industry and often results in serious environmental problem.

A. Location of factories (41 effective responses)

Table 4.5.7-13 shows factory location of the companies to which the survey was made. Half or more of them are located in the residential area, while only four (approx. 10%) are in the industrial district.

Table 4.5.7-13 Location of Factories

| | No. of factories | Percentage (%) |
|---|---|---|
| Industrial district | 4 | 9.8 |
| Tax free, free export zone | 0 | 0 |
| Commercial area | 5 | 12.2 |
| Residential area | 23 | 56.1 |
| Not defined | 9 | 22.0 |
| Total | 41 | 100% |

B. Protests against pollution

Eight companies (20%) have been made some protests against, which have naturally been about wastewater pollution. Six of these companies are located in the "not defined" area of Table 4.5.7-13 and two in the industrial area. Unexpectedly no protest has been made in the residential and commercial areas.

C. Discharging place of plant effluent (40 effective responses)

Up to 34 companies (85%) in total provide their own discharging or septic tank. This figure denies a myth of Thai plating plants that they discharge wastewater without giving any treatment. We will have to change our preconception on this matter.

(See Table 4.5.7-14.)

Considering the state of 8 companies that have been protested in respect of this item, two of them have their own septic tank, five have their own discharging tank, and one discharges wastewater to the public sewerage.

Table 4.5.7-14 Discharge of plant effluent

| Place | No. firms | Percentage (%) |
|---|---|---|
| Septic tank of factory | 14 | 35 |
| Lagoon system of factory | 20 | 50 |
| Public sewerage system | 4 | 10 |
| Creek and river | 2 | 5 |
| Sea | 0 | |

D. Wastewater treatment (multi-response)

Table 4.5.7-15 shows how plating companies treat plating wastewater before discharging. Six (approx. 13%) of them give no treatment, however 80% or more gives to some treatment before discharging. It is notable that one company employ a circulatory purifying system.

Table 4.5.7-15 Waste water treatment

| Treatment | No. firm | Percentage |
|---|---|---|
| No treatment | 6 | 15 |
| Settling | 20 | 50 |
| Filtration | 12 | 30 |
| Neutralization | 25 | 62.5 |
| Circulating system | 1 | 2.5 |

This company can be included as one of the model factories in the course of future training tour to be planned by the industry association or the governmental institution.

The level of wastewater treatment in Thailand has been improved since the previous survey which indicated that only 72% of the respondents gave treatment to wastewater. This probably owes to the fact that the new survey was limited to the Capital district and its surroundings, and that approx. 30% of the respondents are the companies which were established after the previous survey.

E. Frequency and entrusting of water inspection

Up to 25 companies (approx. 53%) execute "regular" or "frequent" inspection of wastewater. Other 18 companies (38%) never or seldom execute such inspection. Considering the inquiry of the paragraph (D), it can be said that many of the companies just execute routine treatment of wastewater, without inspection. (see Table 4.5.7-16.)

Table 4.5.7-16 Frequency of wastewater inspection

| Frequency | No. firms | Percentage |
|---|---|---|
| Never | 11 | 23.4 |
| Rarely | 7 | 14.9 |
| Sometimes | 4 | 8.5 |
| Ofter | 7 | 14,9 |
| Always | 18 | 38.3 |
| | 47 | 100.0 |

For the question of "who inspects", 18 companies (approx. 38%) inspect by themselves, 22 companies entrust it to the governmental or public institution, and four (8%) entrust it to other companies or a private inspection agent. Thus, at present plating factories are not forced by any laws to treat wastewater or examine treated water before discharging. However it will probably be necessary in future that they should be compelled to some extent to treat plant effluent, and inspection should be given by the authorities. Some certification system might also be required. Otherwise pollution casued by plating wastewater may lead to serious social hazard in a low and damp ground with poor drainage like Bangkok, as the plating industry becomes more prosperous.

2-4 Market and finance

A. Market

The research on category of customers (see paragraph 2-1 G.) shows that approx. 70% of the respondents sells mainly to small or medium firms. The regional sorting of the market is as follows;

| | |
|---|---|
| In the region | 2 companies |
| In the province | 1 company |
| Countrywide | 38 companies |
| Even to neighbouring developing countries | 3 companies |

As shown in the above, most companies (38, or 86%) have the countrywide market, probably because almost all Thai plating companies are located in Bangkok or its surroundings and quite few are in local areas. The previous survey shows the same tendency that 80% or more of the Thai metalworking enterprises are located in Bangkok or its surroundings.

B. Price decision

Prices are decided by the following factors;

| | | |
|---|---|---|
| Market price | 24 companies | 55.8% |
| Customer's inquiry | 10 companies | 23.3% |
| Seller's estimate | 7 companies | 16.3% |
| Price agreement for 6 months or longer | 1 company | 2.3% |

In spite of these replies most companies said that final prices are after all decided close to the market price. One company makes an agreement on prices for 6 months or more. a rather long period of 6 months or more.

C. Delivery date instruction

The date of delivery is instructed in the following methods;

| | | |
|---|---|---|
| Oral instruction | 35 companies | 83.3% |
| Order sheet | 3 companies | 7.1% |
| Fixed agreement for a short or long term | 2 companies | 4.8% |
| No specific instruction | 2 companies | 4.8% |

Thus the date of delivery is instructed to the plating mostly by oral instruction.

D. Frequency and extent of delayed delivery (43 effective responses)

Table 4.5.7-17 shows frequency of delayed delivery surveyed.

Table 4.5.7-17 Frequency of Delay

| | No. of firms | Percentage |
|---|---|---|
| Very often | 4 | 9,3 |
| Sometimes | 9 | 20.9 |
| Rarely | 14 | 32.6 |
| Seldom | 8 | 18.6 |
| Not at all | 8 | 18.6 |
| Total | 43 | 100.0 |

An approximate 30% belongs to the "rarely" delayed delivery group, and another 30% belongs to the "sometimes" and "very often" groups in total.
The dominant length of delay is 0 to 3 days (37 companies, or 86%), followed by 2 to 4 weeks (4 companies), and then by 4 to 7 days (2 companies). When 16 companies which have "not at all" or "seldom" delay are subtracted from 37 companies which have delay of 0 to 3 days, it shows that 21 companies (49%) delay only 3 days or fewer.

E. Causes of delay and measures against delay (multiresponse responded by 36 companies)

The following table shows causes of delay in the descending order.

| | | |
|---|---|---|
| Shortage of labour | 19 cases | (approx. 53%) |
| Inferior production management | 8 cases | (approx. 22%) |
| Too short term of delivery | 8 cases | (approx. 22%) |
| Delayed delivery of material | 7 cases | (approx. 19%) |
| Occurrence of defect | 4 cases | (approx. 11%) |
| Others | 3 cases | (approx. 8%) |

Shortage of labour can be regarded as a result of absence of effective labour plan supported by a long-term production plan. Other causes of delay may be due to poor managemental technique. Another factor may be their careless attitude to receiving orders without considering their own production capacity.
To prevent delay, the companies take the following measures;

| | |
|---|---|
| No preventive measures | 29 cases (67%) |
| Rare check for delay | 8 cases |
| Weekly check | 1 case |
| Daily check | 2 cases |
| Check by specialized staff | 3 cases |

It shows their poor understanding of importance of delivery control that 67% of the respondents have no measures for delivery control.

F. Labour productivity

There are some definitions of labour productivity, however in this analysis is used the same definition as the previous survey did for easy comparison,

$$\text{Labour productivity} = \frac{\text{Sales}}{\text{Number of employees}}$$

It is usually rather difficult to survey administrative figures from enterprises. However, responses from 20 companies could be given.

| | |
|---|---|
| Total sales of 20 companies | 22,780,000 Baht |
| Total employees of 20 companies | 282 |
| Sales per employee | Approx. 80,780 Baht |

The following is a list of these 20 companies sorted by sales.

Sales per employee

| | |
|---|---|
| Less than B.20,000. | 4 companies |
| B.20,000. to 60,000. | 6 companies |
| B.60,000 to 100,000. | 7 companies |
| B.100,000 to 150,000. | 1 company |
| B.150,000. or more | 2 companies |

In the previous survey, sales per employee of the Thai plating industry was US$2,385.00, which equals approx. B.54,860. (US$1.00 ≒ B.23.00). Therefore this survey shows that sales per employee has increased nearly 50% since then.

G. Capital equipment ratio

Capital equipment ratio is defined as it was defined in the former survey as follows:

Capital equipment ratio = fixed assets per employee, excluding land and buildings.

Responses were obtained from twenty three specialized plating companies with the result as follows;

| | |
|---|---|
| Total fixed assets of the twenty three companies | 39,660,000 |
| The total number of employees in the twenty three companies | 338 |
| The fixed assets per capita | 117,300 |

The twenty three companies are classified by their capital equipment ratio as follows;

| | |
|---|---|
| less than 20,000 | 6 companies |
| 20,000 to 60,000 | 5 companies |
| 60,000 to 100,000 | 6 companies |
| 100,000 to 150,000 | 3 companies |
| 150,000 to 300,000 | 1 company |
| 300,000 or more | 2 companies |

The capital equipment ratio was US$2,201 (about B.50600) in the previous survey. It has increased by 2.3 times of that in 1978.

The increase of the capital equipment ratio is positively evaluated as the progress of mechanization and rationalization, while it is considered as the negative aspect due to the excessive facilities in the other view. It is necessary to judge it from the analysis of productivity of capital mentioned in the following item.

H. Productivity of capital

Productivity of capital is defined as it was defined in the previous survey, that is, sales amount per unit fixed assets excluding land and buildings;

Productivity of capital = sales amount/fixed assets

Expected data was obtained from sixteen specialized plating firms.

| | |
|---|---|
| Total sales amount of the 16 firms | B 21,190,000 |
| Total fixed assets of the 16 firms | B 20,510,000 |

Total sales amount/total fixed assets = 1.03

This ratio has decreased by about 5% of that in the previous survey which was 1.08. The capital equipment ratio has increased to 2.3 times as mentioned above. This means that capital of these firms could not be effectively invested.

These 16 companies are classified as follows;

| Their productivity of capital | number |
|---|---|
| 1.0 or less | 5 |
| 1.1 to 2.0 | 4 |
| 2.1 to 5.0 | 3 |
| 5.1 to 10.0 | 1 |
| 10.1 or more | 2 |

In a sense, low productivity of capital is considered to be an accumulation of various problems in technological and managerial fields. To improve this will lead to the comprehensive improvement of the industry itself, so some measures for the improvement led from the analysis are presented in the following article.

(3) Issues and Measures

In the analysis of the status quo in item (2), we analyzed the present situation of the plating companies in and around Bangkok in Thailand, based on the data obtained from the survey, in comparison with those of the previous survey in 1978. It can be definitely concluded that industry scales have become larger than those in the previous survey and companies have been improved in most fields, such as equipment, technology or waste water treatment.

However, when their level is compared with that of leading industrial countries or newly industrialized countries called NICs, there remain many problems and they are behind in all aspects of management, equipment and technology.

In this article all of the issues and problems are not discussed individually, but an emphasis is placed on two points which have not been improved in comparison with those of the previous survey. These problems are an accumulation of various problems and if these are improved, the root problems will be also resolved.

Problem 1. High defect ratio

As described in 2-2 Item F, two-thirds of the surveyed companies answered that their defect ratio was 1% or less, but the other, one-third answered that it was from 2% to 20%. High defect ratio is related not only to technological problems but also other problems on manufacturer's activities such as management and equipment. Therefore, to improve this will be significant since it will also improve the firm's constitution.

Problem 2. Low productivity of capital

The previous survey showed that the capital productivity of the plating industry in Thailand was the lowest among the other ASEAN countries and the second lowest among the other demestic industries. In this survey, it is proven that it has become worse. To clarify the cause and to take a measure to improve the situation will be naturally a direct method to increase the profit of the enterprises, and it will also result in desirable development of the plating industry in Thailand.

3-1 Causes of defects

This survey was not performed through our direct observation on the firms but based on a questionnaire by the counterparts of Thai Government. The problems thus cannot be discussed microscopically to look for the causes and strategies thereof. Therefore, the causes and strategies against the defects cannot help being studied macroscopically.

Firstly items supposed to be general causes of defects in the plating industry are enumerated and compared with the levels revealed by the questionnaire.

Figure 4.5.7-3 shows the possible causes in a fish-bone diagram.

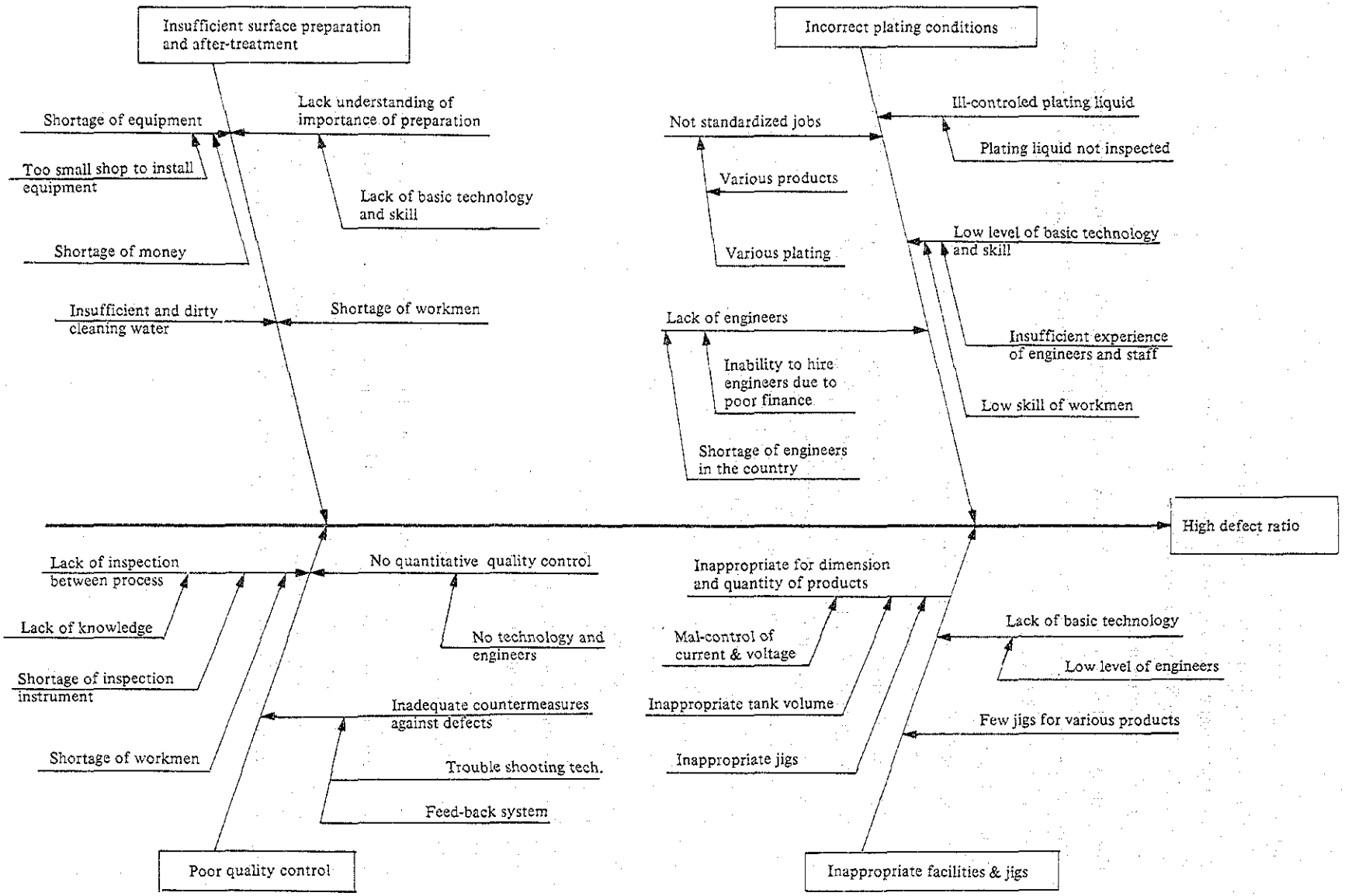



Fig. 4.5.7-3 Fish-bone diagram of High Defect Ratio

The primary causes are assumed as follows:

1) Correct plating conditions are not satisfied.
2) Surface preparation and treatment are not sufficient,
3) Facilities and jigs are not appropriate, and
4) Quality control is poor.

Furthermore, the secondary and tertiary causes of the primary causes are pursued, and ultimately some common factors are extracted. These extracted factors are picked up and summarized as follows,

Personnel factors.

1)* Capable engineers are few or non-exsistent,
2)* Skills of workmen are low or lacking,
3) Concepts of quality control and responsibility for defects are not recognized among firm's leading staff, factors causes by the diversificaiton of products,
4)* Job procedures are hardly standardized,
5)* Plating conditions are hardly standardized and unstable,
6)* Inspection procedures and methods are hardly standardized,
7) Provision of suitable facilities and jigs are difficult,

Factors caused by facilities and jigs

8) Facilities are lacking,
9) Facilities and jigs are not appropriate,
10) Inspection instruments are lacking,
11)* Electric sources are not suitable,
12) Shop space is small to equip more facilities,
13) Funds for investment are in shortage, etc.

The items with star marks * are proven by the questionniaire through the survey that they are real situations of the plating industry in the country. However, the other items are not proven because effective questions were not given in the questionnaire. In particular, regarding the facilities, it should not be discussed without observation on individual firms, and size, shape and quantity of products, facilities and jigs etc.

3-2 Causes of low capital productivity

The same method as that in the previous article 3-1 is applied to pursue the causes of low capital productivity. Cause- effect diagram (fish-bone diagram) is shown in Figure 4.5.7-4.

Possible primary factors are:

1. Sales amount is small.
2. The efficient working ratio of equipment is low.
3. The balance between products and equipment is not appropriate.
4. Other factors.

The primary factors are investigated, and the secondary and tertiary factors thereof are pursued, which are classified into some common factors.

Factors caused by market situations

1) Market is still small,
*2) Market is high competitive, therefore market prices are low,
3) Prices are led by customers,
4) Specifications from customers are diversified,

Factors caused by management and control

*5) Production plan and equipment plan are poor,
6) Plan and activity to get job orders are insufficient,
*7) Delivery time is sometimes delayed due to poor production control,

Factors caused by technology or skill.

*8) Job procedures are not standardized due to varieties of products,
*9) Workmen are low in skill and technology,
10) Jigs are not appropriate,

The factors with mark * have been proven by the questionnaire through the survey.

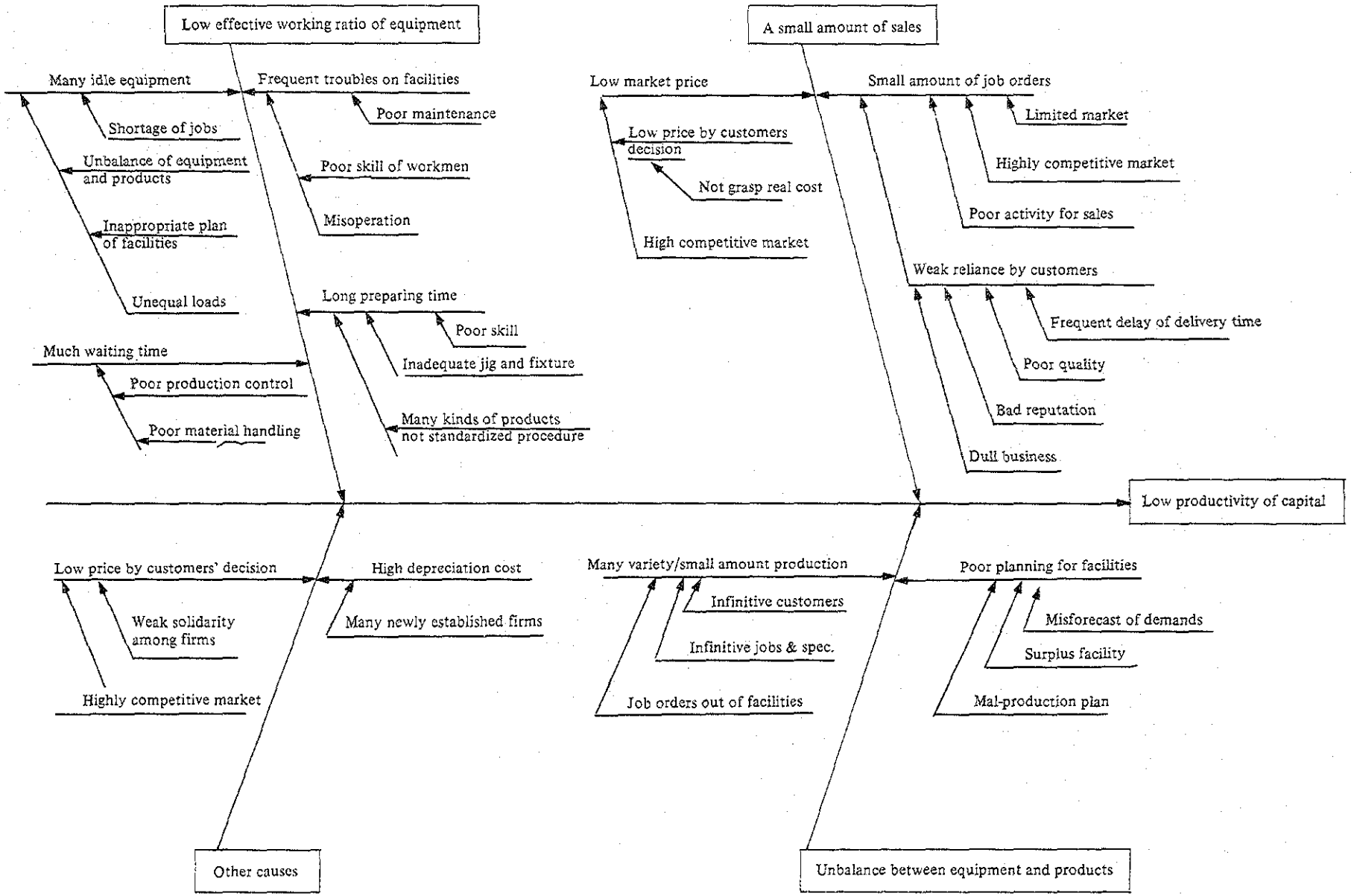



Fig. 4.5.7-4 Fish-bone diagram of Low Productivity of Capital

3-3 Countermeasures

In Article 3-1 and 3-2, the major two problems high defect ratio and low capital productivity have been investigated and it has been proven that these problems are caused by the following fundamental issues:

1) issues on personnel
2) issues on market
3) issues on facilities
4) issues on finance

It is assumed that these issues are not independent each other but related to each other, and as a result, the above mentioned problems are caused.

Possible countermeasures are classified into two categories; one is measures to be taken by individual firms and the other is measures to be taken by the government or public sectors. Those are summarized in Table 4.5.7-18.

Table 4.5.7-18 Countermeasures for plating industry

| | Short and Middle Term | Middle and Long Term |
|---|---|---|
| Governmental or Public Sector | • Roving extention service and business diagnosis for smalle medium scale firms.<br>• Wastewater inspection & administrative guidance by government or public institution. | • Completion of education system and facility in the existing technical and vocational school.<br>• Establishment of training & education institute for leading persons in private firms.<br>• Reorganization, coordination and specialization of small firms. Setting up industrial estates.<br>• Qualification system for excellent firms.<br>• Increase loans & simplify procedure thereof to modernize rationalize facilities. |
| Private Sector | • Effective training system in firm<br>• Standardize and simplify daily routine works<br>• Review products and facilities and clear surplus old and idle equipment.<br>• Review jigs and fixtures. | • Establish plating industry association, or cooperation.<br>• Stable job orders from large scale industry.<br>• Promote specialization & standardization, to attain stable quality. |

It seems that the short term measures by individual firms are difficult and limited in efficiency due to the shortage of financial and human resources. Particularly, the issue of human resources should be resolved by governmental strategies on the standpoint of long-term and national wide view.

Among from the above-mentioned measures in the table, the following two recommendations are highlighted.

A. Establish educational and training organization for leading persons of the firms.

Active and leading persons in the firms, especially in the case of small industry, can hardly get an opportunity to learn advanced technical and managerial technologies due to the shortage of time and money. However, it is essential for them to pursue always advanced technologies in order to take the part of supporting industry for industrialization in the country.

For this purpose a governmental or public organization should be established to re-educate or train active and leading engineers and managers of the firms. In this organization, some management and control technologies such as production control, quality control and business management should be taught in addition to industrial technologies.

B. Reorganize and specialize small scale industry and establish plating industrial estates.

As shown in the present situation, there are many plating firms with 10 employees or less and they compete each other in the small market. It is one of effective strategies for the development of Thai plating industry to reorganize and specialize those firms and to organize them in industrial estates.

Various effective results can be obtained in industrial estates, especially in the case of plating industry. For example, common utilization of facilities like electrical source, industrial water, wastewater treatment and inspection and testing are effective for the cost saving. Recycling system of wastewater will be also helpful for water resource saving and pollution protection, especially in Bangkok where the land level is low and drain condition is ill.

4.5.8 Heat Treatment

Of the 334 enterprises covered by the present survey, seventeen (5.1%) including 7.3% of their 235 subcontractors, have been conducting on the business of heat treatment anyway. In addition, some enterprises are engaged in the heat treatment as part of their diversified lines of business. Therefore, six companies only have answered to the questions relating to the heat treatment industry. Based on those data, it is difficult to make a statistical analysis accordingly. Nevertheless, the local situations have been investigated. Therefore, their relations with code numbers given in our questionaire will be shown here in our desire to grasp problems involved and search for solutions thereto.

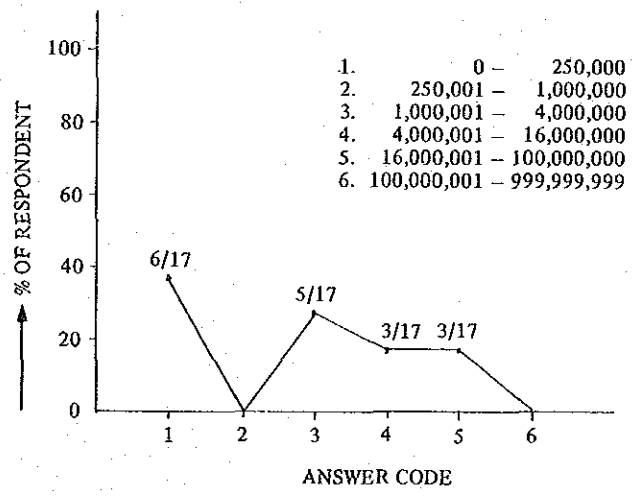
(1) Scale of Enterprises

1) Capital (Fig. 4.5.8-1)

Approximately 65% of the enterprises (11/17 companies) have a capital of ฿1,000 x $10^3$ Moreover, approximately 18% (3/17) have a capital of ฿16,000 x $10^3$ or more. These figures are unexpectedly large as a capital of the heat treatment enterprises.

This is presumably because they are engaged in the heat treatment as part of their diversified lines of business. On the other hand, however, approximately 35% (6/17) have a capital of ฿250 x $10^3$ or less. They seem engaged nearly exclusively in this line of business as small heat treatment enterprises.

Fig. 4.5.8-1 Capital



2) Sales (Fig. 4.5.8-2)

Approximately 53% (9/17 companies) have an annual sales of ฿4,000 x $10^3$ and below, which is felt rather low as compared with the amount of their capital. However, approximately 35% (6/17) have an annual sales of ฿16,000 x $10^3$, which is compatible with their business size. The difference in annual sales is assumed to arise from the difference in business size. Their sales are small on the average in comparison with ¥180 million (source : 1980 Statistics, Ministry of International Trade and Industry, Japan) per factory in the Japanese heat treatment industry.

3) Area of Site (Fig. 4.5.8-3)

Approximately 50% of the enterprises (8/17 companies) have an area of 2,500 square meters and below while about 30% (5/17) have an area of more than 16,000 square meters.

Fig. 4.5.8-2 Sales

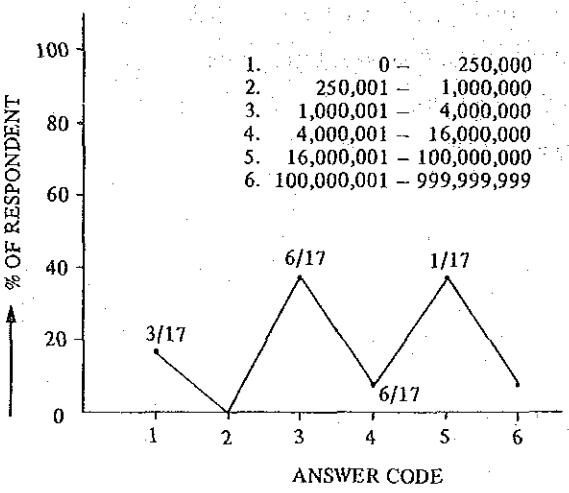
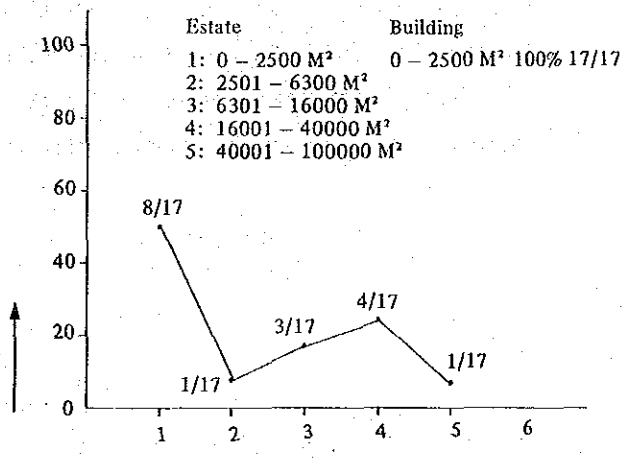



Fig. 4.5.8-3 Area ($M^2$) of Site




4) Equipment Scale (Table 4.5.8-1)

100% (17/17 companies) have an equipment size of ฿250 x $10^3$ and below. This small equipment size as compared with their capital is assumed to arise from a primitive level of equipment.

Table 4.5.8-1

Q6: Amount of Equipment

| | % | No. of companies |
|---|---|---|
| ฿250 x $10^3$ and below | 100 | (17/17) |
| Over ฿250 x $10^3$ | 0 | |

5) Employees (Fig. 4.5.8-4, Fig. 4.5.8-5)

a) Number of employees

Approximately 50% of the enterprises (9/17 companies) have a number of 50 employees or more. In Thailand, a relatively large number of enterprises in this industrial sector could be classified into the medium size of business. In Japan, enterprises exclusively engaged in the business of metal heat treatment have the number of 14.5 employees per factory (1980 Statistics, MITI) As shown in Fig. 4.5.8-4 & Fig. 4.5.8-5, Thai heat treatment enterprises seem to have a workforce size nearly equal to that in Japan, considering that the four Thai enterprises who could understand what the heat treatment business is, (who have a high speciality level) "Speciality Level"), have the number of 5 thru 10 employees (3/4 companies) and of 11 thru 20 employees (1/4).

Fig. 4.5.8-4 Number of employees

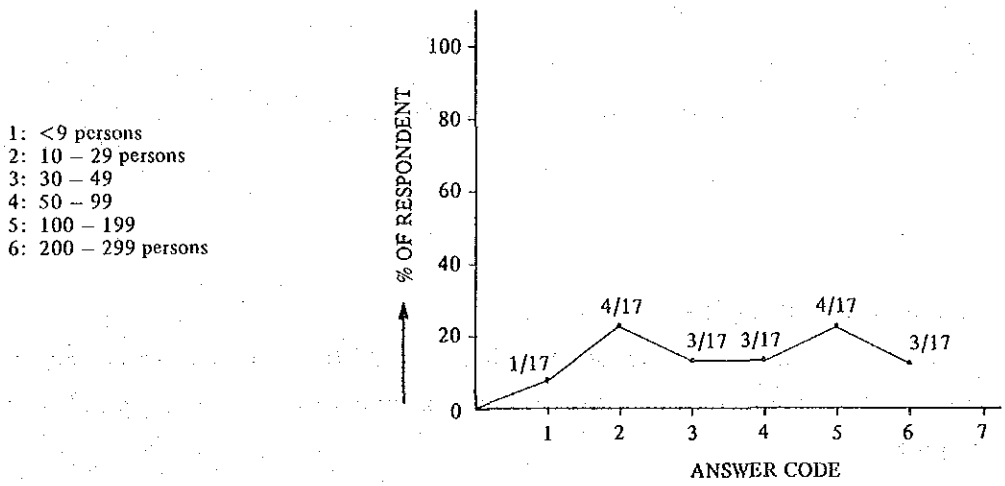
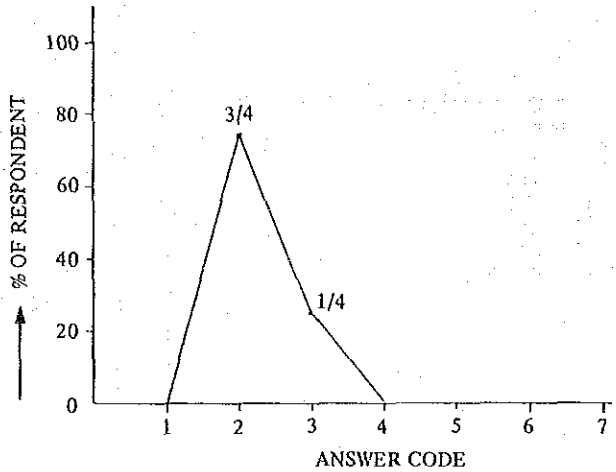


Fig. 4.5.8-5 Number of employees

Q252 How many employees are engaged in heat-treatment? (S)

1. Less than 5 persons
2. 5–10 persons
3. 11–20 persons
4. 21–30 persons
5. 31–50 persons
6. More than 51 persons




b) Employees years of experience, wages, education levels and training systems (Fig. 4.5.8-6, 7, 8, 9, 10, 11)

On the average, employees mostly have a service period of 0 thru 2 years (Fig. 4.5.8-6). As shown in Fig. 4.5.8-7, many enterprises (8/17) have 50% or more of their employees experienced (five or more years of experience).

100% of the 17 enterprises (Fig. 4.5.8-8) pay a mean wage of ฿1,000 and below. For education level, many employees have completed an elementary school course. The higher the education level, the smaller the number of employees.

To educate and train the employees in line with their distribution of education level, therefore, it is necessary to provide a curriculum of training, including patrol guidances, consultant services and seminars.

Fig. 4.5.8-6

303 Average service year of employee

1. 0 – 2
2. 3 – 5
3. 6 – 10
4. 11 – 15
5. 16 – 99

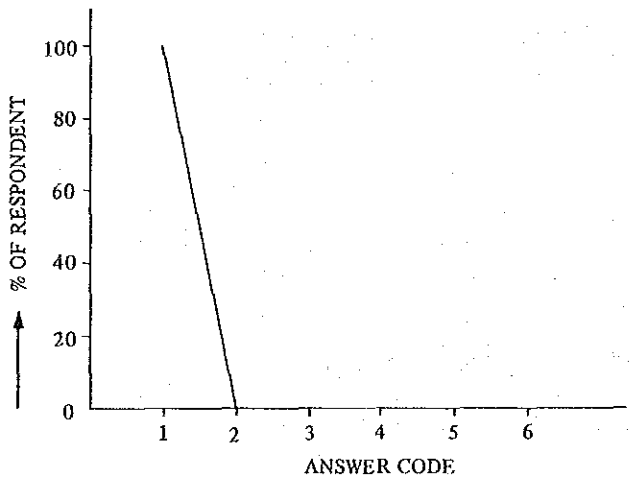


Fig. 4.5.8-7

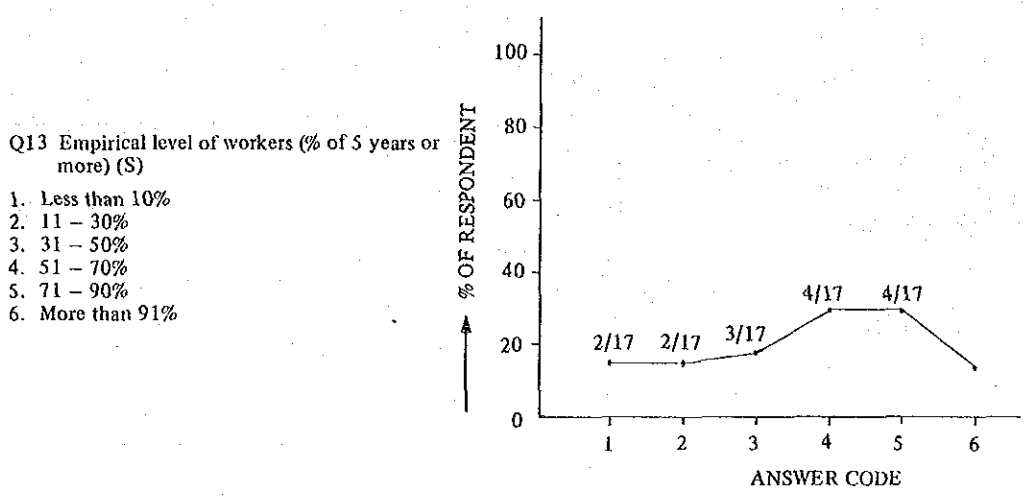



Fig. 4.5.8-8

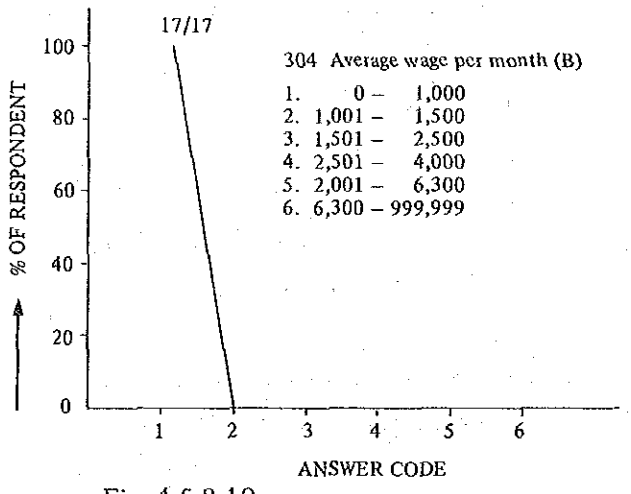



Fig. 4.5.8-9

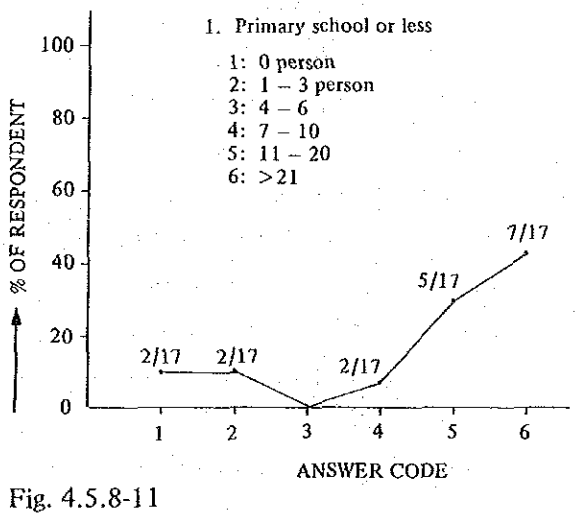



Fig. 4.5.8-10

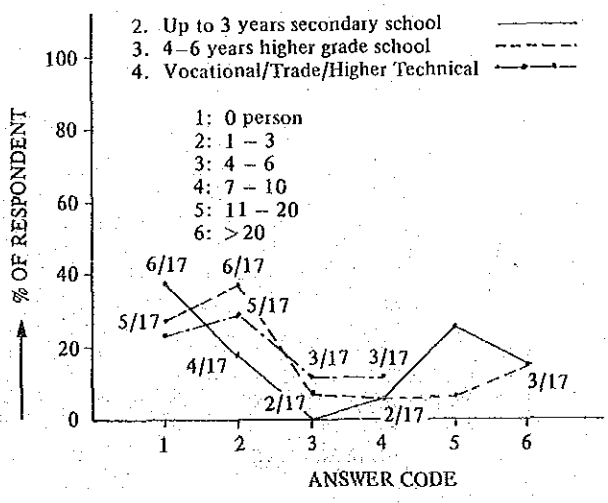
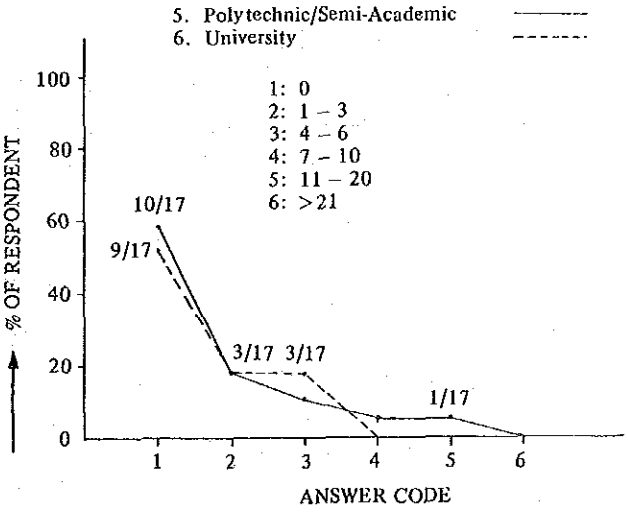



Fig. 4.5.8-11



c) Breakdown of employees (Fig. 4.5.8-12, Fig. 4.5.8-13, Fig. 4.5.8-14 and Fig. 4.5.8-15)

Five and three of the 17 enterprises have no employees engaged in marketing and in cost estimation, respectively. Most of the enterprises, however, have one or more employees engaged in inspection/quality control and in design engineering.

Fig. 4.5.8-12

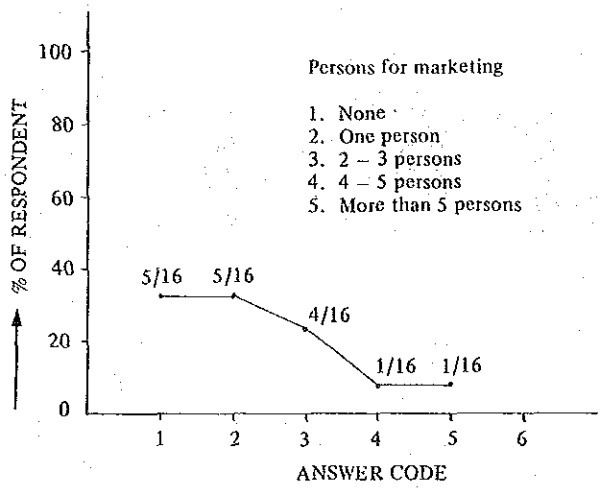



Fig. 4.5.8-13

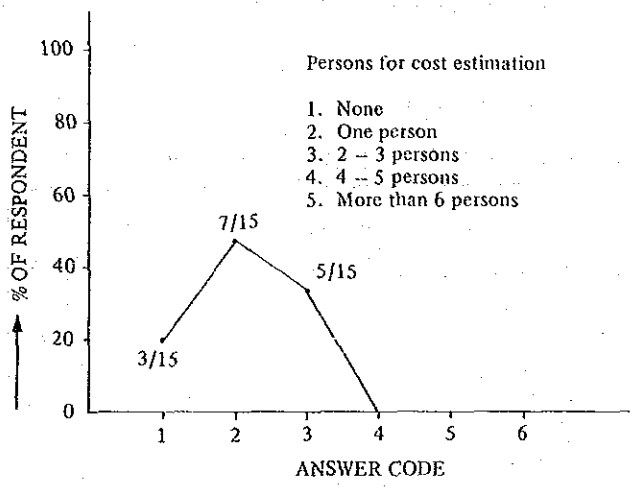



Fig. 4.5.8-14

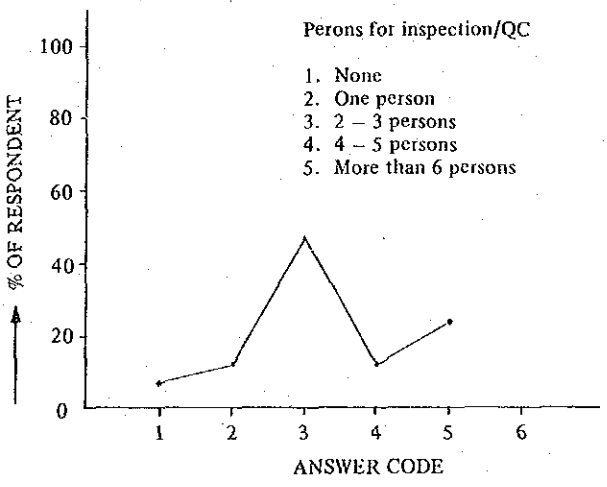
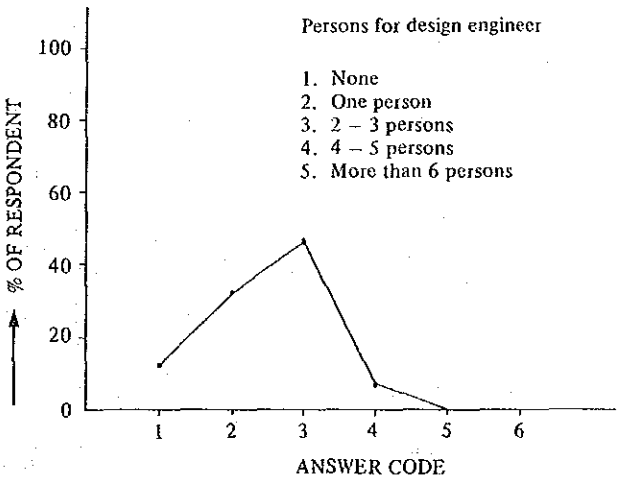



Fig. 4.5.8-15



6) Specialization Percentage (Fig. 4.5.8-16)

Approximately 80% (13/17 enterprises) have a heat treatment business share of 20% and below in their internal lines of business. In other words, many enterprises are conducting on another line or lines of business in parallel. And the heat treatment shows a low percentage, among others. As shown in Graph Fig. 4.5.8-16, however, this percentage is high for the four enterprises who could understand what the heat treatment is. In other words, these four enterprises have a high speciality level. (One of the four is specialized in the heat treatment business.)

Fig. 4.5.8-16

Q05-1 What are the main products of your company in terms of principal products and processings? (M/R)

| Category of products | Ratio (%) |
|---|---|
| Processing and/or subcontracting services | |
| 1. Machining | |
| 2. Casting | |
| 3. Forging | |
| 4. Heat treatment | |
| 5. Plating | |
| 6. Welding | |
| 7. Painting | |
| 8. Sheetwork/pressing | |
| 9. Precision machining for gears, die mold, etc. | |

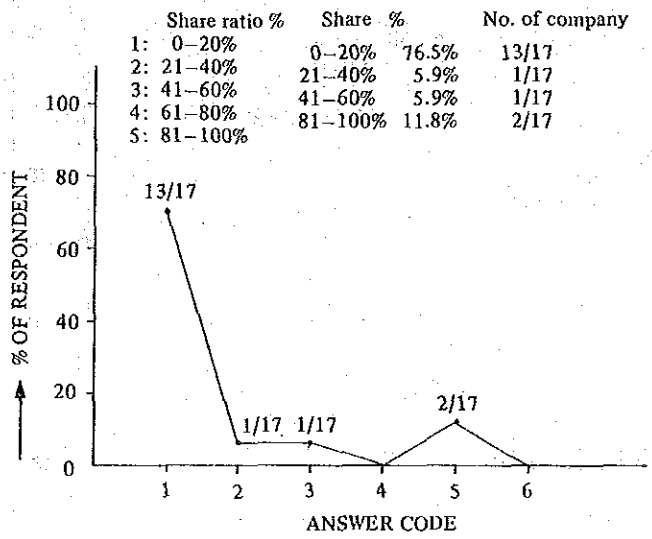
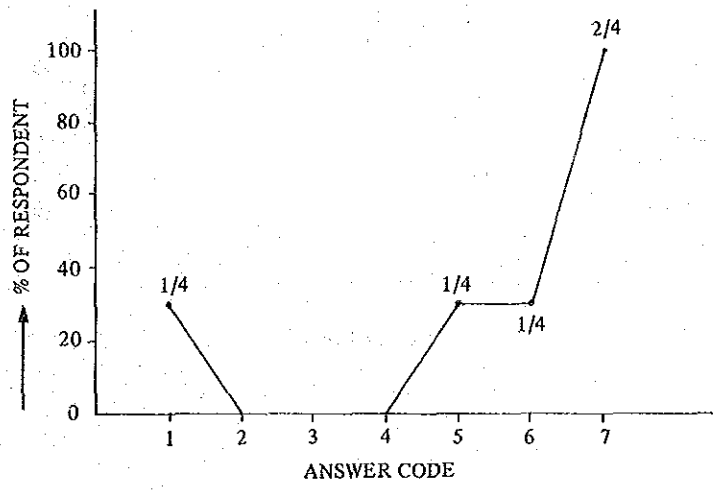



Fig. 4.5.8-17

Q251 Do you employ other processes except heat-treatment? (M)

1. None
2. Forging
3. Casting
4. Sheet metal working
5. Welding
6. Machinering
7. Others specify



7) Kind of Products (Table 4.5.8- 2 , 3 & 4

Table 4.5.8- 2 , 3 & 4 shows the kind of those products which are produced by the enterprises conducting on the business of heat treatment.

Motor vehicles or parts are ranked at the first in both Own Use and Subcontracting In. From this, it could be gathered that auto parts are mainly heat treated in the Thai heat treatment industry.

In addition, agricultural parts, mold dies, tools and gears are treated in the industry.

Heat-treated products have an unexpectedly heavy weight of 100 thru 1,000 kilograms per piece (3 of the 4 companies).

Table 4.5.8- 2

| Ranking | Parts name | No. of company |
|---|---|---|
| 1 | Motor vehicles or parts | 42.9% (3/7) |
| 1 | Mold & dies or parts | 42.9% (3/7) |
| 2 | Agricultural machinery or parts | 14.3% (1/7) |
| 2 | Pipework or parts | 14.3% (1/7) |
| 2 | Working tools or parts | 14.3% (1/7) |
| 2 | Metalworking machinery or parts | 14.3% (1/7) |
| 2 | Machine tools | 14.3% (1/7) |

Table 4.5.8- 3

| Ranking | Parts name | No. of company |
|---|---|---|
| 1 | Motor vehicles or parts | 53.8% (7/13) |
| 2 | Agricultural machinery or parts | 38.5% (5/13) |
| 3 | Working tools or parts | 30.8% (4/13) |
| 3 | Gears | 30.8% (4/13) |
| 3 | Other machinery | 30.8% (4/13) |
| 4 | Mold & dies or parts | 23.1% (3/13) |
| 5 | Industrial machinery or parts | 15.4% (2/13) |
| 5 | Electrical & telecommunication machinery | 15.4% (2/13) |
| 5 | Metalworking machinery or parts | 15.4% (2/13) |
| 6 | Railway equipment & average parts | 7.7% (1/13) |
| 6 | Tableware/utensiles or parts | 7.7% (1/13) |
| 6 | Pump & valves | 7.7% (1/13) |
| 6 | Machine tools | 7.7% (1/13) |

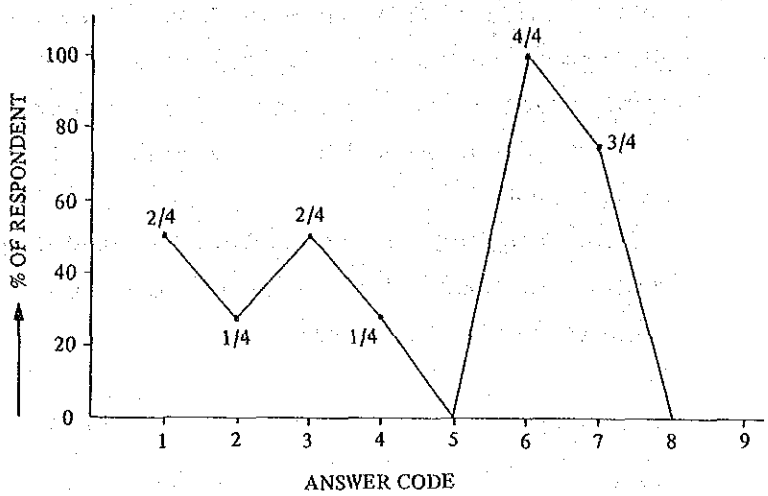
Table 4.5.8-4

| Ranking | Parts name | No. of company |
|---|---|---|
| 1 | Motor vehicles or parts | 40 0% (2/5) |
| 2 | Agricultural machinery or parts | 20.0% (1/5) |
| 2 | Electrical & telecommunication machinery or parts | 20.0% (1/5) |
| 2 | Mold & dies or parts | 20.0% (1/5) |

Fig. 4.5.8-18.

Q252 What is the kind of main customers? (M)

1. Forging manufacturer
2. Casting manufacturer
3. Other metal working manufacturer
4. Automobile manufacturer
5. Other cars manufacturer
6. Agricultural machineries manufacturer
7. Mining machineries manufacturer
8. Daily use
9. Others specify



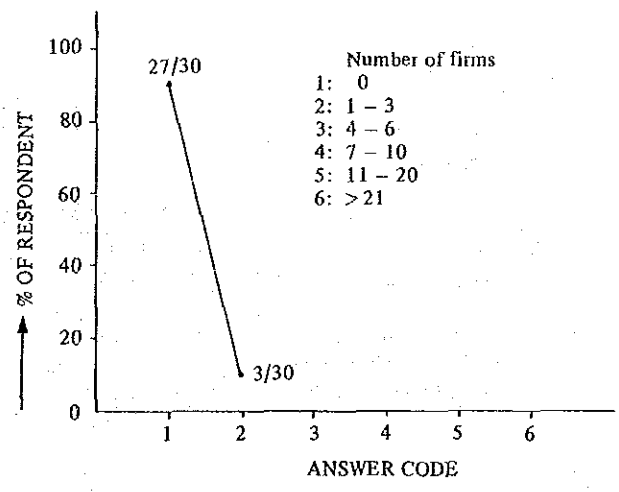

8) Subcontractors (Fig. 4.5.8-19)

The heat treatment enterprises have scarcely subcontracted. (90% do not subcontract in conducting their heat treatment business.) Casting (1/17 companies) and sheet working/pressing (2/17) only are subcontracted (at a ratio of 1 thru 3 to 46 companies).

Fig. 4.5.8-19

Q31-1 Do you have subcontractor(s)? If yes, indicate the number and the share of payment by processes. (M/R)

| | Numbers of sub-contractors |
|---|---|
| Complete products | 1. |
| Parts, component & processing | |
| · Machining | 2. |
| · Casting | 3. |
| · Forging | 4. |
| · Heat treatment | 5. |
| · Plating | 6. |
| · Painting | 7. |
| · Welding | 8. |
| · Sheet Work/Pressing | 9. |



(2) Equipment Owned and Heat Treatment Process: Table 4.5.8- 5 , 6

The equipment, such as heating furnances, etc. which are mostly owned by the enterprises, is as follows:

Table 4.5.8-5 (Q256) Equipment of Heat treatment

| Ranking | Equipment | No. of company | % | No. of equipment | |
|---|---|---|---|---|---|
| 1 | Electric resistance H.F. | 5/6 | 83.3 | 1–3<br>4–6 | 4/6 company<br>1/6 company |
| 2 | Oil heating F | 3/6 | 50 | 1–3 | |
| 2 | Quenching & tempering bath | 3/6 | 50 | 1–3 | |
| 3 | Salt bath heat treating | 2/6 | 33.3 | 1–3 | |
| 3 | Carburizing | 2/6 | 16.6 | 4–6 | |
| 4 | Cokes oven | 1/6 | 16.6 | 4–6 | |
| 4 | Charcoal oven | 1/6 | 16.6 | 7–10 | |
| 4 | Coal oven | 1/6 | 16.6 | 1–3 | |
| 4 | Gan heating F | 1/6 | 16.6 | 1–3 | |
| 4 | Electric induction heating F | 1/6 | 16.6 | 1–3 | |
| 4 | Nitriding F | 1/6 | 16.6 | 1–3 | |
| 2 | Test and inspection equipment | 3/6 | 50 | 1–3 | |

Table 4.5.8-6 (Q256) Specify the kind of heat treatment equipment used (M)

| | | Number (set) | Number of company | |
|---|---|---|---|---|
| 1. | Cokes oven | 4–6 | 1/6 | 5/6=0 |
| 2. | Charcoal oven | 7–10 | 1/6 | 5/6=0 |
| 3. | Coal oven | 7–10 | 1/6 | 5/6=0 |
| 4. | Oil heating furnace | 1–3 | 3/6 | 5/6=0 |
| 5. | Gas heating furnace | 1–3 | 1/6 | 5/6=0 |
| 6. | | 0 | 6/6 | |
| 7. | Electric resistance heating furnace | 1–3 | 4/6 | 1/6=0 |
| | | 4–6 | 1/6 | |
| 8. | Electric induction heating furnace | 1–3 | 1/6 | 5/6=0 |
| 9. | Salt bath heat treatment equipment | 1–3 | 2/6 | 4/6=0 |
| 10. | Quenching and tempering bath | 1–3 | 3/6 | 3/6=0 |
| 11. | Carburizing equipment | 1–3 | 2/6 | 4/6=0 |
| 12. | Nitriding equipment | 1–3 | 1/6 | 5/6=0 |
| 13. | Flame hardening equipment | 0 | 6/6 | |
| 14. | Electric induction heat treatment equipment | 0 | 6/6 | |
| 15. | Shot blasting machine | 0 | 6/6 | |
| 16. | Swing grinder | 0 | 6/6 | |
| 17. | Reforming machine | 0 | 6/6 | |
| 18. | Test and inspection equipment | 1–3 | 3/6 | 3/6=0 |
| 19. | Others, specify: ( ) | 1–3 | 2/6 | 4/6=0 |

As gathered from the table given above, the electric resistance heating furnace is employed at the highest percentage (83% or 5/6 companies) as the heating furnace. And many enterprises are conducting quenching and tempering by the use of a heavy oil heating furnace (50% or 3/6 companies). Next, salt baths (33% or 2/6) and carburizing process (33% or 2/6) are used for the heat treatment.

In addition, coke ovens, charcoal ovens, coal ovens, gas heating, electric induction heating and nitriding processes, among others, are used, all of which however, occupy 16% or 1/6 companies.

The flame hardening process has not been used at all while none of the enterprises has such post-heat treatment finishing equipment as swing grinders, shot blasting machines and reforming machines.

However, 50% (3/6) have the test/inspection equipment. Are they conducting tests and inspections without finishing products?

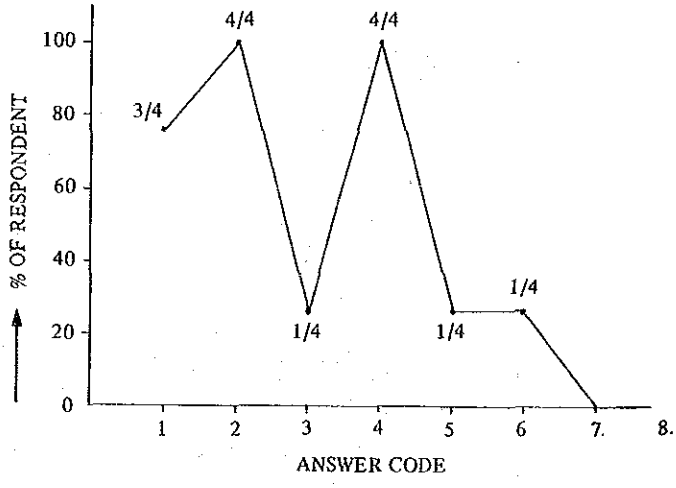
In other words, the heat treatment processes used in Thailand are the annealing/normalizing (Fig. 4.5.8-20 – 3/4 company) and quenching/temperaing (Fig. 4.5.8-20 – 4/4 company), nitriding (Fig. 4.5.8-20 – 1/4 company) and solt bath heat treatment (Fig. 4.5.8-20 – 1/4 company).

As shown in (1)-4), the enterprises have a small mean size of the equipment, which may be considered primitive.

Fig. 4.5.8-20

Q253 Specify your type of heat treatment work? (M)

1. Anneal or normalize
2. Quench and temper
3. Salt bath heat treatment
4. Carburize
5. Nitride
6. Flame hardening
7. Induction hardening
8. Others specify,




(3) Production, Production Engineering and Quality Control

Grasping the production in detail is difficult because many heat treatment enterprises are conducting on the business of heat treatment as part of their diversified lines of business and few of them have answered to the questions relating to the details of heat

treatment. However, consideration will be given to their heat treatment production as part of their diversified lines of business, including the data shown in 'Summary" as well.

1) Monthly Production Capacity

As shown in Fig. 4.5.8-21 (Q30), about 65% (11/16 companies) are producing 1,500 pcs/month or more while approximately 18% (3/17) are yielding 300 pcs/month and below. As shown in Table 4.5.8- 7', the enterprises mostly have a production of 1,000 thru 2,500 kilograms/month through such popular heat treatment processes as annealing/normalizing and quenching/tempering.

What should be noted, however, is the fact that two of the four companies have a carburizing production of 1,000 thru 2,500 kilograms/month and one 16,000 thru 40,000 kilograms/month. Thus, those enterprises who are specialized or nearly exclusively engaged in heat treatment seem to carry out a significant volume of heat treatment operations.

Except for the four who are specialized or nearly exclusively engaged in heat treatment, however, those who are conduction on the business of heat treatment as part of their diversified lines of business seem to have a low production of heat treatment.

Fig. 4.5.8-21

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

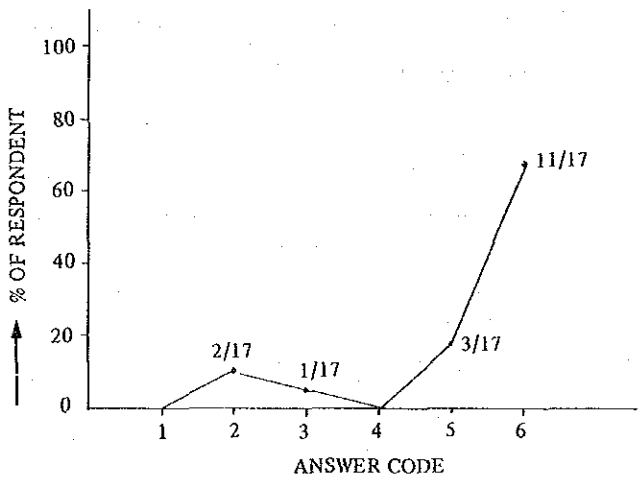



Table 4.5.8- 7'

Q260 What is the amount of your heat treatment production and price? (M, R)

| | Number of firms | Weight (kg/month) |
|---|---|---|
| 1. Anneal, Normalize | 1/4 | 1001 – 2500 kg |
| | 3/4 | 0 – 1000 kg |
| 2. Quench, temper | 4/4 | 1001 – 2500 kg |
| 3. Carburize | 2/4 | 1001 – 2500 kg |
| | 1/4 | 16001 – 40000 kg |
| | 1/4 | 0 – 1000 kg |
| 4. Nitride | 4/4 | 0 – 1000 kg |
| 5. Flame hardening | 4/4 | 0 – 1000 kg |
| 6. Electric induction hardening | 4/4 | 0 – 1000 kg |
| 7. Others - specify | | |

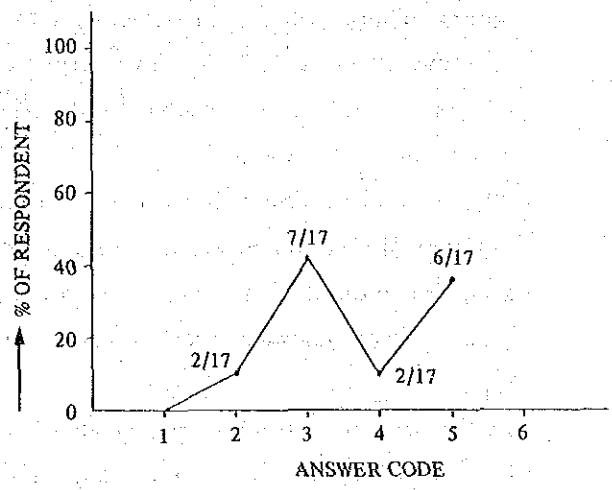
2) Employees Capable of Reading a Technical Drawing (Fig. 4.5.8-22)

Approximately 90% (15/17 companies) have two thru four employees capable of reading technical drawings. This may be considered as a favorable situation for a material-associated industrial sector. It is far more favorable than that in the case of foundries.

Fig. 4.5.8-22

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



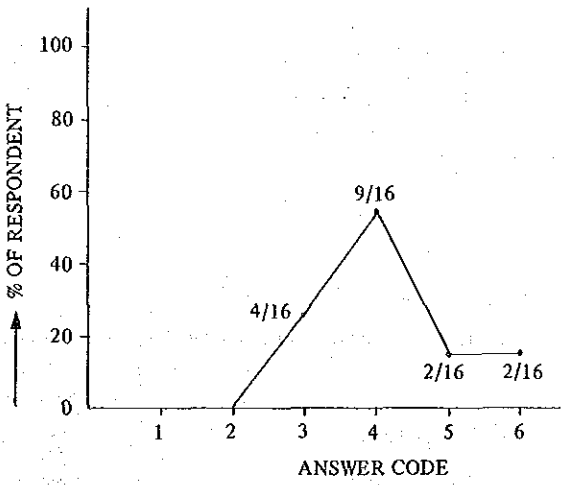

3) Dimensional Accuracy of Products (Fig. 4.5.8-23)

56% (9/16 companies) have a dimensional accuracy of 1/10 mm specified for their products and 25% (4/16) 1 mm. These accuracy levels may be considered barely acceptable as material suppliers.

Fig. 4.5.8-23

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



## 4) Measuring/Testing Equipment (Table 4.5.8- 8 )

### Table 4.5.8- 8 Kind of measuring tool

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

a. Length/Flatness

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

b. Angle/Squareness/Parallelism

21. Angle plate
22. Steel protoractor
23. Universal benei protoractor
24. Square
25. Straight edge
26. Combination square set
27. Micro protoractor
28. Optical protoractor
29. Iron level
30. Precision level
31. Box precision level

c. Profile

32. Radius gauge
33. Screw pitch gauge
34. Taper gauge
35. Drill gauge
36. Gear tooth gauge
37. Projector
38. Roundness tester

d. Temperature

41. Etched stem thermometer
42. Thermo electric thermometer
43. Registance thermometer
44. Optical pyrometer
45. Surface thermometer
46. Temperature recorder
47. Immersion pyrometer

e. Hardness

51. Brinell tester
52. Vickers tester
53. Rockwell tester
54. Shore tester
55. Harnester

f. Machined surface roughness

61. Standard piece for surface roughness (Surface roughness scale)
62. Optical roughness tester
63. Electrical roughness tester
64. Interference roughness tester
65. Surface measuring instrument

g. Electric performance testing

71. Wattmeter
72. Voltmeter
73. Ammeter
74. Power factor meter
75. Torque meter
76. Insulation resistance meter

h. Testing

81. Colour checker
82. Magna flux tester
83. Ultra sonic tester
84. Tensile strength tester
85. Chemical analyser
86. Tachometer
87. Stop watch
88. Dynamometer
89. Noise meter
90. Vibrometer
91. Stroboscope

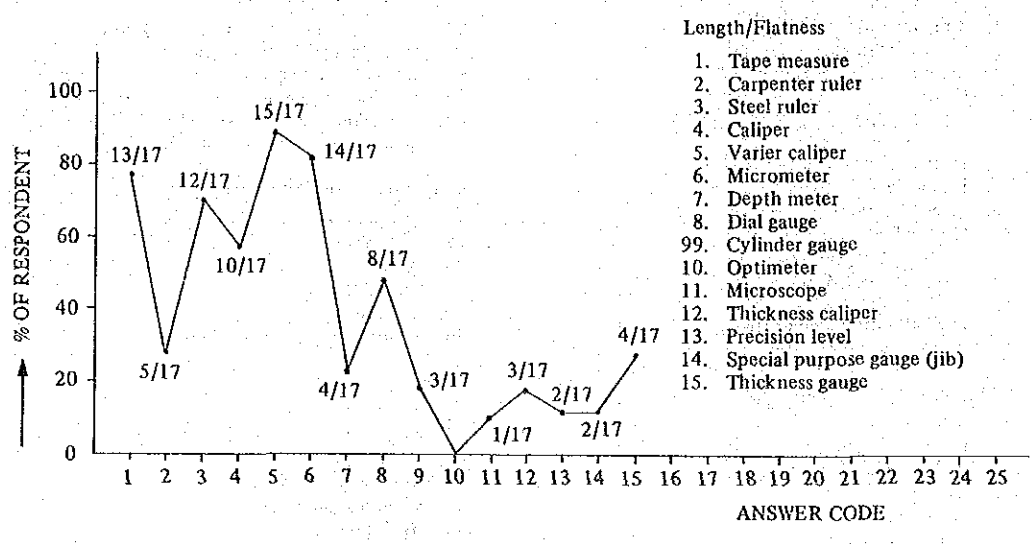
i. Miscellaneous

95. Surface plate
96. V-block
97. Magnetic V-block
98. Surface gauge

a) Length and flatness (Fig. 4.5.8-24)

50 thru 60% of the enterprises have the ordinary measuring and testing equipment (12 thru 15/17 companies).

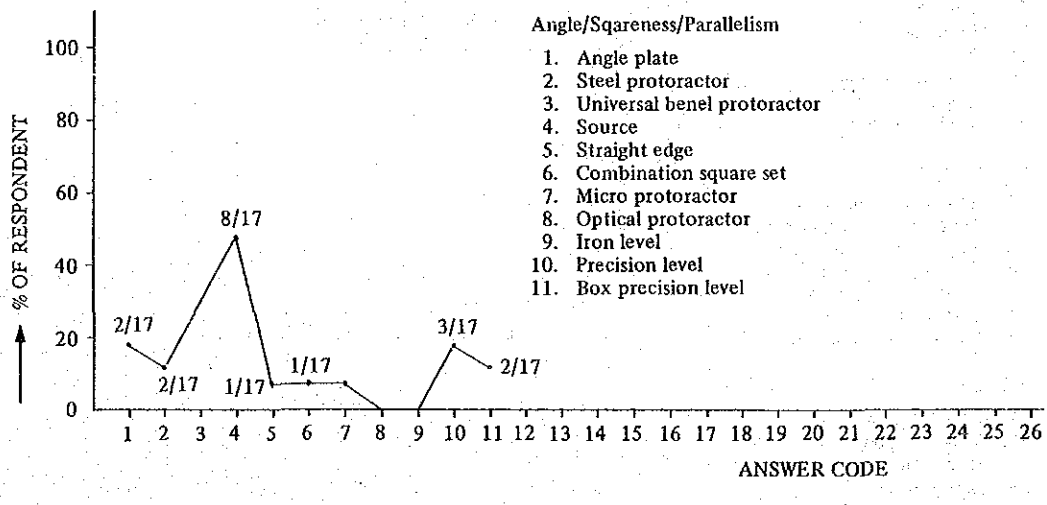
Fig. 4.5.8-24




b) Angle, squareness and parallelism (Fig. 4.5.8-25)

Few of the enterprises have tools of this type.

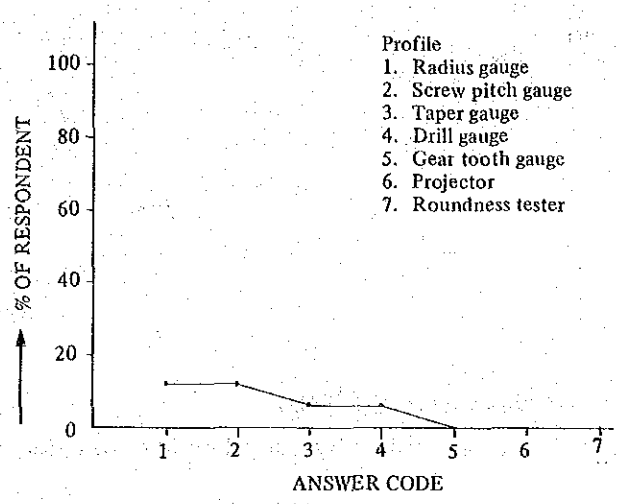
Fig. 4.5.8-25



c) Profile (Fig. 4.5.8-26)

Few of the enterprises have tools of this type. The level of having these tools is considered barely acceptable as far as the material industry only is concerned.

Fig. 4.5.8-26




d) Temperature (Fig. 4.5.8-27)

As gathered from Fig. 4.5.8-27, the thermometer which is essential to the heat treatment industry is owned by few of the enterprises.

Optical thermometers and surface temperature gages, in particular, are owned by a small number of enterprises. Approximately 30% (5/17 companies) only have a temperature recorder.

e) Hardness (Fig. 4.5.8-28)

65% (11/17 companies) have a Rockwell hardness tester. Few of the enterprises however, have another types of hardness testers. Since the hardness tester is an important measurement tool for heat treatment operations, it is desirable to increase the rate of those enterprises which are equipped with some types of hardness testers.

Fig. 4.5.8-27

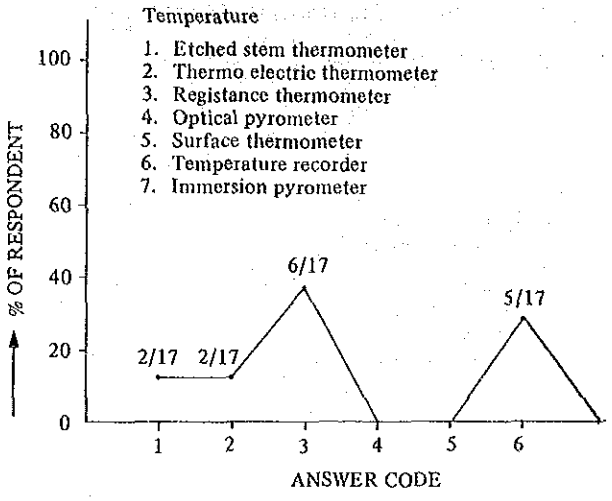
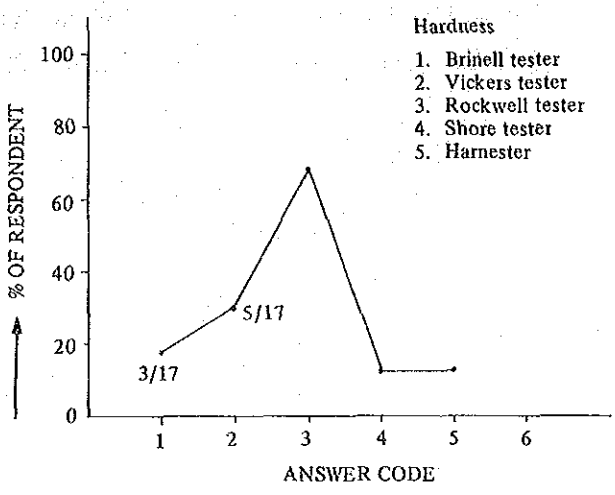



Fig. 4.5.8-28




f) Machined surface roughness (Fig. 4.5.8-29)

Measurement tools of this type are owned by a small number of enterprises.

g) Electric performance testing (Fig. 4.5.8-30)

In the Thai heat treatment industry, many enterprises are equipped with electric furnaces. (83% as shown in Table 4.5.8-5 )

From this point of view, few of the enterprises have voltmeters (47% or 8/17 companies), ammeters (47% or 8/17 companies) and wattmeters (23% or 4/17 companies). It is desired to increase the rate at which they are equipped with those meters.

Fig. 4.5.8-29

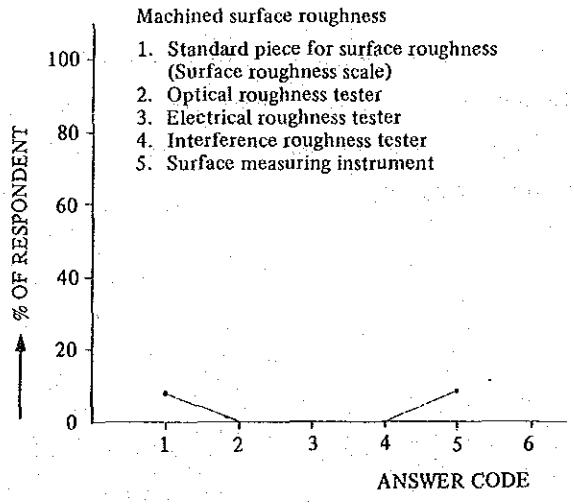
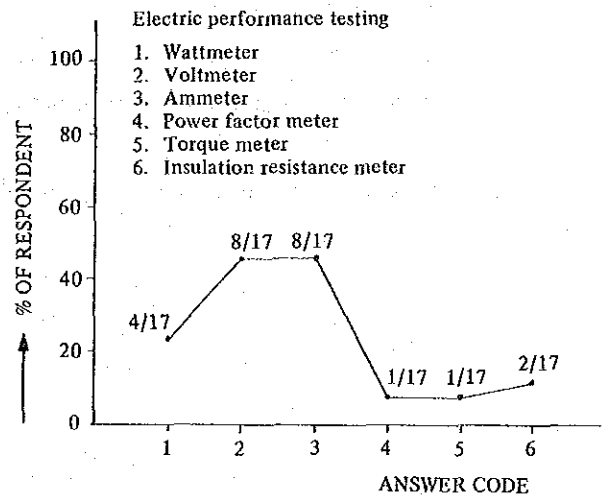



Fig. 4.5.8-30

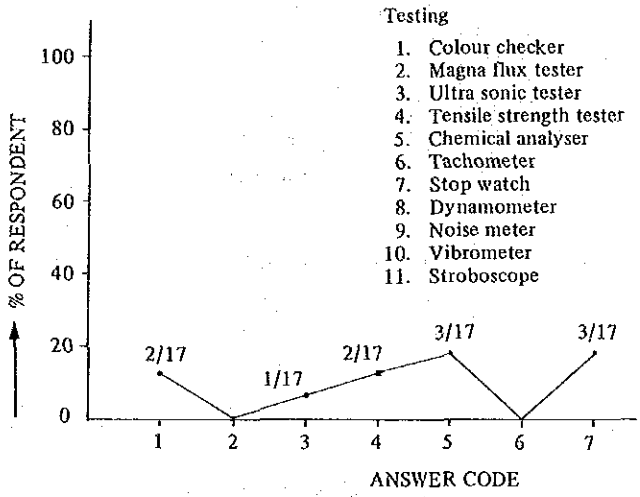


h) Testing (Fig. 4.5.8-31)

As gathered from Fig. 4.5.8-38, the enterprises generally show a poor level of testing equipment. (18% and below or 3/17 companies and below)

The testing equipment is important for heat treatment operations. Inexpensive testing tools (e.g. a checker, for example, is currently owned by two of the 17 companies), therefore, should be owned by each enterprises while testing should be entrusted to a public institution, etc. as required).

Fig. 4.5.8-31

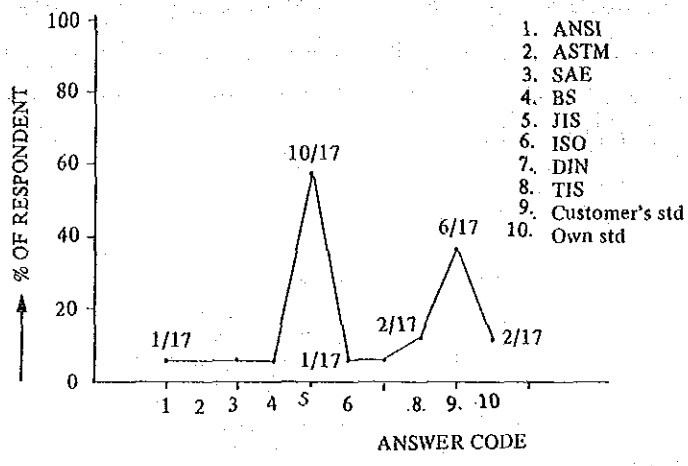



5) Trends of Standards and/or Specifications (Fig. 4.5.8-32)

Most of the enterprises apply the JIS (about 60% or 10/17 companies) and each customer's internal specifications (35% or 6/17 companies). Judging from the present trends of measurement tools, however, it is necessary to grasp the actual situations of standards a little more accurately.

From this point of view, a support by public organizations would be important.

Fig. 4.5.8-32




Q44 What kind of industrial standards do you use? (S/A)

6) Costs for Research and Development (Fig. 4.5.8-33)

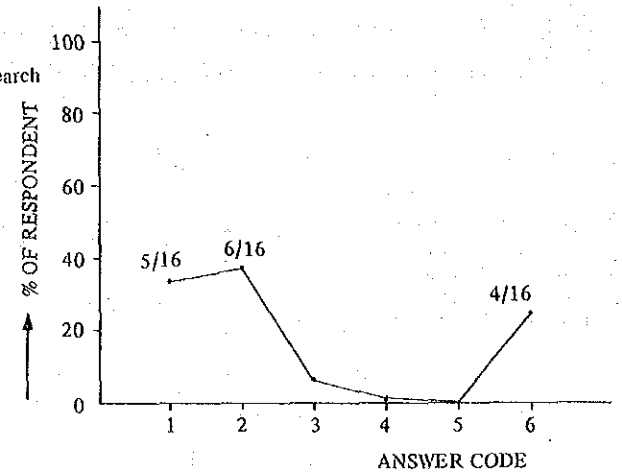
75% of the enterprises (12/16) spend costs of research and development at a rate of 1% or less on the sales. And 31% (5/16 companies) spend none for R&D. It should be noted, however, that 25% (4/16) spend 3% or more of the sales for R&D costs.

It is necessary for a public organization to support the enterprises in this connection. As shown in Fig. 4.5.8-14, the enterprises also expect such support by a public organization.

Fig. 4.5.8-33

Q45-1 How much to the sales do you spend on research and development? (S)

1. None
2. Less than 0.5%
3. 0.5% – 1%
4. 1.1% – 2%
5. 2.1% – 3%
6. More than 3%




7) Quality Control System (Fig. 4.5.8-34)

a) Inspection System

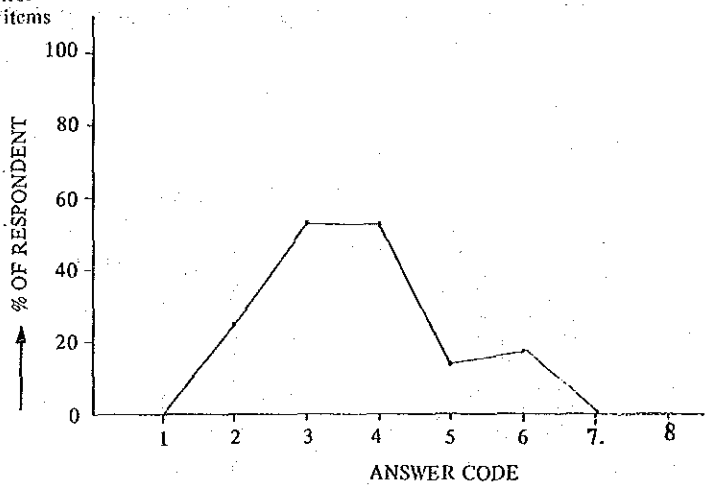
As gathered from the graph, most of the enterprises are conducting a sampling inspection (single in 9/17 and multiple in 9/17 companies). In connection with the defect ratio after shipping (20% or more in 60% of the companies (9/15)), the sampling methods currently used should be examined.

Fig. 4.5.8-34

Q46-1 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




b) Inspector (Fig. 4.5.8-35)

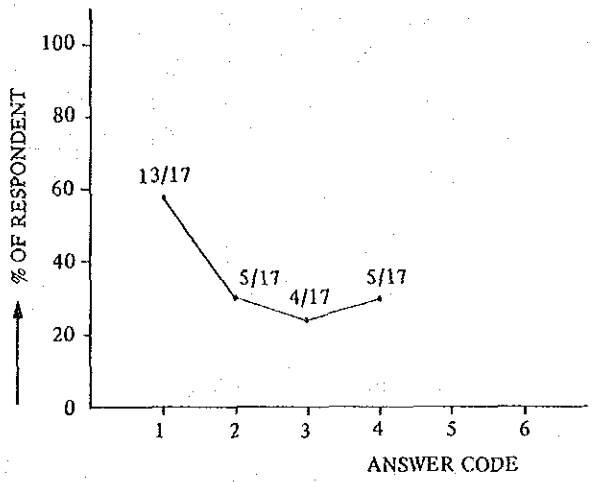
Judging from the graph, it seems that inspections are being conducted by workers (10/17 companies), managers (5/17) and staff (4 or 5/17). It is doubtful, however, whether such inspections are really effective or not. Since the post-shipment fraction defective is high

a defect ratio after shipping of 2% and above in 60% of the companies (9/15)), inspectors should be deemed to have some problem. Education and traning is condisered essential.

Fig. 4.5.8-35

Whom is it inspected by?

1. Workers themselves
2. Manager or the owner
3. Professional staff, patrol
4. Professional staff, stationary




c) Checking methods (Fig. 4.5.8-36)

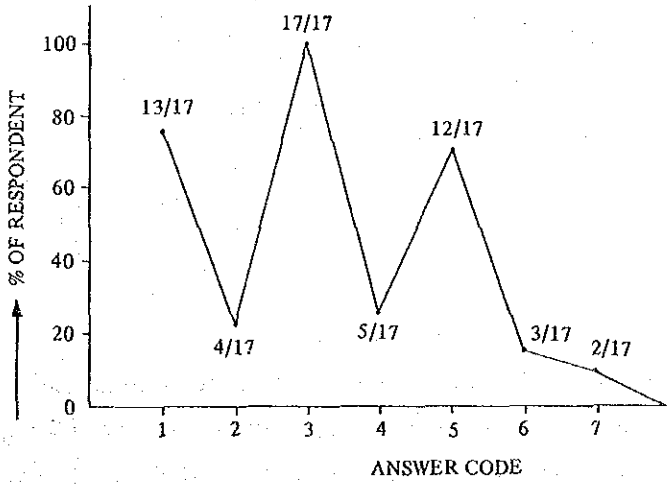
Visual inspection (13/17 companies), dimensional checkout (17/17) and hardness testing (12/17) are being conducted while few of the enterprises are performing a non-destructive inspection. This is quite natural, since they have a poor amount of non-destructive inspection equipment. What is more important is the problem that products after shipped have shown a high fraction defective (2% and above in 60% of the companies).

In this respect, it is necessary to provide guidance and support by public institutions.

Fig. 4.5.8-36

Checking methods and items are

1. Visual check
2. Sensory check
3. Dimensional check
4. Clearance check for moving parts
5. Hardness check
6. Surface roughness check
7. Colour check
8. X-ray check
9. Magna flux check
10. Noise check
11. Vibration check
12. Life test/running test



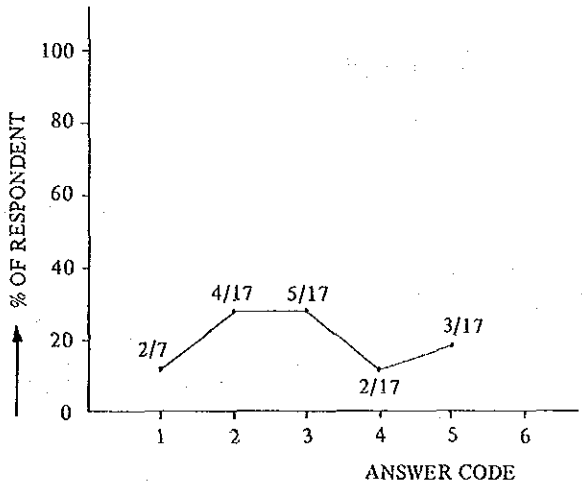
d) Feedback method (Fig. 4.5.8-37)

It seems that inspection results are fed back anyway (circular notice: 5/17 companies and notice 4/17). Few of the enterprises, however, have established a positive feedback method (by workers in 2/17 and by staff in 3/17). Two of the 17 companies do not feed back inspection results at all. This has also led to the high post-shipment fraction defective (2% and above in 60% of the companies in 9/15, Fig. 4.5.8-40). A public organ, therefore, needs to educate and train the responsible persons and workers, accordingly.

Fig. 4.5.8-37

Feedbacked of the results of inspection is:

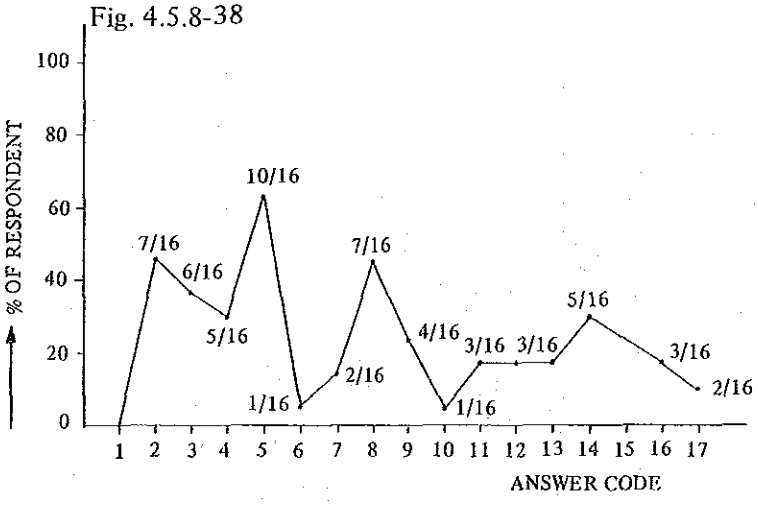
1. Only in file no feedback
2. Notice on the boad
3. Circulating notice or inspection record to workers/managers
4. Establishing counter measures by workers/managers
5. Establishing counter measures by professional staff, statistical quality control system




8) Standardization Level (Fig. 4.5.8-38)

The items which have been standardized at a higher level include the tests and inspections (10/16 companies) quality control (7/16), production (7/16), production process (6/16), cost (5/16), warranty (5/16) and so on. Designing, decision-making, follow-up services and trouble-shooting are the problematical items to be promotely standardized in the future.

Fig. 4.5.8-38




Q49-1 Standardization level (Please specify appropriate items of your firm) (M/A)

1. Design
2. Production/Works
3. Process
4. Costing
5. Inspection/Testing
6. Measuring
7. Transportation
8. Quality Control
9. Price
10. Administration
11. Decision Making
12. Accounting
13. After Services
14. Guarantee
15. Trouble Shooting
16. Tolerance
17. Others (Specify)

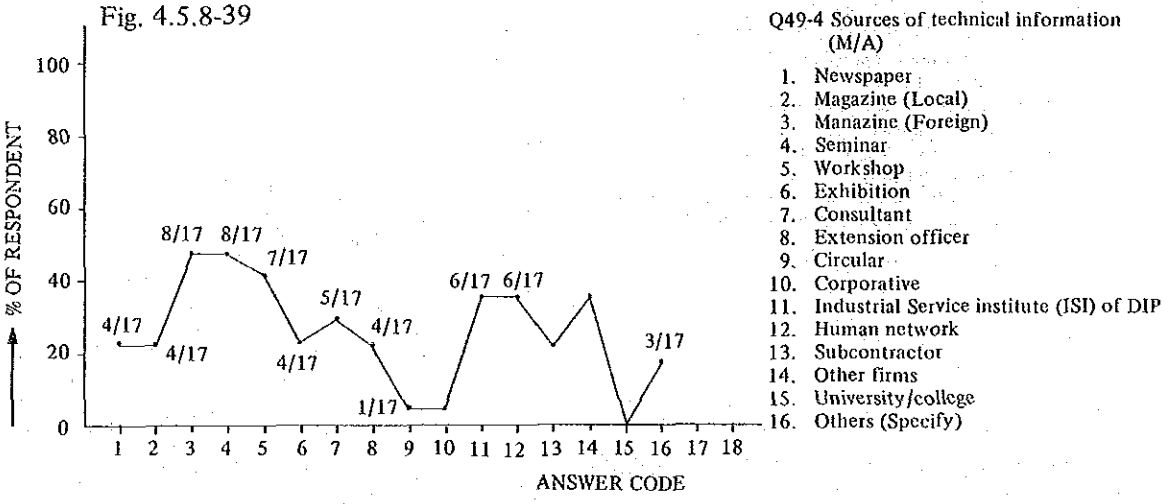
9) Sources of Technical Information and/or Knowhow (Fig. 4.5.8-39)

Most of the enterprises are obtaining their technical information and/or knowhow from seminars (8/17 companies), magazines (8/17), workshops (7/17), other enterprises (6/17), I.S.I., Ministry of Industries, Thailand) (6/17) and consultant firms (5/17).

Few of the enterprises are obtaining such information from universities, patrol guidances, etc. Public organizations and institutions are expected to play a positive role in providing such information.

Fig. 4.5.8-14 shows that the enterprises also so expect.

Fig. 4.5.8-39



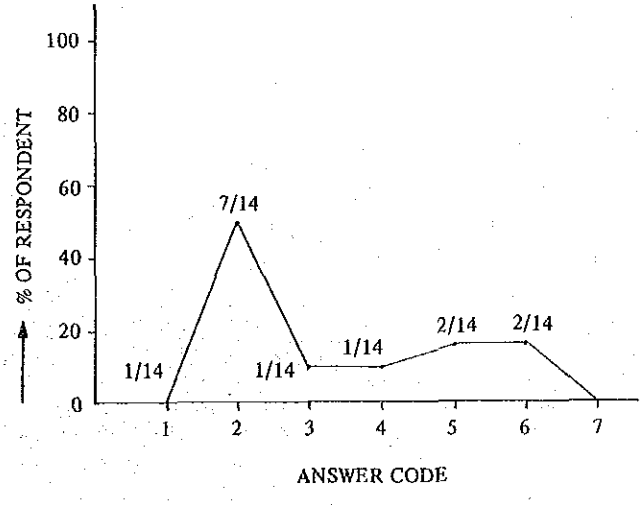

10) Shipment Inspection (Fig. 4.5.8-40)

Eight of the 14 companies have shipment inspections conducted by subcontractors' personnel. Since the post-shipment fraction defective is very high (2% and above in 60% of the companies), it is necessary to consider what should be done as an enterprises. It will be also necessary for public organizations and institutions to provide guidance, education and training.

Fig. 4.5.8-40

Q49-7 Shipping inspection system (For subcontracted goods) (S/A)

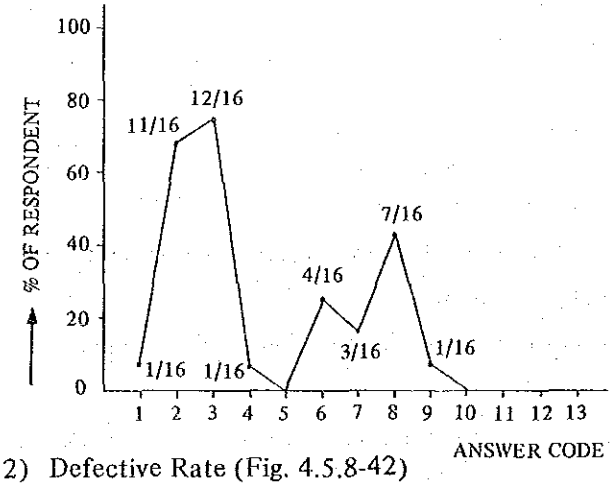
1. None
2. Permanent check by subcontractor's staff before delivery
3. Temporary check by subcontractor's staff before delivery
4. Visual check after delivery
5. Inspection records check after delivery
6. Self-management of subcontractee
7. Others (Specify)



11) Inspection Records (Fig. 4.5.8-41)

Dimensional inspection records are kept by 12 of the 16 companies, visual inspection records by 11 of the 16, heat treatment records by 7/16 (44%), material test records by 4/16 and material analysis records by 3/16. And very few of the companies are keeping non-destructive inspection records. (Only one of the 16 companies is keeping the results of color checks.) As far as they conduct on the business of heat treatment, all of the enterprises should keep heat treatment records. As referred to in d) "Temperature of (4) "Measuring/Testing Equipment", approximately 30% only have a temperature recorder. From this, it can be gathered that record are not totally kept. Thermometric records should be kept on a total inspection basis. In this respect, it is necessary for public organizations and institutions to provide guidance and assistance.

Fig. 4.5.8-41



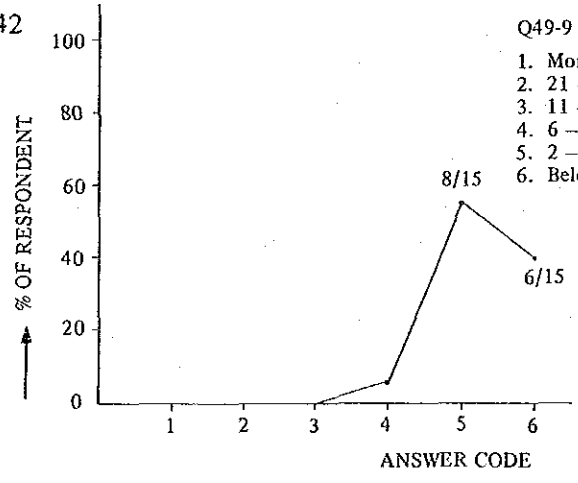

Q49-6 Inspection records (M/A)

1. Nothing
2. Visual inspection records
3. Dimension check records
4. Colour check records
5. X-ray, ultrasonic, magna-flux text records
6. Material test records
7. Material analysis records
8. Heat treatment records
9. Statical operation test records
10. Dynamical operation test records
11. Others (Specify)

12) Defective Rate (Fig. 4.5.8-42)

60% (9/15 undertakings) show a post-shipment defective rate of as high as 2% or more. Half (56%) of the enterprises are not recording heat treatment operations. It is necessary to positively conduct quality control.

Fig. 4.5.8-42




Q49-9 Defect Rate after shipping (S)

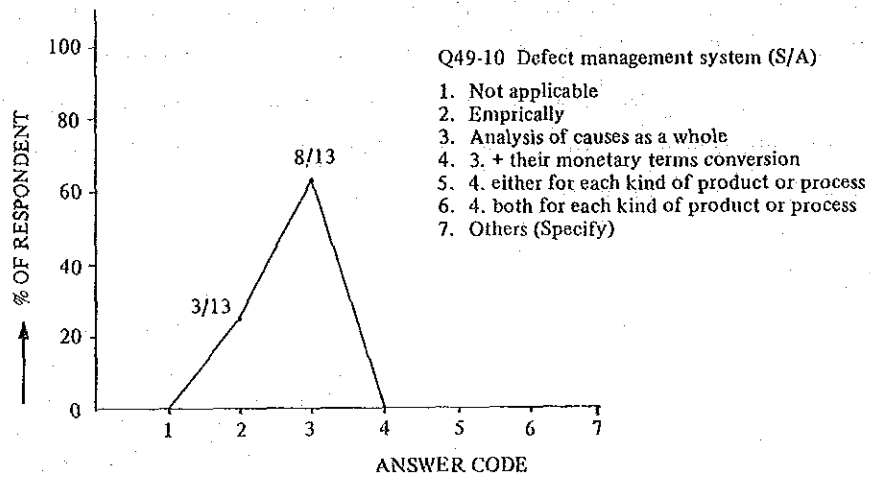
1. More than 30%
2. 21 – 30%
3. 11 – 20%
4. 6 – 10%
5. 2 – 5%
6. Below 1%

13) Defective Control (Fig. 4.5.8-43)

Investigation of defects is performed empricially (3/13 companies) or ingeneral analysis (8/13 companies). However, very few of the enterprises performs individual analysis or analys for each product in process (2/13).

It is necessary to educate and train employees. Guidance and support by public organizations are desired accordingly.

Fig. 4.5.8-43

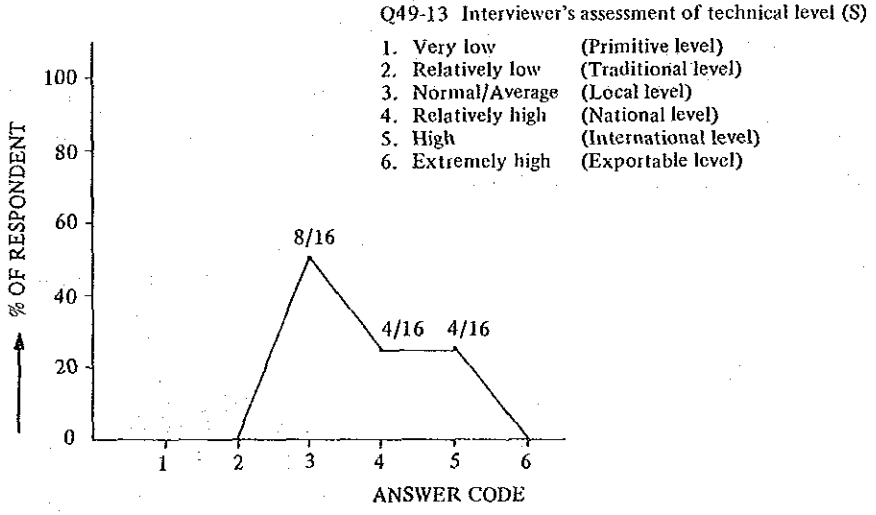



14) Enterprise's Technical Levels Evaluated through Interviews (Fig. 4.5.8-44)

Half (8/16 companies) have a technical level only acceptable locally. It is desired to improve their technical level to that nationally acceptable.

The role to be played by a public organization in this respect is of great significance.

Fig. 4.5.8-44



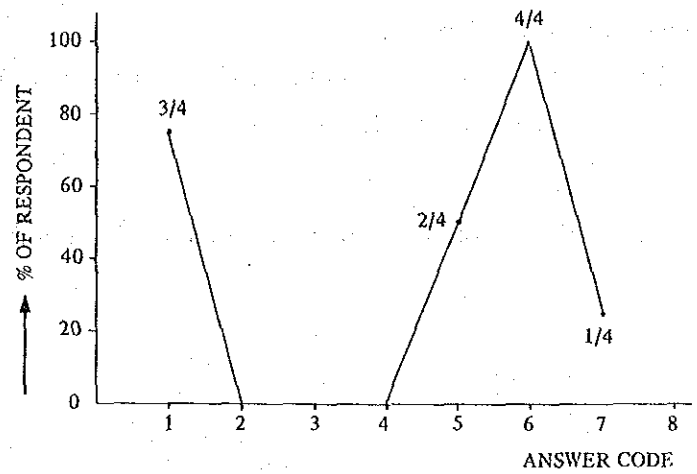
(4) Raw Materials (fuels and materials for those parts which are to be heat-treated)

1) Fuel

As shown in Graph Fig. 4.5.8-45, resistance electricity (4/4 companies), petroleum (3/4), gas (2/4) and induction electricity (1/4) are used as fuels. This tendency shows a rough resemblance to that given in Table "Heat Treatment Equipment" of 2) "Equipment Owned and Heat Treatment Process".

Fig. 4.5.8-45

1. Oil
2. Coke
3. Coal
4. Charcoal
5. Gas
6. Electric (Resistance)
7. Electric (Induction)




The natural ras domestically produced in Thailand is expected to be used as the fuel for heating furnaces in future. It produces a small amount of smoke, soot and harmful gases. From a pollution control point of view, the natural gas should be preferably exploited and utilized.

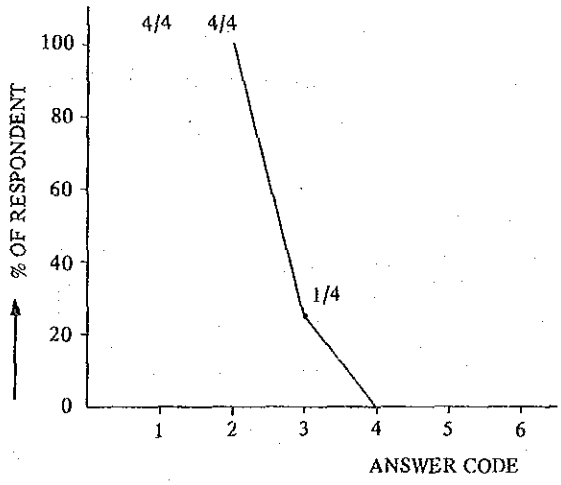
2) Materials of Parts Heat Treated (Fig. 4.5.8-46)

Carbon steel and alloy steel (4/4 companies) are heat treated as materials. Cast iron is also heat-treated by one of the four companies.

Fig. 4.5.8-46

Q254 What kind of materials do you heat-treat? (M)

1. Carbon steel (Cast steel, Forged steel, Steel plate or bar, etc.)
2. Alloy steel (Cast steel, Forged steel, steel plate or bar, etc.)
3. Gray iron (Casting)
4. Ductile iron or malleable iron (Casting)
5. Non-Ferrous metal (Casting, Forging, Others)



With salt baths owned, the enterprises are assumed to heat-treat tool steel too.
The carburizing process is used by an unepectedly larger number of the enterprises. From this, it may be gathered that case hardening steel is used.
Considering that the nitriding process is used by some of the enterprises, nitride steel is assumed to be applied more or less. In the place of the solt bath process which has aroused a significant pollution problem, the vacuum heat treatment will begin to be used in Thailand to heat-treat the tool steel in the future.

(5) Markets, Demand and Prices

Markets, demand trends and prices in the heat treatment industry will be analyzed one by one, based on a very small number of data.

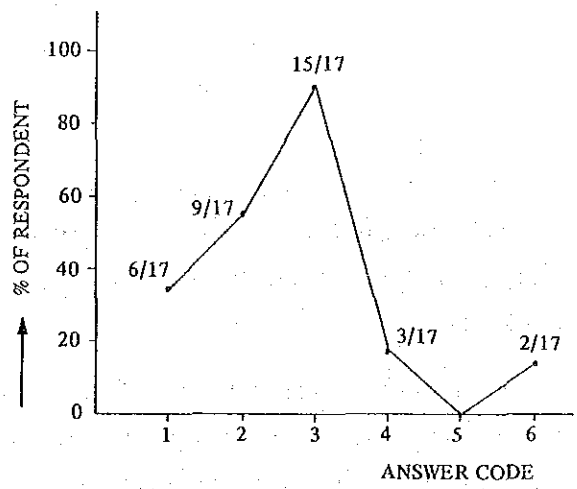
1) Market Area (Fig. 4.5.8-47)

As many as 15 of the 17 companies are selling their products in the domestic market.

Fig. 4.5.8-47

Q20 Where are your products sold and consumed? (M)

1. Region/District
2. Province/State
3. Country
4. Developing countries
5. Newly industrialized countries (NICS)
6. Developed countries



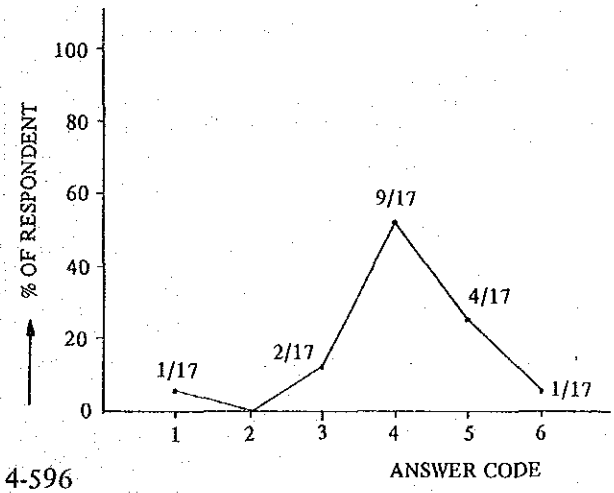

2) Back Orders (Fig. 4.5.8-48)

Approximately 30% of the companies (5/17) have back orders enough to cover the production for one month or more ahead. The remaining 70%, however, can ship their existing back orders within one month. There are a small number of production orders in the Thai heat treatment industry.

Fig. 4.5.8-48

Q22-1 How much of production orders do you have in hand? (S)

1. None
2. One week or less
3. 8 – 15 days
4. 16 – 30 days
5. 1 – 5 months
6. More than 5 months



3) Price Competitiveness (Table 4.5.8-9 , Table 4.5.8-10)

Approximately 70% of the companies (11/15) are selling their products at a market price while 13% (2/15 companies) are selling at a lower price and at a price higher by 11 thru 20% than the market price, respectively.

Table 4.5.8-9

| Price | Number of company | |
|---|---|---|
| | Number | % |
| 11– 20% higher | 2/15 | 13.3 |
| Market price | 11/15 | 73.3 |
| Less than market price | 2/15 | 13.3 |

Table 4.5.8-10

| Price competitiveness | Number of company | |
|---|---|---|
| | Number | % |
| Very strong | 2/17 | 11.8 |
| Strong | 6/17 | 35.3 |
| Moderate | 9/17 | 52.9 |
| Weak | 0/17 | 0 |

Most of the enterprises are moderately competitive in the market. Some (47%) of them, however, think that they are highly competitive in the market (8/17).

4) Cost Control (Fig. 4.5.8-49)

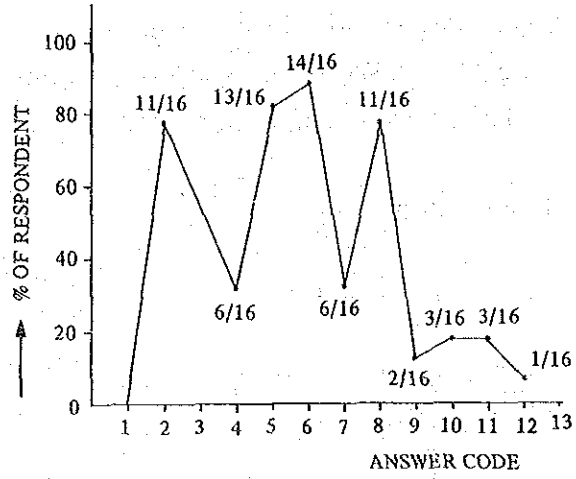
Most of the enterprises are controlling the labor cost (14/16 companies), the material cost (13/16), the general and administrative expenses (11/16) and the equipment cost (11/16).

Few of the enterprises however, think about costs, taking into account the sales charges, profits, depreciation expenses, etc.

Fig. 4.5.8-49

Q23 Break down of Costing/Accounting System (M/A)

1. None
2. Every kinds of products
3. Every kinds of parts and compartments
4. Material cost
5. Labour cost
6. Direct cost/indirect cost
7. Overhead
8. Sales charge
9. Profit
10. Depreciation
11. Fixed cost
12. Variable cost
13. Others (Specify)




5) Market Survey (Table 4.5.8-11)

As gathered from Table 4.5.8-11, 45.5 thru 72.7% are making a survey of the market concerning competitors, selling prices, material-purchasing prices and qualities.

Few of the enterprises are investigating into new technologies, subcontractors or demand projections. In terms of information, a public organization will be requested to assit the enterprises.

Table 4.5.8-11

| No. | | | Number of company | |
|---|---|---|---|---|
| | | | Number | % |
| 1 | Market tendency | Competitors | 7/11 | 63.6 |
| 2 | | Selling prices | 8/11 | 72.7 |
| 3 | | Purchasing prices raw materials key parts/component | 5/11 | 45.5 |
| 4 | | Quality | 5/11 | 45.5 |
| 5 | | Subcontractors | 1/11 | 9.1 |
| 6 | | New technology | 3/11 | 27.3 |
| 7 | Demand situation | Total demand | 0 | 0 |
| 8 | | Domestic output export | 0 | 0 |
| 9 | | Import | 0 | 0 |

Table 4.5.8-12

Q29 Have you ever marketed directly or indirectly the products, if so, what and how? (M)

Market tendency

1. Competitors
2. Selling prices
3. Purchasing prices, raw materials key parts/component
4. Quality
5. Subcontractors
6. New technology

Demand situation

7. Total demand
8. Domestic output/export
9. Import

(6) Management and Control

In the aspects of management and administration, a fact-finding survey made and the measurements desired to be taken in the future are as summarized below. Crucial factors are intensively gathered herein.

1) Profit Control System (Fig. 4.5.8-50)

60% of the companies (9/15) are calculating profits and losses while 40% are grasping the figures as a whole. Approximately 30 (4/15 companies) are analyzing their break-even points. However, about 13% (2/15) only are making an analysis of break-even points by product. An improvement of profit control aspects is desired (as shown in Fig. 4.5.8-50) However, six of the 16 companies are checking profits and losses as a whole and involving a certain problem.

Fig. 4.5.8-50

Q71 Profit management system (M/A)

1. Check as a whole business
2. Every business for main products
3. Every business for each products
4. Deference between standard cost & actual cost
5. Break even point
6. Profit & loss calculation/account
7. Others (Specify)