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ABSTRACT

A Survey of Manufacturing Practices in Southeast Asia

by
Fe Irma A. Ramirez

This paper presents a study of the current manufacturing practices in Southeast Asia particularly Indonesia, Malaysia and the Philippines. This region is regarded as the next region to watch in terms of economic performance and potential. A mail survey of manufacturing companies in these countries was performed in order to get the data. A six-page questionnaire was sent and covered the following areas: company profile, production control and management, quality management and automation and computerization. Majority of the respondents were medium- and large scale companies and carried a wide array of products. Most of the firms were labor intensive rather than capital intensive. This is due to the fact that high interest rates in the region prevails, which limits spending on capital investments. Thus, there is a low level of automation and computerization in the companies. This is particularly true on the shop floor. With regards to their production control and management, there are a lot of improvements needed. Judgmental techniques are predominantly used in forecasting. The average lead time for most firms is one week to one month. Also, most of them have an inventory turnover ratio of less than 10. In terms of quality management, the firms perceive quality to be important in order to stay in business. However, most of them still use sampling inspection, although some have been using more advance techniques to control quality. In conclusion, the region may have a lot of potential in terms of economic growth, however, there are still a lot of potholes that have to be straightened out. These include financial constraints (high interest rates), inadequate infrastructure and the need for more technically trained workforce.

A SURVEY OF MANUFACTURING PRACTICES IN SOUTHEAST ASIA

by
Fe Irma A. Ramirez

A Thesis
Submitted to the Faculty of the
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in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Manufacturing Systems Engineering

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Para sa aking mga magulang
at sa aking mga kababayan
na sana'y dumating ang araw na hindi na tayo
mamaliitin ng mayayamang bansa . . .

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This study would not have been completed if not for the help of a number of individuals. First of all, I would like to thank my advisor, Dr. Sanchoy K. Das for his patience and guidance through the whole paper. Thank you also to Dr. Sodhi and Dr. Levy for agreeing to be in my thesis committee. Special thanks also to my friends, Connie, Polly, Loidie, Marinette and Rick for their invaluable inputs.

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CHAPTER 1

INTRODUCTION

The continued surplus in the supply of goods relative to their demand, has made efficient and quality manufacturing a prerequisite for corporate success. Efficient manufacturing has also become the stimulus in the economic growth of many nations. In terms of manufacturing output, a handful of nations can be said to dominate the world. These include Japan, United States, Western Europe and the newly industrialized economies (NIEs) of Hong Kong, Singapore, South Korea and Taiwan.

The four largest economies in the ASEAN (Association of Southeast Asian Nations) community are Indonesia, Malaysia, Philippines and Thailand. These are widely considered to be in the next tier of developing countries following the development track of the NIEs. The gross domestic product of these Southeast Asian economies together grew at an 11.2% annualized growth rate between 1988-1992. This phenomenal growth can be accounted by four emerging trends namely: (1) vast wave of cross-border investment from Japan and the NIEs; (2) rise in intra-Asia trade; (3) gathering pace of deregulation and privatization; and (4) increasing diversification from commodity-based to manufacturing-based economies.

Foreign investments in the four ASEAN countries showed an average annual growth rate of 103% between 1987-1990. Of these investments, Japan and the Asian NIEs accounted for more than 50%. However, unlike Japan, Taiwan, Hong Kong and South Korea who rose in stature by exporting to the U.S., these Southeast Asian nations are doing most of their business with other Asian countries. Trade within this region could soon surpass that between the U.S. and Canada. Moreover, the governments of these ASEAN countries have also increased their commitments toward the deregulation, liberalization and privatization of their economies and financial markets

The most encouraging trend in Southeast Asia is the increasing diversification and sophistication of the ASEAN economies. Spurred by rising intra-Asian investments and trade, the ASEAN four are now embarking on a fundamental shift from their traditional dependence on primary commodities to manufacturing and services. According to the Asian Development Bank, industry and services collectively accounted for an average of 80% of the total gross domestic product of the ASEAN four in 1990. Consequently, for the first time in the history of Southeast Asia, the share of employment in agriculture among the four countries fell to an average of below 50%. This economic restructuring has allowed the four nations to increase proportion of manufacturing exports to total exports. This ratio rose from an average of 17% in 1980 to 51% in 1990. Instead of selling only rubber, tin, palm oil and oil and gas to the world markets, the ASEAN four are now exporting electronic goods, apparel, machinery and equipment and in the case of Malaysia and Indonesia even automobiles and aircraft. As a result, the economies of the ASEAN four are now much less vulnerable to fluctuations in world commodity prices. This process of transformation will in all likelihood be sustained well into the 1990s by the growth momentum of intra-regional capital and trade flows. As more ASEAN workers are absorbed into the manufacturing and services industries, their skills and wages will rise accordingly and so will the general affluence of the Southeast Asian societies.

1.1 Objectives of the Study

Considering all these developments in the region, and the importance of manufacturing in the continuous growth of a nation, a study on the various manufacturing practices in these ASEAN countries would be significant. This paper would be helpful not only to the countries under study but also to potential foreign investors. One of the objectives of the study is to determine the prevailing manufacturing practices in these ASEAN countries. How is manufacturing actually managed in this region? Are their practices similar to that

in the U.S.? How do they plan and control their production? How do they perceive quality and factory automation?

Another objective of this study is to determine the implications of the firms' manufacturing practices with regards to international competitiveness. Can the companies compete globally? Do they have the necessary tools to make it in the international market? In conjunction with this, we wanted to determine the strategic options of the companies in the region. Which aspects in manufacturing should they improve? What are the advantages that they may have which they could exploit?

In this study, we also want to determine the extent to which advances in manufacturing has penetrated the region. What is the level of automation in the region? Are they far behind the NIEs? What could be the reason for this? The study will try to answer all these questions. This way

1.2 Scope of the Study

The scope of this study is limited only to the ASEAN countries namely Indonesia, Malaysia and Philippines. Thailand was not included in the final analysis due to unavailability of the data. The study covers the areas of production control and management, quality management and automation and computerization. The production control and management part covers sales forecasting, production planning and shop floor control.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Questionnaire Design

A lot of studies have been made regarding design of questionnaires and industrial mail response rates. A paper by Kopac (1991) provided guidance for the development of generic questionnaires. Successful questionnaire development includes identifying specific problem, understanding the subject matter and knowing the respondents.

Jobber (1986) reviewed experimental studies which investigated methods of improving response rates to industrial mail surveys. His study showed that there are several techniques that can be used to increase response successfully. These include the use of monetary and non-monetary incentives and follow-up letters and questionnaires. Also, stamps on return envelopes consistently outperformed business reply envelopes (Jobber, 1986).

Diamantopoulos, Schlegelmilch and Webb (1991) proposed a new approach to the study of response behavior to industrial mail surveys. They used communications theory as an integrative framework. Their findings indicate that senders and receivers should share a common frame of reference when it comes to industrial mail surveys. This is essential for effective communication.

2.2 Trends in Southeast Asia

The Asia-Pacific Region shown in Figure 2.1 is the next part of the world to look out for in terms of economic growth. It represents one of the fastest growing regions in the world and has a lot of potential for investments. Between 1982 and 1991, the Gross Domestic Product (GDP) of the Asian economies together, i.e., Japan, Korea, Singapore, Hong Kong, Taiwan, Indonesia, Malaysia, Thailand and Philippines, grew at a 6.2%

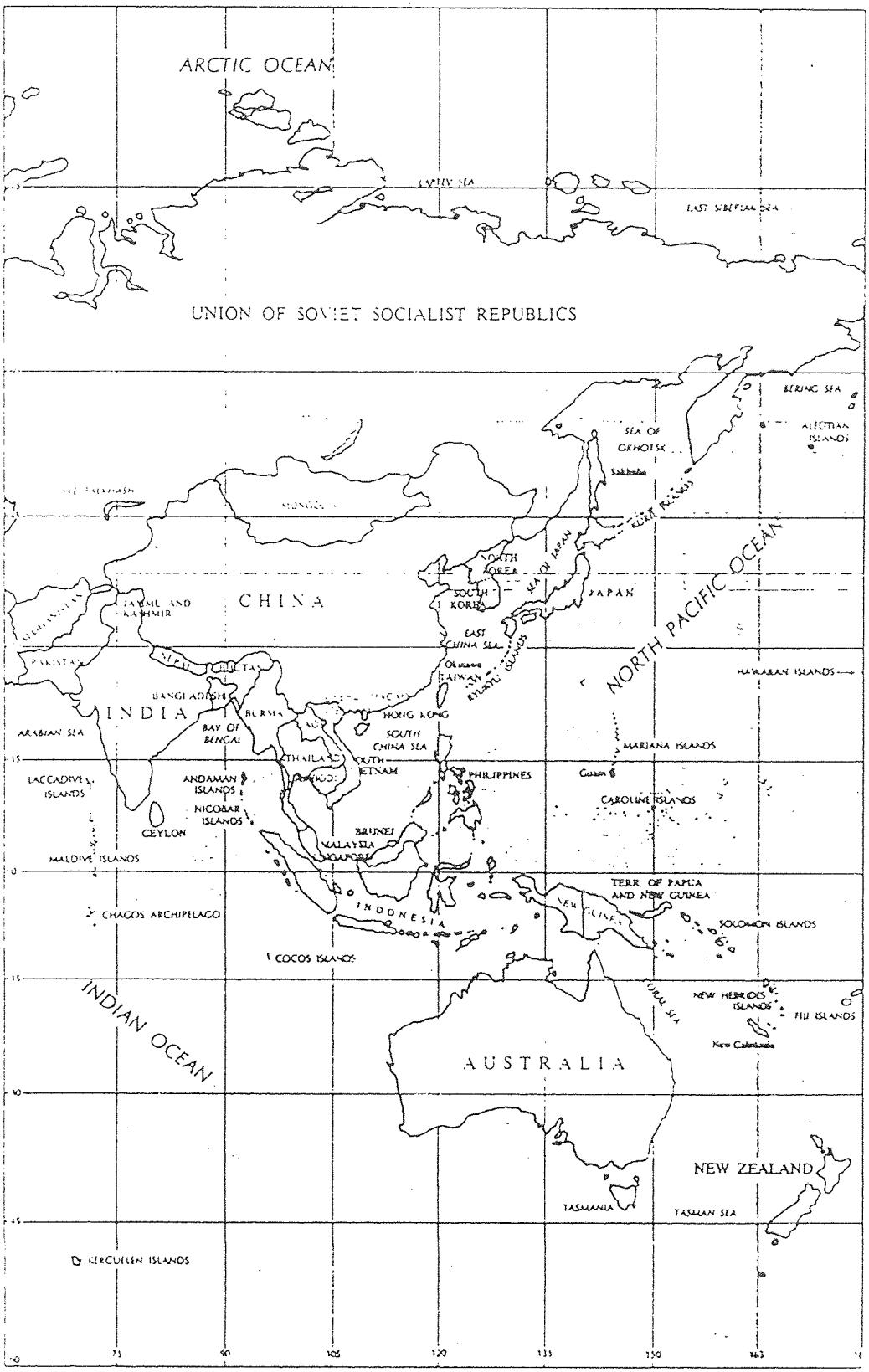


Figure 2.1 Map of Asia-Pacific region

annualized growth rate, versus 2.3% for the U.S. (Tong, 1992). Besides Japan, the Newly Industrialized Economies (NIEs) of Korea, Taiwan, Hong Kong and Singapore boast of continuous growth particularly in manufacturing. Following this tier are the members of the Association of Southeast Asian Nations (ASEAN) particularly Thailand, Indonesia, Malaysia and Philippines. These countries have started to take-off economically on the strength of manufacturing as well as natural resources. These countries also boast of a large, young and growing population, low labor costs and enormous potential of its consumer market. In fact there has been a lot of foreign investments in these countries - especially Asian countries investing within Asia, as can be seen in Figure 2.2.

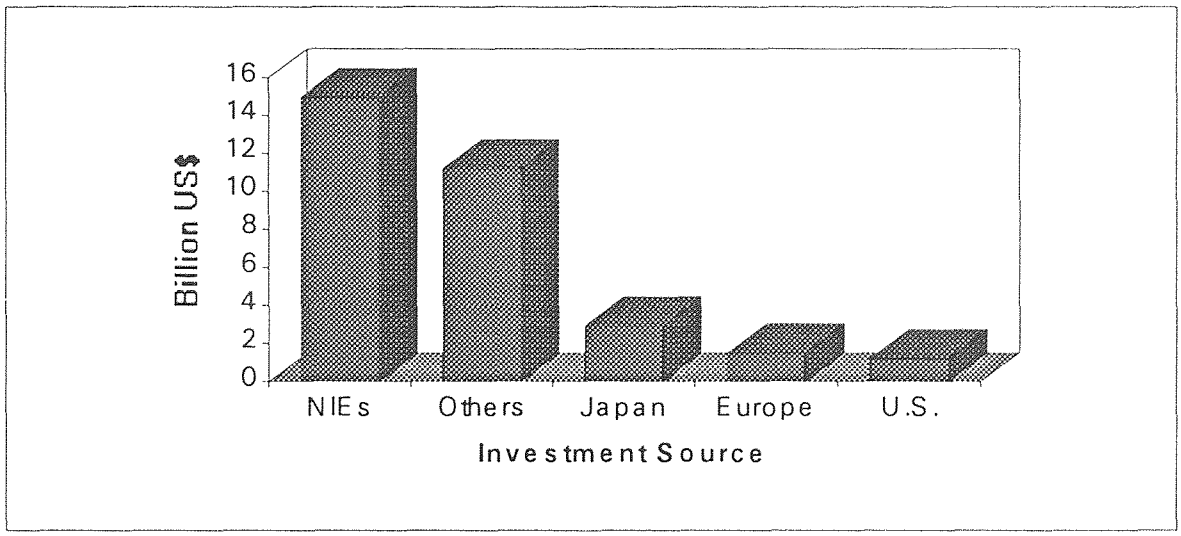


Figure 2.2 Direct foreign investments in Thailand, Malaysia, Indonesia and Philippines, 1986-1991.

Note: For NIEs, figure is from 1986-1990.

Source: International Monetary Fund. World Economic Outlook: A Survey by the Staff of the International Monetary Fund, May 1993.

2.2.1 Industrial Survey of Indonesia

Indonesia covers a land area of 1,926 million square kilometers and territorial waters nearly four times that size. In total the country comprises of 13,667 islands stretching 5,120 kilometers from east to west and 1,760 kilometers north to south. Figure 2.3 shows a map of Indonesia.

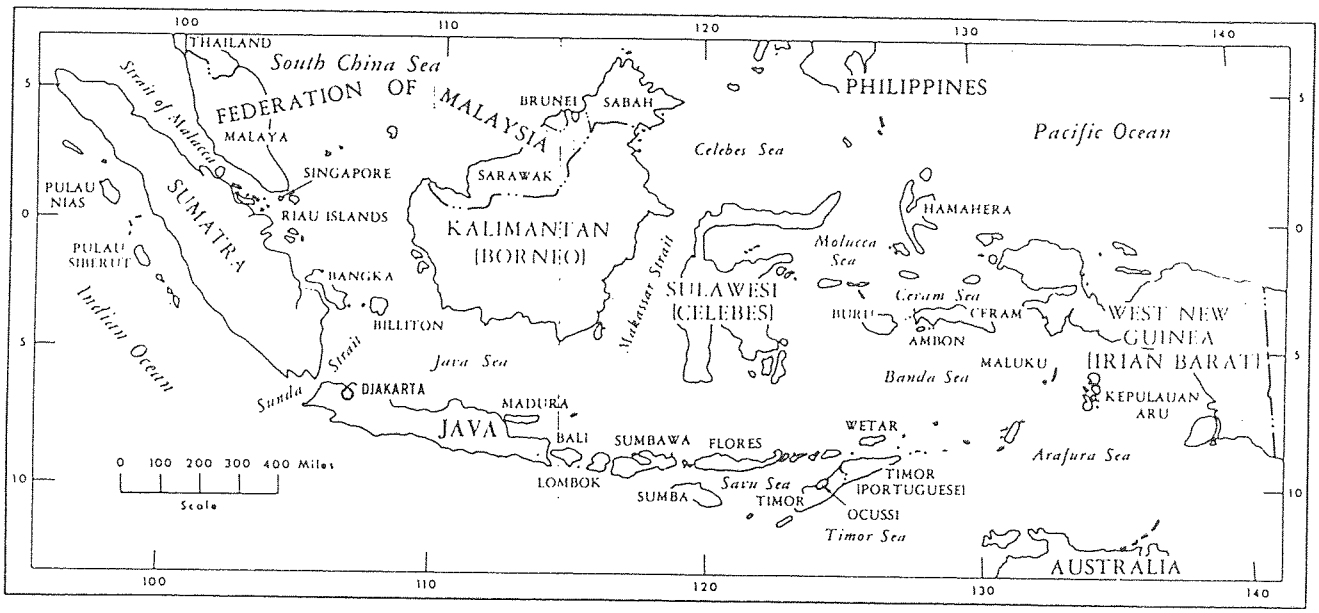


Figure 2.3 Map of Indonesia

Oil and related industries once dominated Indonesia's economy. Significant reinvestment of revenues from this sector, coupled with substantial investment from abroad has propelled the manufacturing sector to become one of the country's most important economic sector. Figure 2.4 shows the growth in manufacturing in Indonesia.

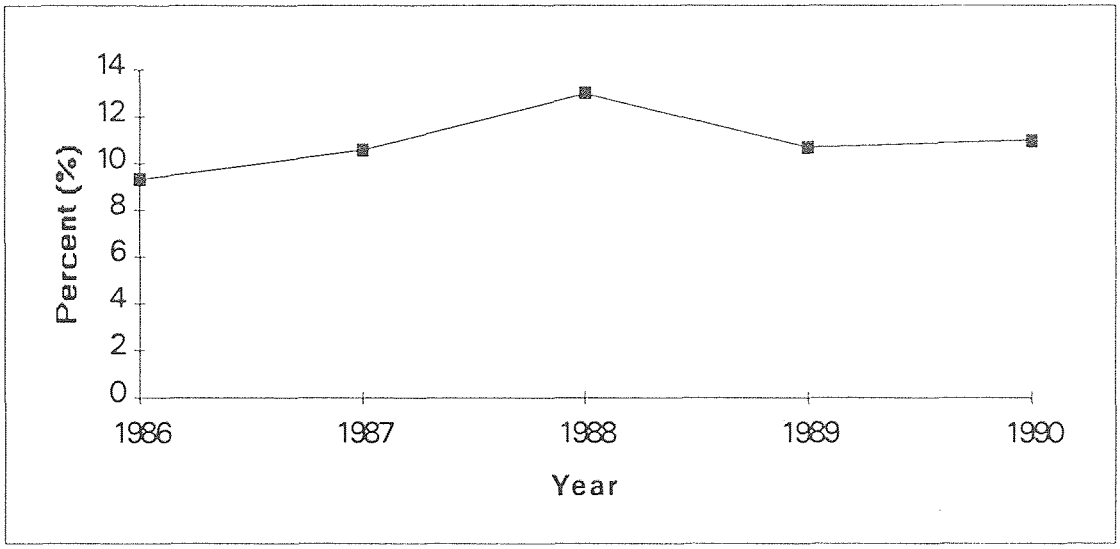


Figure 2.4 Growth in manufacturing output in terms of value added in Indonesia

Source: United Nations, *Monthly Bulletin*, January 1991.

Indonesia's manufactured output is largely comprised of consumer goods. The production of canned foods and beverages, tobacco products, shoes and textiles is undertaken primarily by private-sector enterprises. Cement, fertilizers, petrochemicals and basic metal have only in recent years gained relative importance. These are produced primarily by state-owned industrial enterprises either alone or in cooperation with foreign partners. Figure 4.5 shows the composition of exported goods from Indonesia in 1990.

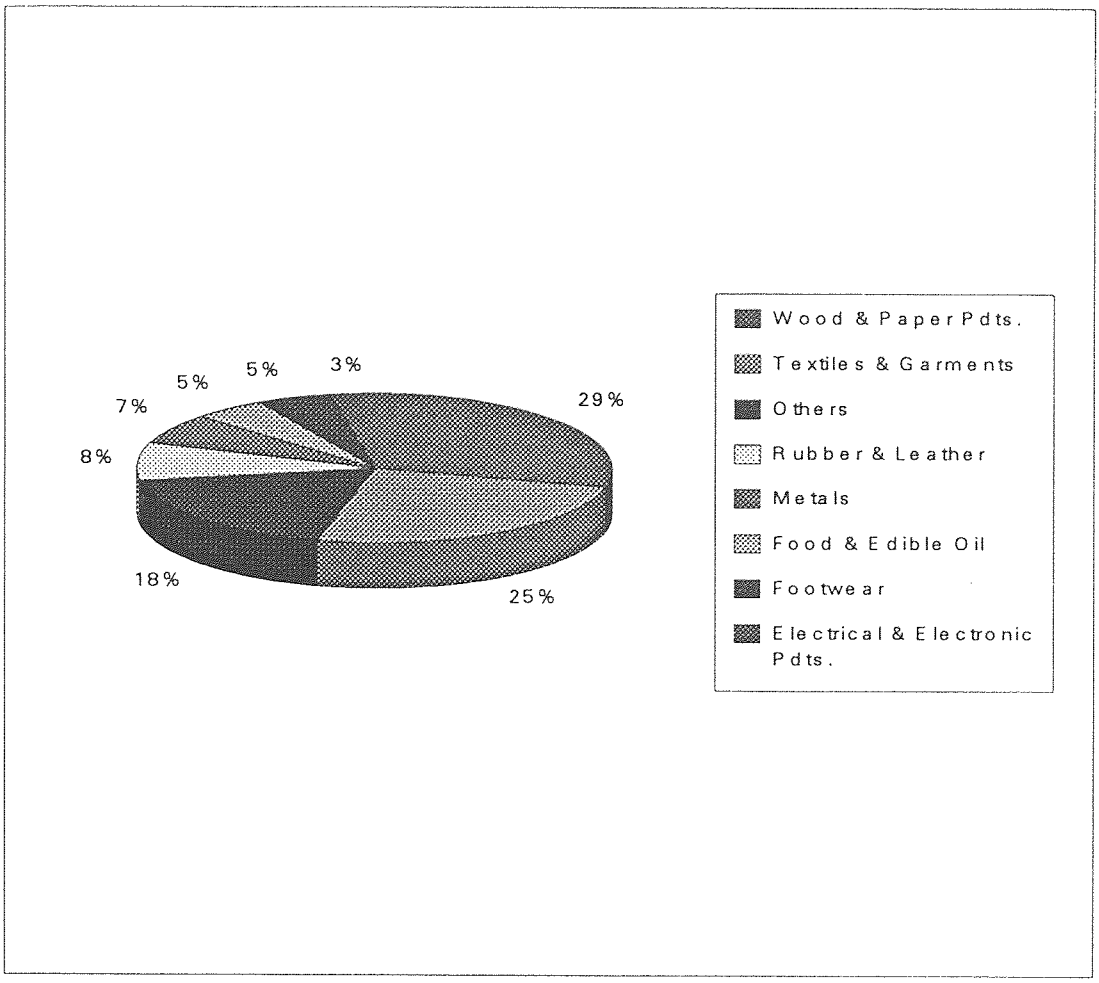


Figure 2.5 Composition of exported goods from Indonesia, 1990.

Source: National Development Information Office, Indonesia Source Book, 1992.

Foreign capital has played an important role in achieving these gains. Between June 1967 and December 1991, 1,422 joint-venture manufacturing projects were approved. These involved a total of $32.2 billion in investment or 66.5% of total approved foreign investment in non-petroleum industries. Labor-intensive industries have drawn a large portion of this investment. This was motivated in large part by the relocation to Indonesia in the late 1980s of textile and footwear companies from other Asian countries experiencing cost push inflation. Attempting to escape appreciating currencies and rising labor costs in such countries as Taiwan, South Korea and Hong Kong, companies have increasingly looked to establish operations in Indonesia. Figure 2.6

shows foreign investment in Indonesia while Table 2.1 shows sources of foreign capital. Table 2.2 gives the manufacturing productivity profile of Indonesia. Appendix C1 gives a list of selected items imported and exported by Indonesia while Appendix C2 gives some manufacturing statistics on Indonesia.

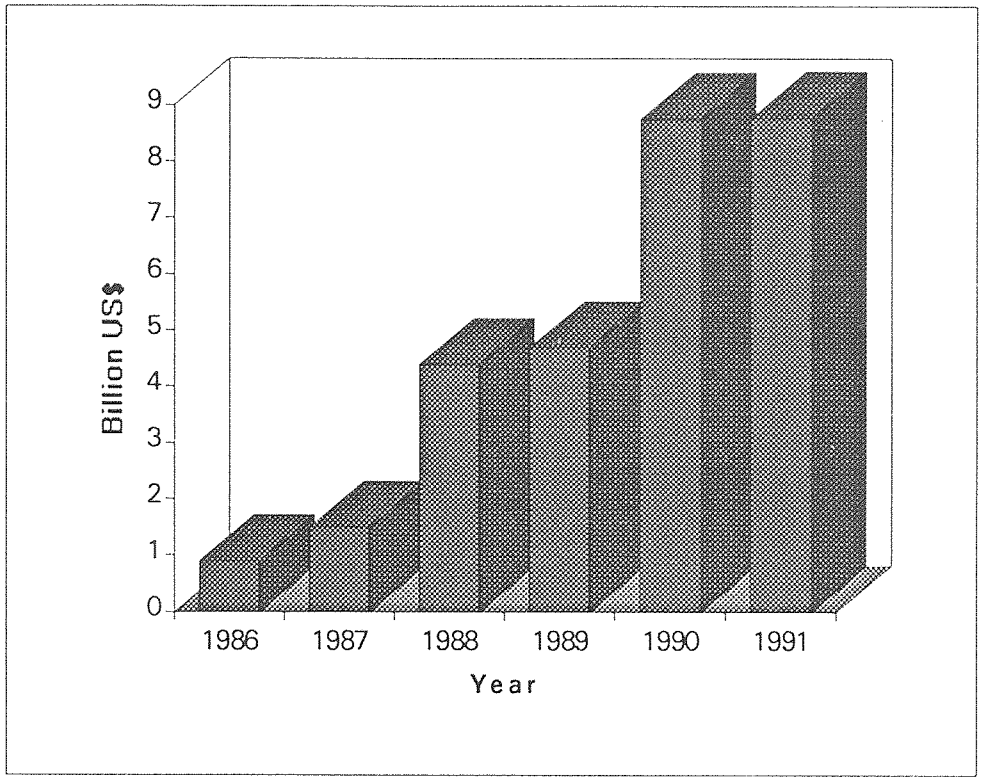


Figure 2.6 Foreign investment commitments in Indonesia.

Source: National Development Information Office, Indonesia Source Book, 1992.

Table 2.1. Cumulative foreign investment approvals by origin in Indonesia, 1967-1991

Country of Origin	No. of Projects	Total (Million $)
Japan	472	11,405
Hong Kong	203	4,213
Taiwan	227	3,375
United States	133	2,496
South Korea	253	2,229
Netherlands	89	2,132
Germany	51	1,822
Singapore	147	1,572
United Kingdom	104	1,415
Australia	116	962
Switzerland	26	492
France	32	322
Belgium	16	242
Norway	7	236
India	14	189
Brunei	1	130
Malaysia	25	121
Denmark	13	98
Sweden	4	50
Thailand	10	41
Canada	14	30
Others	215	14,779

Source: National Development Information Office, Indonesia Source Book, 1992.

Table 2.2 Economic and industrial statistics on Indonesia

MANUFACTURING PRODUCTIVITY PROFILE
INDONESIA

	1986	1987	1988	1989	1990
A. MANPOWER					
Population (millions)	167	171	174	175	179
Annual Population Growth Rate (%)	1.6	2.2	2.1	0.5	2.8
Employed Persons in Manufacturing (thousands)	5,606	5,818	5,997	6,497	7,693
Unemployment Rate (%)	2.6	2.5	2.8	2.9	. . .
B. NATIONAL ACCOUNTS (In Current Market Prices)					
Gross Domestic Product (million $)	80,058	75,923	84,300	94,455	106,859
Gross National Product (million $)	76,789	71,997	78,047	88,019	83,699
GDP Per Capita ($)	481	446	486	535	596
GNP Per Capita ($)	462	423	449	496	570
Foreign Investment Commitments (billion $)	0.9	1.5	4.4	4.7	8.75
C. EXTERNAL TRADE					
Imports (million US$, c.i.f.)	10,718	12,370	13,248	16,360	21,931
Exports (million US$, f.o.b.)	14,805	17,136	19,219	22,160	25,675
D. MANUFACTURING INDUSTRY					
Industrial Production Index (1980 = 100)	145	162	185	208	209
Number of Establishments	12,765	12,778	14,664	14,674	. . .
Gross Fixed Capital Formation (billion rupiahs)	1,564	1,787	2,926	6,532	. . .

Sources: United Nations, Industrial Statistics Yearbook 1990; United Nations, Statistical Yearbook for Asia and the Pacific 1991; Bank of America, Country Data Forecasts 1992; International Monetary Fund, International Financial Statistics Yearbook 1993.

2.2.2 Industrial Survey of Malaysia

Malaysia is located in the heart of Southeast Asia, just north of the equator. Its territory of 330,434 square kilometers is divided into two distinct regions: Peninsular Malaysia, and Sabah and Sarawak. Peninsular Malaysia extends from the Thailand border down to the island nation of Singapore, and across the South China Sea. The two states of Sabah and Sarawak on the northern coast of Borneo are bordered by Indonesia to the south and the Philippines to the east. Figure 2.7 shows a map of Malaysia.

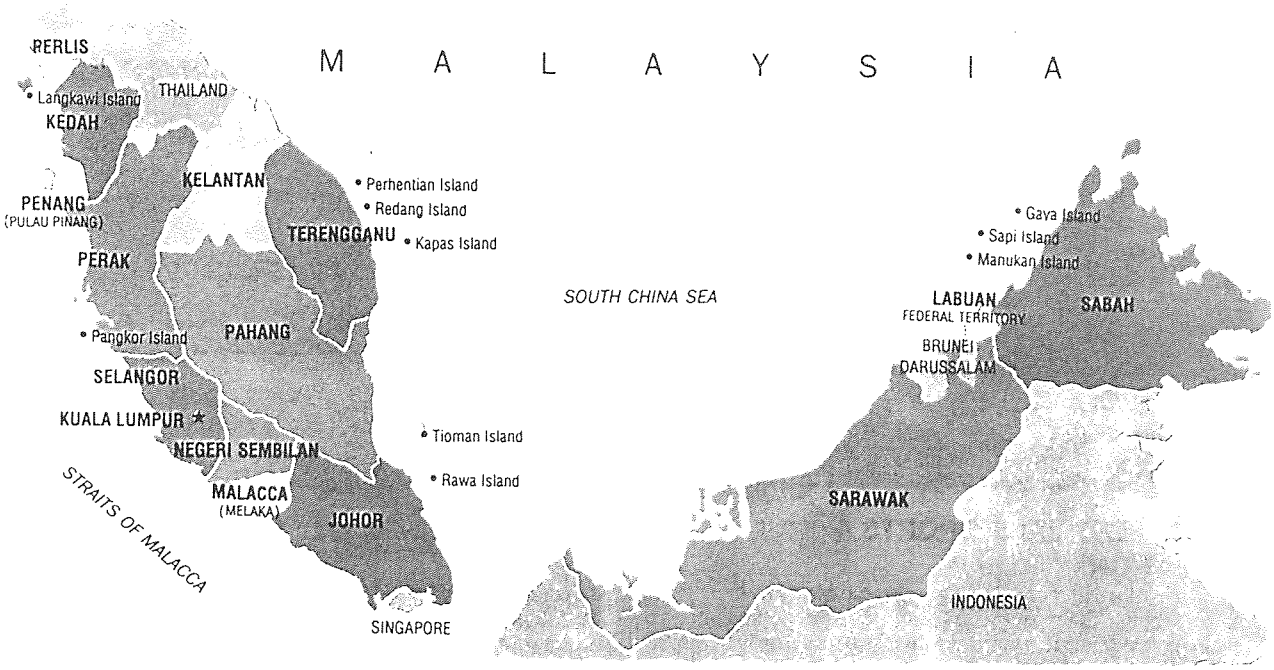


Figure 2.7 Map of Malaysia

Malaysia is moving fast to join Asia's other industrialized countries. Its economy continued its its upward movement with rates of GDP growth accelerating to an average of 9.8% in 1990 from 8.6% in 1989. As in other ASEAN countries, Malaysia's high growth has been sustained by a continuing investment boom fueled by a large inflow of foreign investment.

Industrial growth in Malaysia has been maintained at fairly high rates over the last few years. This resulted from various policy initiatives for diversification of the economy from a primarily agricultural base towards manufacturing. The growth in the production has made a substantial contribution to overall industrial growth. As can be seen in Figure 2.8 manufacturing in Malaysia continues to grow.

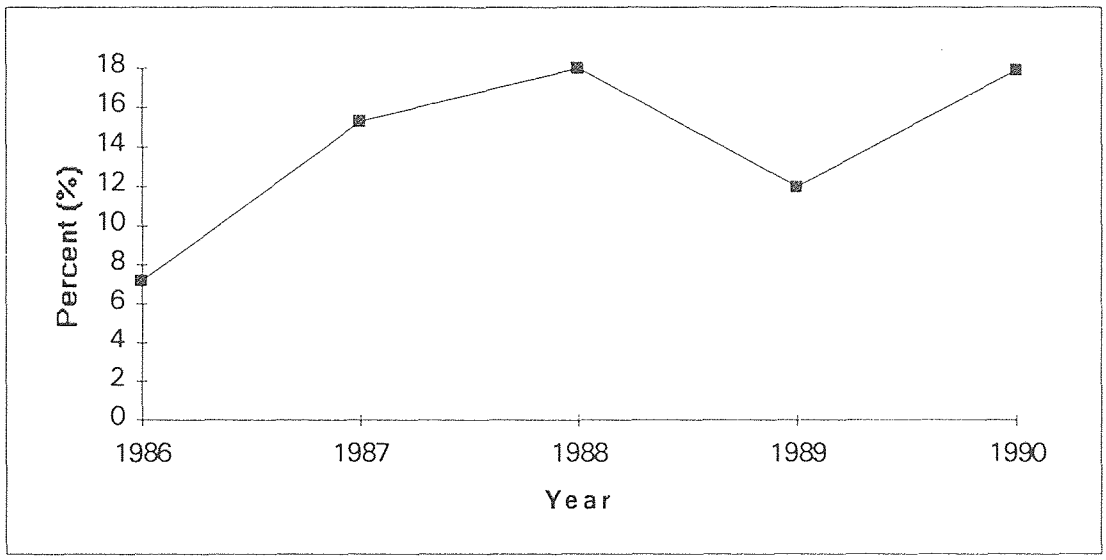


Figure 2.8 Growth in manufacturing output in terms of value added in Malaysia. Source: United Nations, *Monthly Bulletin*, January 1991.

Strong domestic demand and the continuing large inflow of foreign investment provided the stimulus for growth. Figure 2.9 shows the foreign investments in Malaysia from 1986 to 1990 and Table 2.3 indicates the sources of these foreign investments. This was compounded by increased outlays on infrastructure, including highways and the gas utilization projects in Peninsular Malaysia, and other construction activities. Table 2.4 gives some economic and industrial statistics on Malaysia. A list of selected items

imported and exported by Malaysia is given in Appendix D1. Appendix D2 gives some manufacturing data on Malaysia.

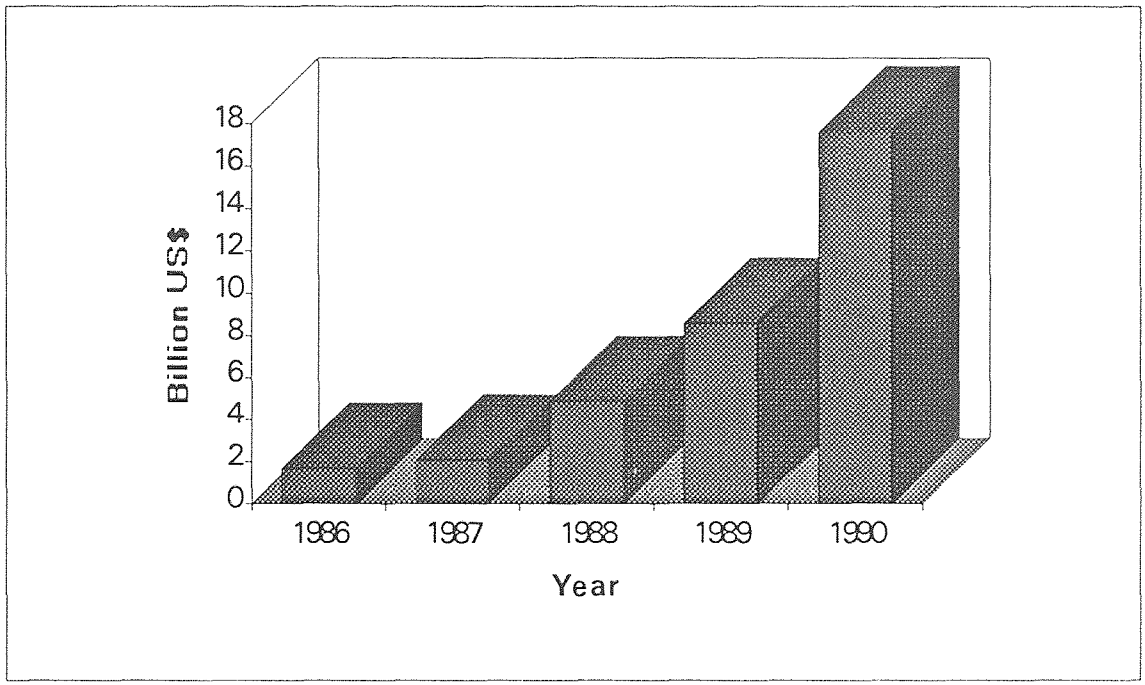


Figure 2.9 Foreign investments in approved projects in Malaysia, 1986-1990

Source: Malaysian Industrial Development Authority, Statistics on the Manufacturing Sector in Malaysia, 1985-1990.

Table 2.3 Cumulative foreign investment approvals by origin in Malaysia, 1985-1990

Country of Origin	No. of Projects	Total (Million $)
Taiwan	379	9,614.2
Japan	488	9,220.8
Singapore	499	2,772.3
United Kingdom	84	1,981.0
United States	171	1,751.5
Indonesia	30	1,226.3
Hong Kong	189	1,198.4
Iran	1	1,013.6
Netherlands	11	989.5
Korea	81	913.7
France	18	650.6
Germany	58	591.9
Sweden	26	533.5
India	25	432.0
Australia	70	296.7
Panama	5	206.9
Finland	3	198.8
Canada	34	153.8
Italy	28	150.1
Belgium	11	137.3
Switzerland	18	85.6
Thailand	296	77.9
Denmark	14	49
Saudi Arabia	3	44.7
Philippines	5	41.7
Sri Lanka	150	30.6
Others	286	1,476.7

Source: Malaysian Industrial Development Authority, Statistics on the Manufacturing Sector in Malaysia, 1985-1990.

Table 2.4 Economic and industrial statistics on Malaysia

MANUFACTURING PRODUCTIVITY PROFILE
MALAYSIA

	1986	1987	1988	1989	1990
A. MANPOWER					
Population (millions)	16.11	16.53	16.94	17.35	17.76
Annual Population Growth Rate (%)	2.7	2.6	2.5	2.4	2.9
Employed Persons in Manufacturing (thousands)	860	921	1013	1171	1290
Unemployment Rate (%)	8.3	8.2	8.1	7.1	6
B. NATIONAL ACCOUNTS (In Current Prices)					
Gross Domestic Product (million $)	27,750	31,597	34,676	37,440	42,450
Gross National Product (million $)	25,897	29,992	31,543	35,721	40,451
GDP Per Capita ($)	1,722	1,912	2,047	2,158	2,390
GNP Per Capita($)	1,607	1,814	1,862	2,059	2,278
Foreign Investment in Approved Projects (billion $)	1.7	2.1	4.9	8.6	17.6
C. EXTERNAL TRADE					
Imports (million $, c.i.f.)	4,195	5,101	6,085	8,332	. . .
Exports (million $, f.o.b.)	5,331	7,204	7,761	9,279	. . .
D. MANUFACTURING INDUSTRY					
Industrial Production Index (1980 = 100)	133	150	177	197	233
Number of Establishments	5,814	5,741	5,787	6,092	. . .
Gross Fixed Capital Formation (million $)	659	1,337	1,318	1,946	. . .

Sources: United Nations, Industrial Statistics Yearbook 1990; United Nations, Statistical Yearbook for Asia and the Pacific 1991; Bank of America, Country Data Forecasts 1992; International Monetary Fund, International Financial Statistics Yearbook 1993.

2.2.3 Industrial Survey of Philippines

The Philippines is an archipelago of about 7,100 islands and islets lying about 500 miles off the southeastern coast of Asia. It has a land area of about 115,00 miles. Figure 2.10 shows a map of the Philippines.

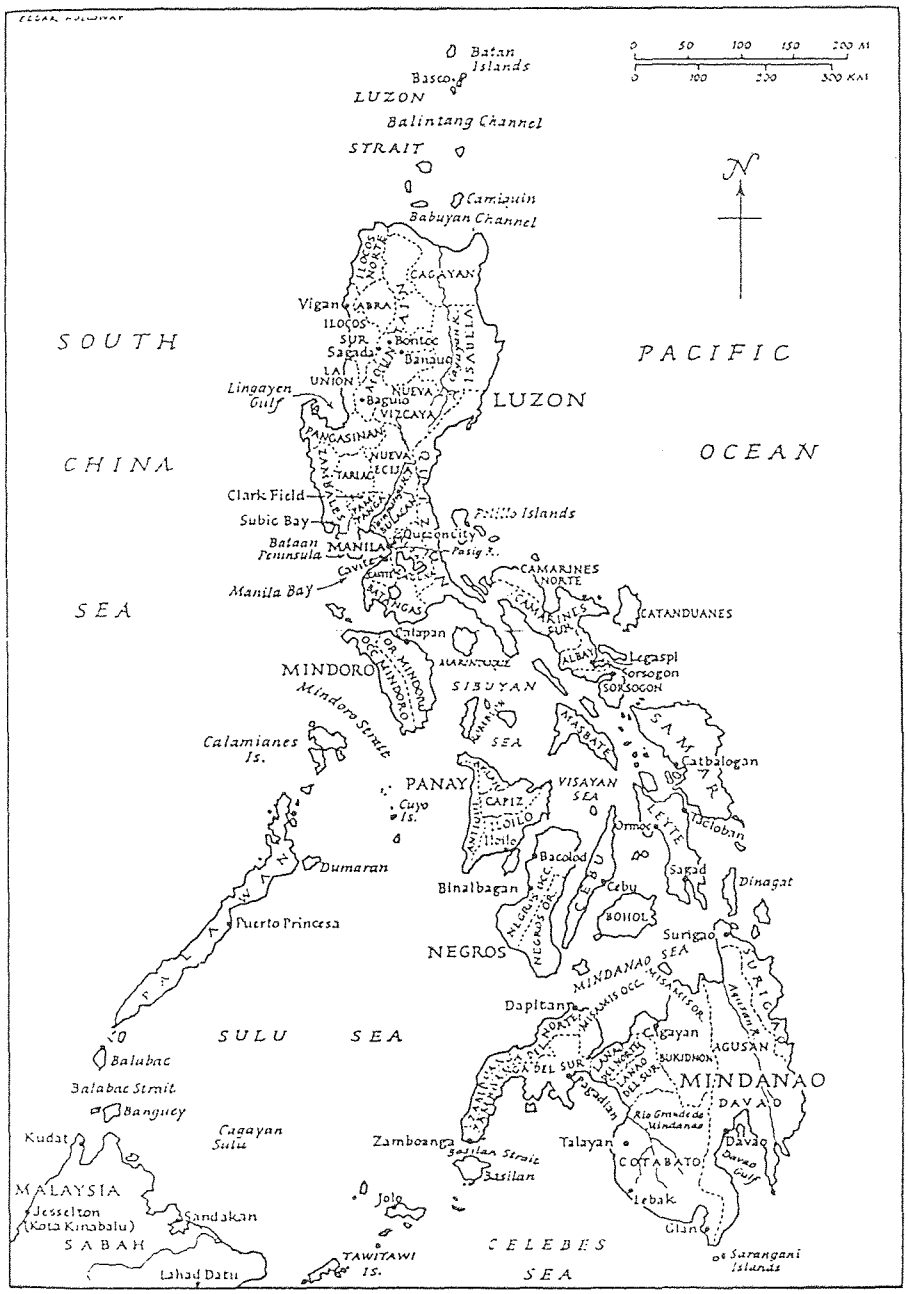


Figure 2.10 Map of the Philippines

The economy of the Philippines is largely based on agriculture, light industries and services. It achieved an average annual growth of 6% in 1989 and experienced difficulties in 1990. In addition to the heavy debt burden, the performance of its economy was adversely affected by several unfavorable factors including severe natural calamities and a weakening of external demand for its exports. Manufacturing accounts for approximately one-fourth of the Gross National Product (GNP) and employs about one-tenth of the work force. Major manufacturers include processes foods, beverages, petroleum products, textiles and footwear. The government has encouraged the development of labor-intensive industries, including the assembly of electrical and electronic equipment.

Manufacturing output fell in the political and economic crisis of 1983 and industry in 1985 was working at as low as 40% of capacity. By the middle of 1988, after economic pump priming by the Aquino regime, industries were again working at full capacity. Figure 2.11 shows the growth of manufacturing output in the Philippines.

Manufacturing production is geographically concentrated. In 1990, 50% of the industrial output came from Metro Manila and another 20% from the adjoining regions of Southern Tagalog and Central Luzon. Prior to 1986, government efforts to distribute industry more evenly were largely ineffective. In the post-Marcos economic recovery, however, investment grew in small- and medium-sized firms. These firms produce handicrafts, furniture, electronics, garments, footwear and canned goods in areas outside Metro Manila particularly in Cebu City and Davao City.

Growth in industrial output in the Philippines declined to around 3.6% during the first half of 1990 compared with the average annual growth rate of 7.8% from 1987-1989. This was mainly due to the steep decline in the growth of the manufacturing sector 2.8% in the first half of 1990 versus 7.5% per year in 1987-1989. Apart from the slackening overall consumer demand the shortage of power was a major factor contributing to the depresses industrial activities and investment in 1990. Figure 2.12 shows the foreign investments in the Philippines and Table 2.5 cites the sources of foreign equity investment.

Table 2.6 gives some economic and industrial statistics. A list of selected items imported and exported by the Philippines is given in Appendix D1. Appendix D2 gives some manufacturing data.

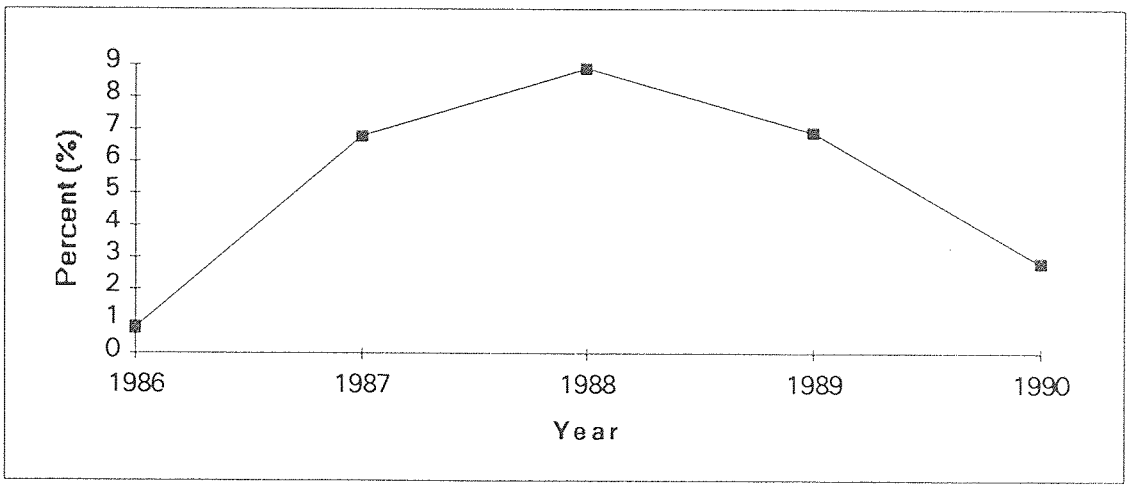


Figure 2.11 Growth in manufacturing output in terms of value added in Philippines.

Source: United Nations, *Monthly Bulletin*, January 1991.

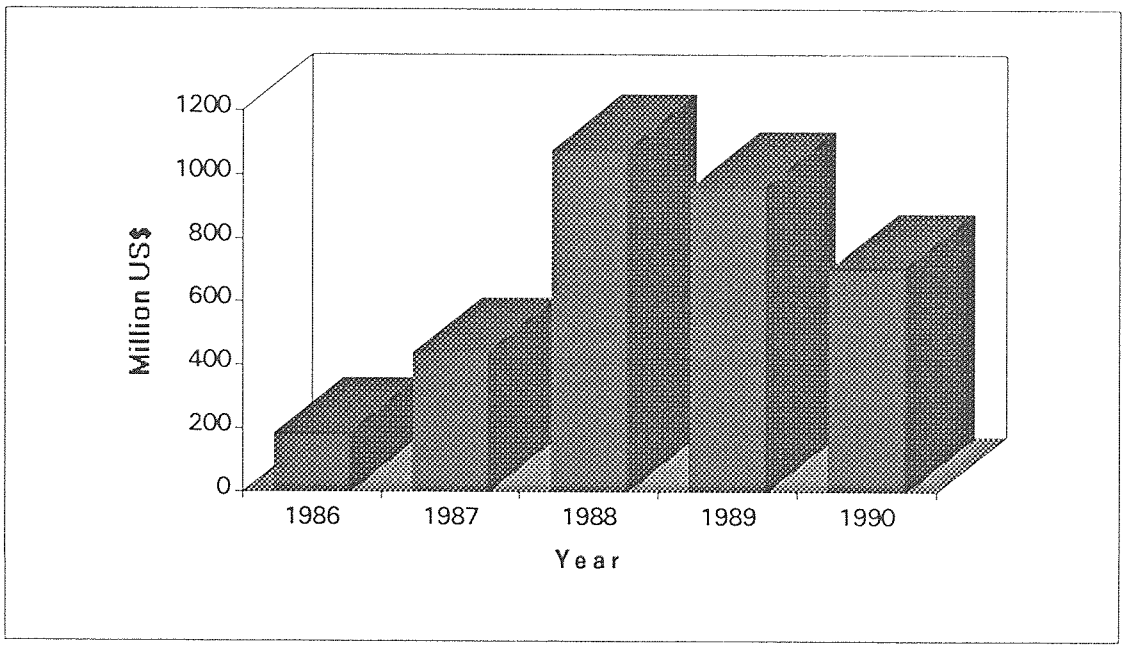


Figure 2.12 Foreign investments in the Philippines, 1986-1990

Source: National Economic and Development Authority, Philippines.

Table 2.5 Cumulative foreign equity investment in the Philippines by origin, 1986-1990.

Country of Origin	Total (Million $)
United States	309.9
Japan	140.5
Hong Kong	61.4
Netherlands	32.5
United Kingdom	26.2
Australia	21.1
Switzerland	15.6
Singapore	12.1
South Korea	9.3
Sweden	6.9
Canada	5.4
Germany	5.1
Denmark	4.6
Panama	3.5
Bermuda	2.2
Malaysia	1.6
France	1.2
Luxembourg	0.8
Others	39.7

Source: National Economic and Development Authority, Philippines.

Table 2.6 Economic and industrial statistics on Philippines

MANUFACTURING PRODUCTIVITY PROFILE
PHILIPPINES

	1986	1987	1988	1989	1990
A. MANPOWER					
Population (millions)	56	57.36	58.72	60.1	61.48
Annual Population Growth Rate (%)	2.4	2.4	2.4	2.2	2.3
Employed Persons in Manufacturing (thousands)	1,906	2,059	2,238	2,298	2,188
Unemployment Rate (%)	6.4	9.1	8.3	8.4	8.1
B. NATIONAL ACCOUNTS (In Current Market Prices)					
Gross Domestic Product (million $)	30,757	34,056	38,702	42,981	40,350
Gross National Product (million $)	30,147	33,815	38,562	42,865	40,443
GDP Per Capita ($)	1,722	1,912	2,047	2,158	2,390
GNP Per Capita ($)	1,688	1,898	2,040	2,152	2,396
Foreign Investments (million $)	186	439	1,077	961	706
C. EXTERNAL TRADE					
Imports (million US$, c.i.f.)	5,394	7,144	8,721	11,171	13,041
Exports (million US$, f.o.b.)	4,770	5,649	7,032	7,755	8,068
D. MANUFACTURING INDUSTRY					
Industrial Production Index (1980 = 100)	291	333	280	. . .	. . .
Gross Value of Output of Manufacturing (million $)	12,280	14,324	18,042	18,529	. . .
Number of Establishments	5,294	5,000	11,488	. . .	. . .
Gross Fixed Capital Formation (million $)	449	473	755	. . .	. . .

Sources: United Nations, Industrial Statistics Yearbook 1990; United Nations, Statistical Yearbook for Asia and the Pacific 1991; Bank of America, Country Data Forecasts 1992; International Monetary Fund, International Financial Statistics Yearbook 1993; National Statistical Coordination Board, Philippine Statistical Yearbook 1992.

2.3 Other Manufacturing Surveys

Various studies have been conducted regarding manufacturing practices in different countries. Table 2.7 gives a summary of these studies.

Table 2.7 Studies on manufacturing practices

Author(s)	Description of Study	Finding(s)
Mody, Suri, Sanders, Rao and Contreras (1991)	Three classes of countries namely, developed countries, newly industrialized economies and less developed countries, were studied regarding the impact of manufacturing practices on global competitiveness in the bicycle industry.	LDCs not competitive in global market due to low organizational efficiency; NIEs should maintain emphasis on continuous improvement DCs should focus on other strategic options such as rapid response and frequent product changes.
Rho and Whybark (1988)	Presented a paper on general information and procedures for sharing data for a world wide survey of actual practices in production planning and control.	
Rho and Whybark (1989)	Compared the manufacturing production and control practices between South Korea and Europe in the non-fashion textile and small machine tools industries.	The differences are greater between South Korea and Europe than between the textile and machine tool industries.
Whybark and Chikan (1989)	Conducted a survey of production-inventory practices in South Korea, China, Western Europe and Hungary in the non-fashion textiles and small machine tools industries.	Production practices of the different regions vary. Practices of companies reflect the conditions and requirements of the environment.
Whybark and Vastag (1991)	Compared manufacturing practices between Hungary, Western Europe and North America in the non-fashion textiles and small machine tools industries.	Practices differed significantly between the regions.

Table 2.7 (continued)

Ferdows and De Meyer (1988)	Assessed the manufacturing practices of large European companies over five years (1983-1987) and the implications of these practices on the competitiveness of the region.	The average European manufacturer is now focusing more attention to infrastructural elements of production such as quality improvement programs and delivery improvement systems.
Sanders (1992)	Conducted a survey of U.S. companies on forecasting practices in the manufacturing industry.	Judgmental methods are the dominant forecasting techniques in all industries.
Newman and Sridharan (1992)	Surveyed manufacturing companies in the U.S. on the relative performance of various manufacturing production control systems (MRP, ROP, OPT, Kanban).	Use and effectiveness of different MPC systems depend on production environment.
Morris and Kim (1988)	A survey of manufacturing planning and control system used by Korean firms	Korean manufacturers use the same system as U.S. manufacturers.
Hamid, Agus and Hassan (1991)	Survey on the usage of computerized MRP system in Malaysian manufacturing companies.	Level of usage in Malaysian manufacturing companies is low.
Ross and Georgoff (1991)	Conducted survey of members of the Institute of Industrial Engineers (IIE) on quality management practices that are in use and also determined the strategic, marketing and bottom-line impact of these practices.	Companies with higher market share and economic performance did well on commonly accepted good quality-management practices identified.
Ansari and Modarress (1989)	A survey of U.S. manufacturing firms on the use of quality control techniques.	A number of companies use sampling inspection for their manufacturing process followed by statistical charts.

CHAPTER 3

DESIGN OF SURVEY QUESTIONNAIRE

3.1 Survey Procedure

Our mechanism for reviewing the manufacturing practices of the three countries was a mail survey. Given the distance between NJIT and these countries, and the high telecommunication charges, this was the most effective method. The specific activities in conducting the survey were as follows:

1. Design survey questionnaire
2. Procure and select survey recipients
3. Mailing of surveys and follow-up
4. Compilation of survey responses
5. Analysis of results

In this chapter we document activities 1 and 2, while Chapter 4 document activities 3, 4 and 5.

3.2 Design of Survey Questionnaire

After a review of past surveys it was concluded that a questionnaire with multiple choice answers was most likely to be successful. This format also ensures that we will not have a wide array of answers. Survey length is also a critical factor in the return percentage, hence the goal was to have a survey which could be completed in less than 30 minutes.

The questionnaire had 32 questions and covered the following areas:

- Company Profile
- Production Control and Management
- Quality Management
- Automation and Computerization

These four areas were chosen because these areas are very important in determining strategic options of the companies. They would also give us an almost complete picture of how manufacturing is being managed in the region. The entire questionnaire is reproduced in Appendix A.

3.2.1 Company Profile.

This part of the questionnaire would give us background information and the production environment in which the company operates.

1. Company name

This question would assist us in noting down which companies responded from the list and that no duplication of the responses were taken down into account. However, this was made optional as some companies may prefer not to divulge their name as some of the answers might be confidential.

2. Products

We wanted to know what products the responding companies are manufacturing since different products require different type of production environment. Also, we wanted to know whether the survey will be representative of a wide array of products and not biased on a certain type only.

3. Sales last year (in US$ or indicate currency): Domestic

Export

This would indicate the size of the company and the range of the sample population, i.e., whether the sample is made up of small, medium or large-scale companies. Sales for domestic consumption and for export were asked separately since management of an export-oriented company may vary for one that is geared only for domestic sales. A

company competing in the international market and not just locally would somehow be different in some aspects in terms of manufacturing. For instance, the highly competitive export market would motivate a company to employ computer-aided manufacturing technologies. Also, export-oriented manufacturing firms tend to be more receptive to new production technologies than those catering only to the domestic market.

In addition, both sales and products relate to the main thrust of the company, that is, where a big chunk of its monies are spent. For example, companies producing chemicals in high volume would focus on automating the factory floor. On the other hand, firms producing furniture in low volume are labor intensive. Table 3.1 groups the companies into four types depending on their thrust:

Table 3.1 Relationship of products and sales to company's main thrust

Main Thrust	Products	Sales
Automation	chemicals, paper, beverages, textiles, plastic, cement, food, industrial gases, automobile & parts	high volume
Labor Intensive	furniture & fixtures, apparel, footwear, ceramic & china	low volume
Resource Allocation	general machinery, personal care products	low volume
Quality	electrical equipment, household appliances, transport equipment	all levels

4. Number of employees: Total company

Direct in Production

This would also be indicative of the size of the company. The number of people directly involved in production relative to the total company would suggest the relative magnitude of the production operation and also relate to the type of product or operation the company is into. This would also indicate whether the operation is labor intensive or not. It is expected that most of the companies would have large numbers of employees due to the low-cost, trainable and easy-to-manage labor force in the countries under study.

5a. Production type: Batch, Job-shop, Mass, Flow

The nature and complexity of the system being used to accomplish the objectives of the company and the degree to which procedures, forms and reports are developed, is dependent to a great extent on the type of manufacturing operation. In the *batch type* of production, a number of identical articles are manufactured. When production of the batch is terminated, the plant and equipment are available for the production of similar other products. In a *job-shop* environment, products are manufactured to meet specific customer requirements of special orders. The batch and job-shop are similar in such a way that in these types of setup, the machines run for relatively short period of time between setups and, therefore, the volume of any one item is small but the variety of items is large. The plant is arranged on a process or machine center basis with similar general purpose machines placed together in a single work area.

In *mass production*, plant and equipment are flexible enough to deal with other products involving the same production process. And in *flow production* equipment and layout have been primarily designed to manufacture the product. The mass and flow production type involves a large volume of similar products and machines which are used for a long time between setup changes.

It is important to know the type of manufacturing the company is into because there would be differences in managing the production process. Production control will vary, depending on the type of production environment. It is more complex for the batch and/or job-shop type than for the mass or flow production type since detailed processing instructions and operation lists are required to reflect the variations in the manufacture of each production lot. Typical planning and control problems for the batch and job-shop include controlling work-in-process inventory, relating demand to the capacity of the machine centers, frequent out-of-balance conditions, scheduling innumerable operations on different lots through various machine centers in accordance with customer and/or inventory requirements. For a mass or flow production, planning problems include the forecasting of quantity requirements, the timely provision of the right quantity of materials to the production lines, balancing capacity between stations and controlling input through control points. Moreover, repetitive process manufacturers (mass or flow) tend to be capital intensive whereas job-shop manufacturers are material and labor intensive.

b. Make-to-stock, Make-to-order

A company who produces for stock would have differences with one that is producing to meet customer orders. For example, a company producing items to stock would be more concerned with the level of finished goods inventory while the other one would be more concerned with work-in-process inventory. This data would also indicate the manner in which the companies react to the market. Producing to stock would reflect a faster market response because of the greater flexibility of the environment to shift to new products. Generally, the more a company produces to order, the less speedily it can satisfy consumer demand. Thus, the stronger market requirements for speedy delivery the more a firm produces to stock.

6. What is the average capacity utilization rate?

0 - 50% , 50 - 70% , 70 -90% , 90+%

This would tell us the extent to which the companies use their capacities and whether there are still a lot of available capacity in the region. Also, if plants are operating at or near capacity, some managers may feel that forecasting would not be particularly an important component of the planning and control system, since their plants are already operating close to capacity.

3.2.2 Production Control & Management

Production planning and control is one of the key activities in manufacturing and determines to a large extent, the pulse of over-all operations. It focuses on the activity scheduling, the ordering, movement and process of all materials through the plant. It is made up of a set of decisions such as:

- What to produce?
- When to produce?
- How much to produce
- Where to produce?
- How much in inventory?
- Who will supply?
- Who will transport?
- What is the lead time?

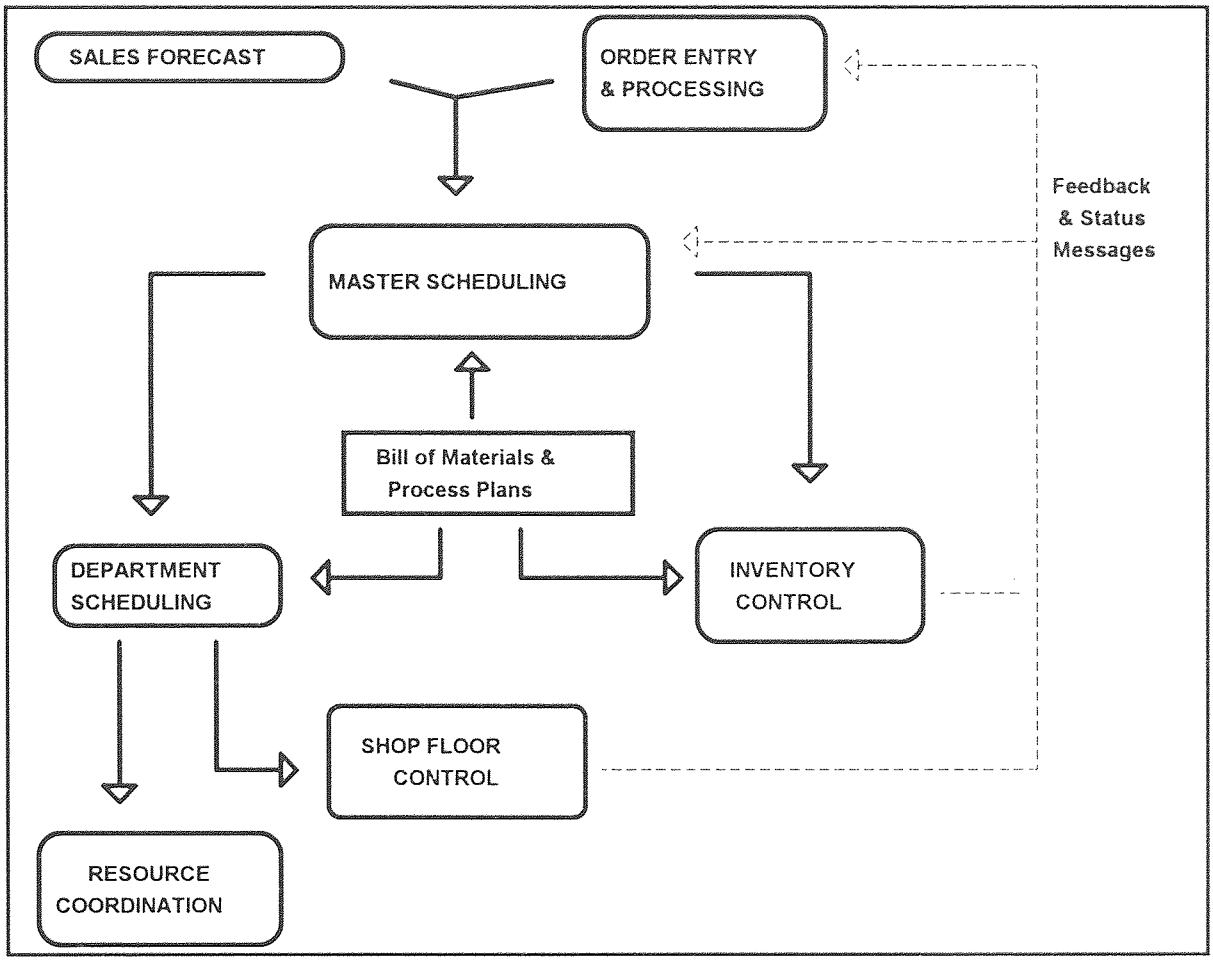


Figure 3.1 Production Control System diagram.

Source: Das, The JIT, MRP-II & TQM Workbook, 1990.

3.2.2.1 Sales Forecasting

As can be seen from the Figure 3.1, the sales forecast is an important input to the production plan or master schedule. An idea of the quantity of products which must be produced to meet customer demand and to satisfy future demand is needed. The sales forecast is also an important input in capacity planning which establishes, measure and adjust limits or levels of capacity. Questions 1 - 4 pertains to forecasting.

1. Which functional group makes the sales forecast?

Administrative/Planning

Sales/Marketing

Production/Engineering

Finance/Accounting

Sales forecasts are usually prepared by Sales or Marketing, but are sometimes prepared as a team effort of several departments or by another appropriate department.

2. How far in the future do you forecast your sales?

1 month , 3 months , 6 months , > 6 months

The time frame within which the forecast is made might be indicative of some things such as the selection of an appropriate forecasting method. Also, a shorter time horizon may indicate that the demand is quite unpredictable as compared to the longer time horizon where demand is relatively constant.

3. Which forecasting techniques are being used for short term and long term planning?

Manager's opinion

Sales force composite

Moving average

Exponential smoothing

Straight line projection

Regression analysis

Box-Jenkins time series

There are various forecasting techniques, both qualitative and quantitative that are currently available. The choices in this question were limited only to the following which are the most commonly used:

Manager's opinion or jury of executive opinion - This method consists of combining and averaging top executives' views concerning the item to be forecast. Generally, the company brings together executives from areas such as sales, production, finance, purchasing and staff operations in order to get the benefit of broad experience and opinion. Often staff groups supply background information to the members of the executive group. This approach has the advantages that forecasts can be provided easily and quickly without elaborate statistics and that a range of management viewpoints can be considered. Also, it requires fewer data than mathematical techniques do. However, this technique is very judgmental and subject to biases.

Sales force composite - The sales force composite approach to forecasting involves obtaining the views of salespersons, sales management, or both, on the outlook for individual products and/or total sales. This is generally a bottom-up approach, since different salespersons can estimate sales for only some subdivision of the company, and these can then be combined to get an aggregate forecast of sales. Like the jury of executive opinion, this approach is not statistical but has the advantages of integrating judgmental factors and experience in situations where historical data may not be available or applicable. However, it has the disadvantage of being susceptible to the biases of those who are most influential in the sales group.

Moving average - This method considers the use of some kind of average of recent observed values. It does this by taking a set of observed values, finding their average, and then using that average as a forecast for the coming period. The actual number of observations included in the average is specified by the manager and remains constant. The term moving average is used because as each new observation becomes available, a new average can be computed and used as a forecast. This method could be used to forecast two or three months in advance as well as one month in advance. However, the

likelihood of error would be much greater because the same three actual values used in a three-month averaging for one month ahead would be used in a three-month moving average for three months ahead. Thus, in most cases, the method of simple moving averages is applied for only one period in advance. Another characteristic of this method is that the more observations included in the moving average, the greater the smoothing effect on the forecast. If a smoother value is desired, either because it is thought that the historical observations contain considerable randomness or because there is little change in the underlying pattern, a large number of observations should be used to compute the moving average forecast.

Exponential smoothing - In principle, exponential smoothing operates in a manner analogous to that of moving averages by "smoothing" historical observations to eliminate randomness. The mathematical procedure for performing this smoothing, however, is somewhat different from that used in moving averages. In this method only the most recent observation, the most recent forecast and a given weight value for the observation (α). However, there is no good rule for determining the appropriate value of the weights. For moving averages the manager sets this value by specifying how many observations to include in the average, in exponential smoothing this is set by selecting a value of α. Most often this is done through trial and error, trying several values to see which is most appropriate. When α has a value close to 1, the new forecast will include a substantial adjustment for any error that occurred in the preceding forecast. Conversely, when α is close to 0, the new forecast will not show much adjustment for the error from the previous forecast.

Straight line projection - In this method, the forecast is expressed as a function of a certain number of factors or variables that determine its outcome. Specifically, it is assumed that the relationship that exist between two variables is linear. Unlike the

exponential smoothing, this method gives equal weight or importance to each observation. This type is the simplest type of regression analysis.

Regression analysis - This method assumes that the variable to be forecast (the dependent variable) can be predicted on the basis of the value of one or more independent variables. For example, if company sales were the variable to be forecast, they might be dependent on time, the economy, or sales of major customer industries. Regression analysis is a statistical technique that fits the specified model to the historical data available. One of its major attractions is that, as independent variables take on new values, the dependent variable will also change. Thus it goes beyond simple time series extrapolations and bases a forecast on a causal relationship. However, one drawback of this method is that it requires estimates for the independent variables before a forecast can be made. Another is that regression can be used reliably when and only when the relationship between the independent variables and the dependent variable does not change. If that relationship does change, it becomes necessary to collect a new set of data in order to redetermine the regression equation.

Box-Jenkins time series - This technique is a highly sophisticated approach to time series forecasting. It seeks to identify patterns in the historical values of a time series and then to extrapolate those patterns into the future. It has the advantage of being able to handle a wide range of time series patterns and to provide statistics indicating the level of accuracy that can be expected in a given situation. However, it is extremely complex and somewhat difficult to understand.

Any manager concerned with the application of forecasting in his or her decision making knows the importance of selecting the appropriate forecasting technique for the specific situation. Sales forecasting for companies which engage in continuous (repetitive) manufacturing will be different from that of companies which are engaged in

intermittent (batch type) manufacturing, and will differ with the product. The time horizon or period of time over which a decision will have an impact and for which the manager must plan clearly affects the selection of an appropriate method. Generally speaking, qualitative methods of forecasting are used more for longer-term forecasts, whereas quantitative methods are used more with intermediate- and shorter-term situations. Also some techniques are appropriate for forecasting only one or two periods in advance; others can be used for several periods into the future. Other factors that influence the choice of the forecasting method include the degree of accuracy required, pattern found in the data to be forecast, simplicity and ease of application and availability of computer software.

We would like to mention several studies which have been made regarding forecasting that might be of use in analyzing the data:

a. A comparison of management forecasts of earnings and those of Box-Jenkins method was made. Findings showed that in cases in which management forecasts proved reasonably accurate, overall they were not more so than those generated from Box-Jenkins. Where management forecasts proved to be relatively inaccurate, those from the Box-Jenkins models were significantly less so (Lorek, McDonald and Patz, 1976).

b. Comparison between sales forecasts made by management and those made by three quantitative models was made. Based on the study, the sales forecasts of corporate executives gave less accurate results than those of quantitative models over the five-year period of comparison (Mabert, 1976).

c. Experimental design to test the accuracy of intuitive judgment versus exponential smoothing models was conducted. Main finding was that Winter's exponential smoothing (similar to linear exponential smoothing but has the advantage of taking into account seasonally and trend) produced forecasts which were statistically more accurate than those of human forecasters (Adam and Ebert, 1976).

d. A comparative study of methods for long range market forecasting was done. The study showed that "objective" methods are more accurate than intuitive ones; causal methods are more accurate than naive ones (uses as a forecast the most recent information available concerning the actual value); and the superiority of objective over intuitive increases as the amount of change in the environment increases (Armstrong and Grohman, 1972)

e. "Simple" time series models often predict as well as or better than more sophisticated versions (Chatfield and Prothero, 1973; Groff, 1973; Makridakis and Hibon, 1979).

f. Mechanistic time series models predict well in comparison to causal econometric models (system of simultaneous regression equations that take into account the interaction between various segments of the economy and/or areas of corporate activity (Cooper, 1975; McNees, 1975).

g. Added complexity in models does not tend to increase predictive accuracy (review of 16 studies). Furthermore no single econometric model is consistently superior to others (Armstrong, 1978).

4. What are the two most important uses of sales forecast?

Budget preparation

Manpower planning

Production planning

New product development

Material/inventory planning

Facilities planning

Sales planning

Use of the forecast information may or may not vary within the region. The main use of the forecast would indicate what aspect of planning does the company or market deemed important. For example, if the forecast is used mostly for financial budgeting, it would indicate the importance of financial planning in that market.

3.2.2.2 Production Planning

Referring back to Figure 3.1, the production plan or the master schedule is the centerpiece of the plan for meeting customer demand for each item. The American Production and Inventory Control Society (APICS) define it as "a statement ... of what the company plans to produce, expressed in specific configurations, quantities and dates." It is formed by a merger of the sales forecast, capacity or supply plans, order entries and the bill of materials and process plans. Production planning is also directed toward the attainment of desired manufacturing results in terms of low production costs and efficient methods. Questions 5 - 8 are about the production plan.

5. Which functional group makes the production plan?

Administrative/Planning

Sales/Marketing

Production/Engineering

Finance/Accounting

The production plan is generally done by the Production Department. However, since other inputs are also needed to generate a good plan such as sales forecast and inventory levels, other groups may be assigned to do this.

6. What are the two most important bases of your production plan?

Actual orders/backlog

Level of inventories

Previous sales

Customers' plans

Production capacity

Sales forecast

Others

Various factors are taken into account in developing the production plan, depending on the product, the type of manufacturing process, the company's objectives and other things. The basis of the production plan would tell us how the companies relate to the market. For example, a company whose major basis is the level of inventories would mean that in terms of delivery the company would be very good. However, if the market is demanding in terms of variety or new products, customers' plans or actual orders may be the important factor.

7. What is the frequency with which your production plan is made?

Daily , monthly , quarterly , annually

We wanted to know whether the frequency of the production plan is dependent on the type of manufacturing process, the product or any other factor.

8. What percentage of the time is the plan actually followed?

0 - 25% , 25 - 60% , 60 - 90% , 90+%

Any plan made is hoped to be followed, however, not every problem or changes can be foreseen. Revisions to the plan may be due to customers' requests, engineering improvements, breakdowns, poor quality, etc. But generally, an effective plan tries to anticipate as much of the problems as possible. The frequency with which the plan is

followed together with the frequency with which it is made would indicate the demand pattern of the products, and how market-oriented the firms are.

9. What is your company's average leadtime, i.e., from start of production until delivery to customer or inventory?

Leadtime in this case is defined from the start of production until delivery to customers or inventory. The composition of leadtime is shown in Figure 3.2.

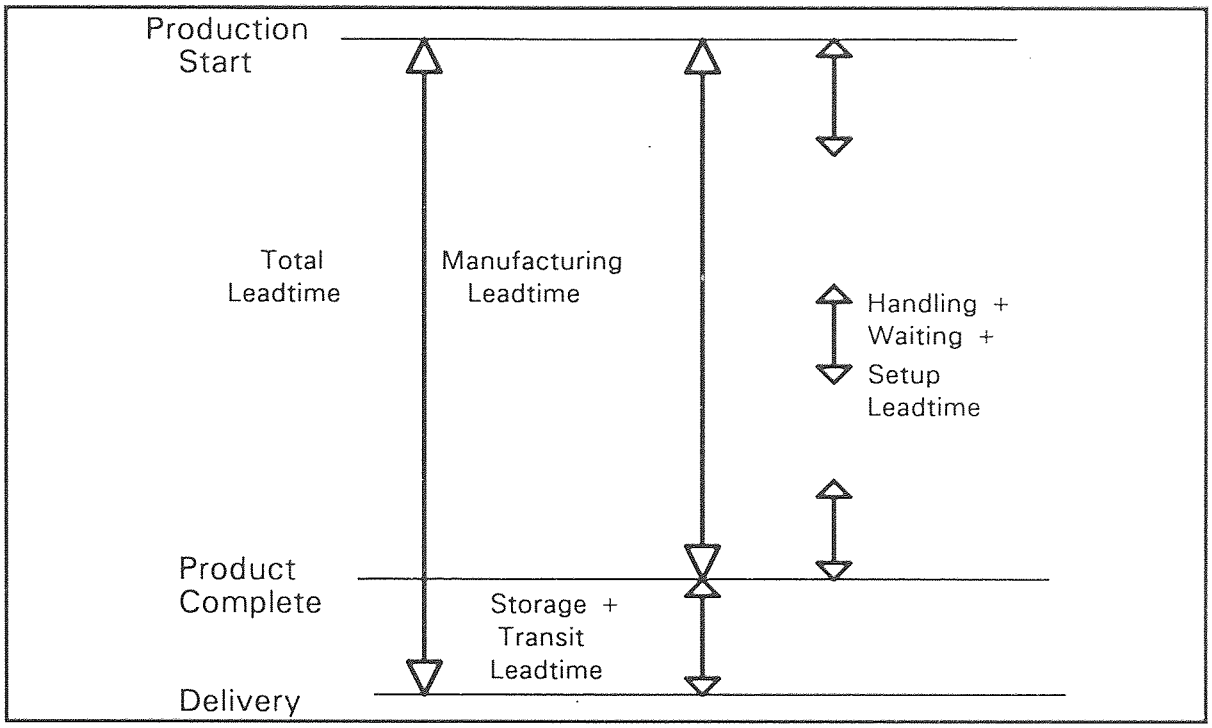


Figure 3.2 Composition of leadtime.

Source: Das, The JIT, MRP-II & TQM Workbook, 1990.

Leadtime is related to the company's inventory levels, as shown in Figure 3.3. If the customer leadtime is greater than the procurement + production + transit leadtime, there can be no finished goods inventory and raw materials inventory. If they are equal, the firm can have zero finished goods inventory and low raw materials inventory. However, if customer lead time is shorter, this implies a large finished goods inventory.

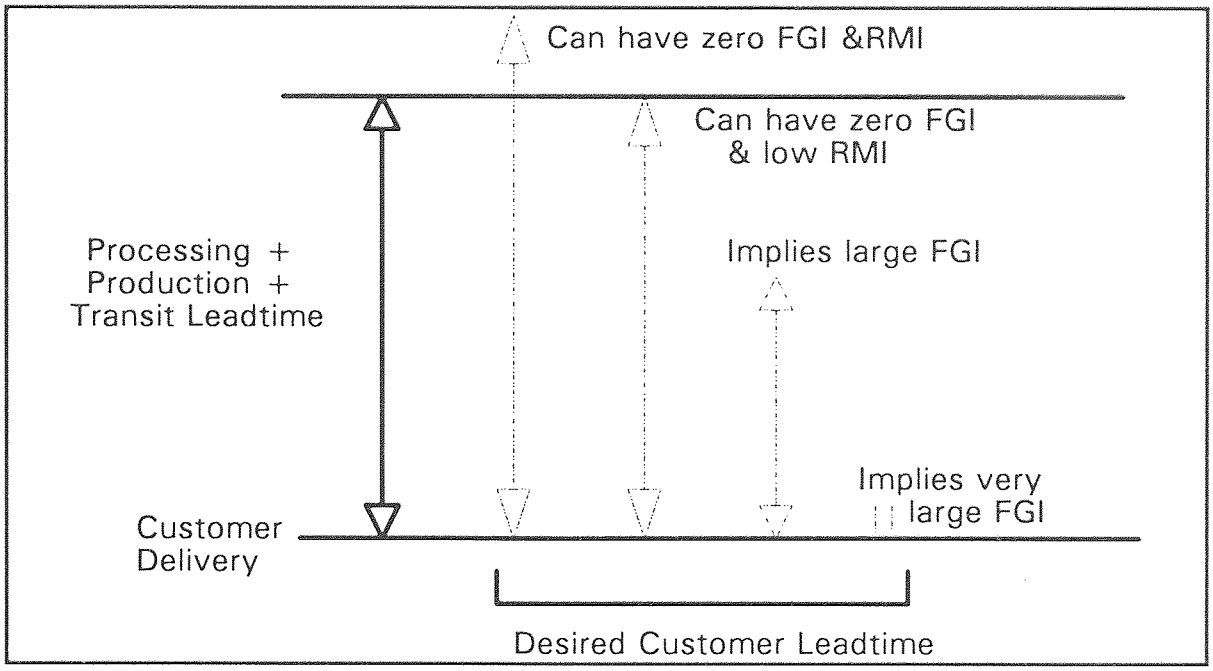


Figure 3.3 Customer leadtime and inventory levels.

Source: Das, The JIT, MRP-II & TQM Workbook, 1990.

Leadtimes will vary depending on a number of factors such as the product, production environment and the responsiveness of the company to market demand. However, with the surplus in supply versus the demand, leadtimes have become a competitive edge for companies who want to stay in business. Customers now are more demanding, they prefer to do business with reliable sources who deliver quality products at the shortest possible time. They like to get their product when they want it and/or when it is promised, whether it is an item purchased off the shelf or an item requested for delivery.

3.2.2.3 Shop Floor Control

Shop floor control is a short term function which is concerned with the release of the production orders to the factory. Referring back to Figure 1, it is based on the master schedule. The production plan is interpreted into the major steps involved in meeting the

requirements and determining their time relationship and sequence in the light of all other commitments, available capacity, material requirements and other factors. The objectives of scheduling are as follows:

- To provide delivery schedules which will insure timely delivery of salable goods to the customer or to finished stock inventories.
- To insure that all raw material, purchased components, or subassemblies are available when required for progressive steps in manufacturing the end product.
- To level and balance the over-all production load in order to maximize the utilization of available machines and manpower.
- To determine, in advance, excesses or bottlenecks in machines or manpower in order that corrective action can be taken
- To designate the sequence of production in a manner which will minimize production costs and inventories.
- To insure the best possible use of capital funds and the company's investment in plant and equipment.
- To provide tangible production plans so that a system for control of production can be developed and administered.

Questions 10-13 refer to shop floor scheduling.

10. What are the two most important criteria for sequencing the release of jobs to production?

Customer order due dates

Similarity of setups

Marketing preferences

Selling price of item

Processing time required

Material availability

First-come first-served

Management directive

The bases for the sequence of the jobs to be done can be any of the following:

Customer order due dates - Based on this, the order with earliest due date is processed first.

Similarity of setups - Products which involve the same machines or similar setups will be processed right after each other to minimize setup time.

Marketing preferences - Scheduling of jobs is sometimes dictated by the demands of the market.

Selling price of item - Priority is given to items which sells at a higher price or which generates better margins.

Processing time required - Items which can be produced in shorter times are processed first.

Material availability - Raw materials may sometimes not be readily available, thus, items which can be processed with whatever is available are processed first. This basis would indicate a scarcity, shortage or procurement problem in the system.

First-come first-served - Depending on the order in which the orders arrive, the one which comes first is processed first.

Management directive - Management sometimes directs the sequence of the jobs.

Knowing the most important criteria for job sequence would allow us to see whether a company is market-oriented, profit-oriented or cost-oriented. And is there a consensus in the region?

11. What are the two most frequent causes of delivery lateness?

Lack of production capacity

Material shortages

Labor or other strikes

Optimistic due date promised at start

Transportation problems

Quality problems

Knowing the most frequent causes of delivery lateness dominant in the region would assist us in analyzing this problem and what can be done about it. On the other hand, the causes may be uniformly distributed which means that the causes are random individual events.

12. What type of planning and control system is being used by your firm?

Material Requirement Planning (MRP) based system

Manufacturing Resource Planning (MRP II)

Reorder Point System (ROP)

Just-in-time/Kanban

Others

There are different types of planning and control system available for use these days. Historically, the selection of the systems has been influenced more by the latest system developments, internal knowledge and information processing constraints of the firm than by environmental factors faced by the firm. Beginning in the 1960s, many traditional reorder point systems were replaced by MRP. In the early 1980s the "MRP crusade" ran

up against the "JIT crusade" built around the kanban system. With all these systems, we wanted to know which are actually being used in the region and whether there is a dominant one or not. If not, what are the environmental characteristics of the firms using these systems and is there evidence to suggest that certain systems may be more appropriate than others in a given environment.

Material Requirement Planning (MRP) - This system was devised for dependent-demand items, especially component parts for end products in factories. It initiates procurement or production on the basis of forecasted or scheduled demand for a product in a future period. MRP is very effective when the demand between items are dependent and so the relationship between them is constant and predetermined. It is appropriate when most of the parts to which it is applied are used sporadically but repetitively over time. It can apply when parts are needed only once but it does not apply when usage is steady, smooth and continuous. In addition, MRP should be used for items and ingredients that are components of the end product.

Manufacturing Resource Planning (MRP II) - This is an extension of the basic MRP. It is a company-wide system integrating production planning and master production scheduling with the company's business plan including requirements for finance and] marketing functions.

Reorder Point System (ROP) - This system provides for replenishing stocks when they get down to some low level. the reorder points based on service levels (statistically determined reorder points) are most useful when the future demand for an item is forecast and cannot be calculated, or when the usage rates are fairly stable. In other words, reorder points based on service levels are best for independent demand items which can be calculated. Order point systems usually require that safety stocks be carried.

Just-in-time - JIT is a philosophy which has as its objective the elimination of waste. In manufacturing environments, waste may appear in many forms, including defective parts, excess inventory, unnecessary material handling, setup and changeover times to name a few. It is designed to provide the right materials at the right time and at the right place at the required quantity. Implementing JIT maybe difficult if suppliers are located at considerable distances or if the flexibility of workers to perform other tasks is still below par. JIT may not always be an appropriate system depending on a lot of different factors.

Kanban is a Japanese term which literally means card or visible record. The general meaning is a communication or a signal from user to maker. It is a pull system driven by the user wherein the product is pulled forward at the rate of use and causes the maker to respond to user problems. This system can be used effectively when demand is relatively uniform, production is in small lots and workers are multi-skilled.

13. What are the two most common actions to ensure the timely supply of purchased materials?

Long-term contract

Single sourcing

Multiple sourcing

Hedging

Large quantity purchases

Using sister plants

As previously mentioned, one of the objectives of shop floor control is to ensure that all purchased materials are available when needed. Thus, many organizations have started to change the buyer-supplier relationship from adversarial to one of partnership. Supplier

development programs now exist in a lot of companies basically to increase reliability of supplier in terms of quality and timeliness. We wanted to know how these South East Asian countries try to ensure that purchased materials arrive on time and see whether there is a dominant method in the region. The answer to this question would tell us how buyer-supplier relationship is generally being managed in the region. Different approaches have been adapted by companies to ensure timeliness of the supply of materials such as:

Long-term contract - Under the adversarial approach, the normal practice is to change supplier often. In the partnership approach, the idea is to try not to change suppliers. The rule is: stay with one and let that supplier stay on the learning curve, get to know the customer's real requirement and perhaps participate with the customer on product and process improvement.

Single sourcing - Today's thinking is that multiple sources indeed offer price competition but they also raise each supplier's costs because they reduce economies of scale. If there are just a few suppliers, it may be possible to get to know each one well enough to keep informed about problems the supplier company might be having such as impending labor strike.

Multiple sourcing - To obtain several sources for each purchased item has been a goal that every buyer understood. The reasons have to do with price competition, protection against supplier failure and the fairness doctrine - spread the large purchasing budget over several suppliers. It also offers protection against strikes, fires, explosions and other disasters.

Hedging - This means buying extra quantities when prices are low. Hedging applies especially to commodities such as wheat, corn, silver and lumber. Extra quantities of

purchased items brought into inventory in advance of a price increase will reduce the total cost of these items.

Large quantity purchases - Many large industrial companies have had a policy of not accounting for more than a certain percentage of any supplier's total sales and many supplier companies have had a similar policy. The reason is the possible severe impact on a supplier if the customer decides to change suppliers or cancel the business. Under the partnership approach, a supplier may elect to build a small satellite plant next to a big customer and do up to 100% of its business with that customer, i.e., become a dedicated supplier plant but remain independent. Each supplier plant then becomes a close partner with its customer plant.

Using sister plants - If another subsidiary of a company produces the other's required materials, it is better to get the materials there since it is assumed that since they belong to the same company, the supplying plant would try its best to deliver on time. The logic behind this is that the supplying plant would be blamed and will not look good to top management if something went wrong in the business.

14. What is the breakdown of your firm's inventories (approximate %)?

Purchased materials & parts inventories

Work-in-process inventories

Finished goods inventories

The investment in inventories for most firms represents a sizable sum. Since this investment is so large, management practices which result in savings of a few per cent of total inventory values represent large savings in dollars.

The effect of inventory policy on production planning depends somewhat on the type of business in which a company is engaged. In a company which manufactures

finished goods for inventory, the control of these inventories have a profound influence on production control. One of the most direct effects can be the smoothing of the production rate. Instead of allowing production to fluctuate with sales, inventories can be used to absorb at least part of the variation. As a result, capacity problems become less critical, and the production control function is made much easier.

Increasing the level of inventory permits larger production runs than would otherwise be possible. For any given volume of production, the number of production orders is reduce. Inventories also have the effect of reducing the need for close communication between manufacturing departments. With sufficient inventories, each department can act more or less independently. Without inventories to reduce the link between departments, any deviation from plans in one must be communicated immediately to all others affected so that corrective action can be taken. Another reasons for carrying inventory is to provide rapid customer service. To some extent this inventory can be reduced by shortening the manufacturing leadtime.

The ratio of raw material and finished goods inventories is a major factor in responding to the market. For example, a high proportion would indicate raw material scarcity in the area. On the other hand, if the ratio of finished goods is high it could indicate a demanding market in terms of speed of supply.

One of the measures of production efficiency is the reduction of WIP stocks. Some companies though, are deliberately using WIP at work centers for which high utilization is important. This policy basically represents hedging against late delivery penalty by holding and paying for WIP. Others make extensive attempts to implement JIT principles fully, i.e., eliminate WIP. We wanted to know how much WIP inventory (compared to raw materials and finished goods) is being carried by companies in the region, and see how WIP is treated, i.e., whether it is excess inventory or a necessary inventory.

15. What is the average Inventory Turnover Ratio of the company?

Annual inventory turnover has long been used as an overall measure of performance - one that accounts for all the wastes tied up in inventory. A poor turnover - below 3 - could arise from poorly controlled production in which flow times stretch out over many weeks or months. It could also result when production flow is fast but achieved with high inventories. Knowing the ITR of a company would reflect how inventory is managed in that firm.

3.2.3 Quality Management

Quality of goods is a global concern. Customers demand satisfaction and are becoming increasingly willing to use worldwide shopping in order to obtain it. The quality revolution that began in the 1980s is changing the way quality is managed. Quality is difficult to manage because of the numerous factors which affect the quality of the product. These factors are:

- Corporate loyalty of employees
- Materials used
- Processes and methods used
- Product specifications
- Performance testing and measurement
- Process maintenance
- Manager/Supervisor knowledge base
- Training of managers and workers
- Work pride and motivation of employees
- Accountability and responsibility of supervisors
- Service life of products

A "total" approach to managing quality is needed in order to focus on all these factors. Total quality management or TQM is an overall program to manage quality. Figure 3.4 shows the TQM components and the activities associated with them.

With the current big push on quality specially in international markets, we wanted to know how the region respond on this issue. The questions in this section covered the role of quality in the company, supplier management and customer satisfaction.

1. Rank the following reasons for improving quality:

To be competitive

To eliminate defective/off-spec products

To satisfy customer

To reduce production cost

To create a reputation for quality products

To create a fulfilling and satisfying workplace

In this question, we wanted to know how the companies perceive quality. Why are they improving it? Is there a common reason?

To be competitive - With the globalization of the market, product quality has become a competitive edge in order for a firm to stay in business.

To eliminate defective/off-spec products - Defective products are waste for the company. Scrapping or returning them back to production gives additional cost. However, if quality is improved, this is minimized or eliminated.

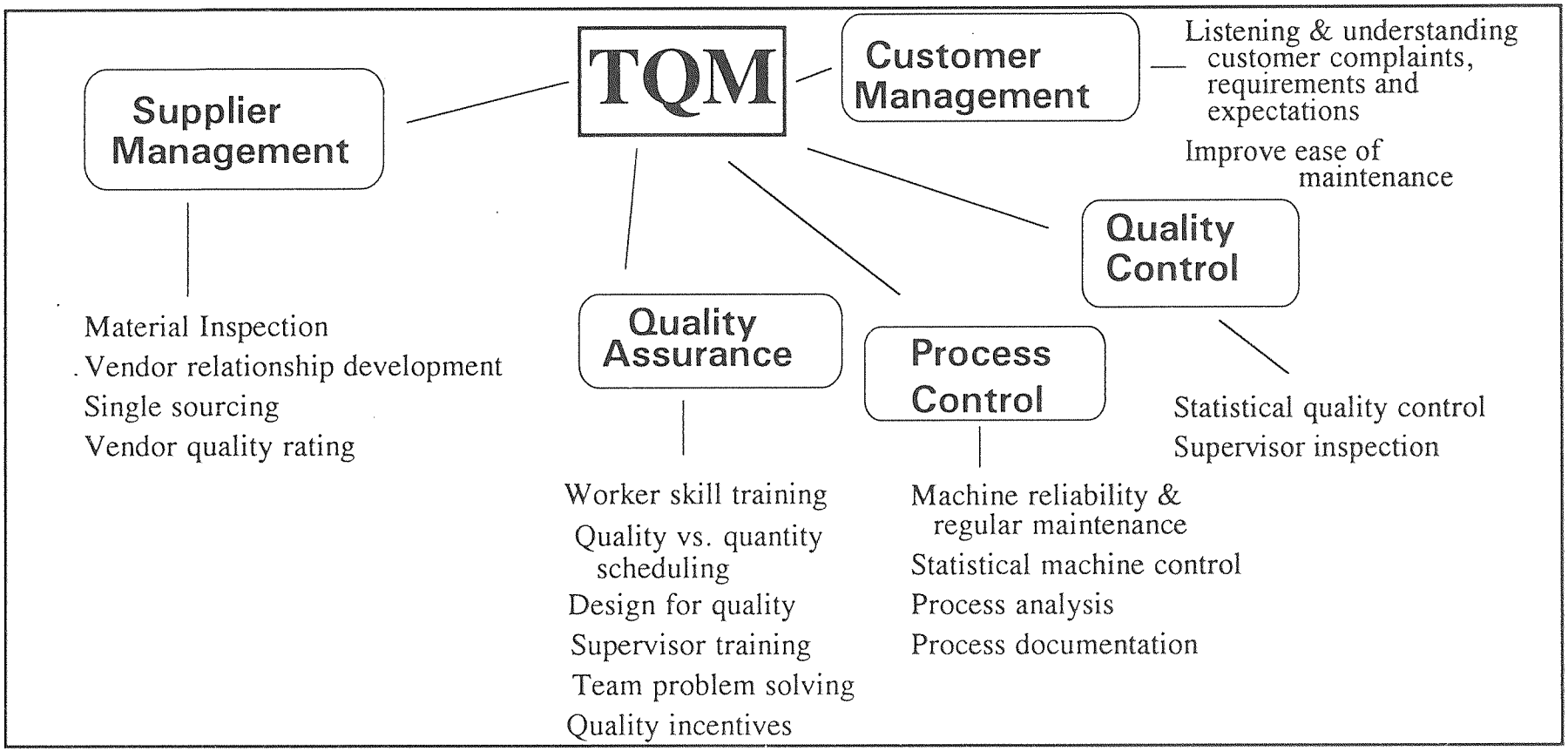


Figure 3.4 Components of Total Quality Management (TQM)

Source: Das, The JIT, MRP-II, & TQM Workbook, 1990.

To satisfy customer - Customers have become more demanding these days and it is important that companies give what they want in order for their products to sell.

To reduce production cost - Better quality is less costly than inferior goods and customer wants both high quality and low price and businesses need low costs in order to price competitively.

To create a reputation for quality products - Consumers are willing to pay at a higher price as long as they are getting quality products. And if a company has a good market reputation in terms of product quality, its market share will increase.

To create a fulfilling and satisfying workplace - When a company is producing good quality products and the workers are very much involved in quality management, the workers feel satisfaction and become proud of what they do.

2. Check which of the following techniques are being used to manage quality for the manufacturing process, finished goods and purchased materials:

Cause-and-effect diagrams

Checklist

Scatter diagram

Pareto charts

SPC charts

Process capability index

Quality function deployment

Sampling inspection

Customer surveys

Analysis of variance

Design of experiments (Taguchi)

TQM process

Quality does not involve only the finished goods but also the purchased materials and the processes in which the material has to go through. Quality variation in manufactured products is affected by materials, methods, equipment or measurement. The causes of such variation can be disclosed through non statistical or statistical quality control. In this question we wanted to know the actual techniques being employed in the companies. Are they basically employing statistical methods? To what extent is quality ensured?

Cause-and-effect diagrams - This is a graphic analysis that visualizes factors affecting quality by sorting and relating them to quality.

Checklist - This consists of a representative listing of factors for monitoring and controlling the product.

Scatter diagram or correlation diagram - This is used to plot effects against experimental changes in process inputs. This is most useful when the process is complex and causes of errors are not well understood or obvious. This approach is particularly useful for chemical, biological, metallurgical, paint and similar complex processes. The approach is less useful for simple standard processes, where most cause-effect relationships are already well known.

Pareto charts - This assumes that a few problems are always significant in severity and frequency of occurrence. The chart or histogram indicates the factor that creates the most serious problem and should be solved first to reduce cost and improve productivity. The use of this method is limited because it does not separate the causes of variations.

Statistical Process Control (SPC) charts - This is a technique for plotting the measured values of certain characteristics of the process output over time to determine if the process remains in statistical control. Variable control charts identify an actual measured quality characteristic, such as dimension, and indicate if the process is controlled and the product is consistent. Attribute control charts identify relative values for products that should visually be confirmed such as cracks or missing components.

Control charts are used to determine if the products in question are within specification, but they cannot determine if the process is capable of producing products satisfactorily. It is most appropriately applied to monitor the critical processes in high- and midvolume production plants.

Process capability index - This method determines the ability to produce units within specification limits. The natural tolerance limits of a process are defined as being $\pm 3\sigma$ from the mean. The process capability ratio is defined as the difference between the upper and lower specification limits over 6σ.

Quality function deployment - This is defined as converting the consumers' demands into "quality characteristics" and developing a design quality for the finished product by systematically deploying the relationships between the demands and the characteristics, starting with the quality of each functional component and extending the deployment to the quality of each part and process. The overall quality of the product will be formed through the network of relationships.

Sampling inspection or acceptance sampling - The statistical process or procedure used to determine the conformance or non conformance of a lot to standards. Its specific objective is to make accept or reject decisions regarding a lot or batch and not to estimate its quality. The information upon which the accept/reject decision is based is obtained

from random samples selected from the lot. It is to be emphasized that the purpose of acceptance sampling is to determine a course of action, not to estimate lot quality. Also it is not an attempt to control quality.

Customer surveys - This method "determines" the quality of the product after it has gone out of the plant. This is a very subjective measure of knowing the quality of the end-product.

Analysis of variance - This method consists of classifying and cross-classifying statistical results and testing whether the means of a specified classification is important in affecting the results. For example, the output of a given process might be cross-classified by machines and operators. From this cross-classification it could be determined whether the mean qualities of the outputs of the various operators differed significantly.

Design of experiments (Taguchi) - Instead of trying to identify and eliminate the causes of quality problems, Taguchi methods seek to design a product or process which is insensitive to the causes. The idea is to eliminate the effect instead of trying to remove the cause. Taguchi uses the properties of orthogonal matrices to produce experimental designs which require far fewer experiments. Taguchi's technique involves building a test matrix based on the various controllable factors, which is called an "inner array", and superimposing on it another matrix based on the principal noise factors called the "outer array". As with SPC, if the mathematical basis of this type of analysis is not fully understood, one can be misled by the ease of computer methods and make some expensive mistakes in decisions about costly processes or plant investments.

TQM process - TQM is an approach to improving the effectiveness and flexibility of business as a whole. It is essentially a way of organizing and involving the whole

organization, every department, every activity, every single person at every level. For an organization to be truly effective, each part of it must work properly together, recognizing that every person and every activity affects, and in turn is affected by others.

3. Rank the following criteria on vendor selection

On-time delivery

Cost

Quality of materials

Efforts of supplier to develop long term relationship

Financial stability of the supplier company

Capacity of supplier's production facilities

Technical sophistication of supplier's production and support facilities

Quality and level of R&D Efforts of supplier

Quality defects may arise due to poor performance of supplier. Thus, it is critical to know how to select suppliers and what to expect from them. Methods for vendor selection and relations with these suppliers have been changing. Many organizations have been adopting single sourcing or the use of a limited number of vendors. Particular conditions including special trust relations are fundamental to the success of these arrangements.

The basic criteria by which most firms judge the suitability of suppliers is changing. It is moving from:

Approach A: 1 price, 2 deliver, 3 quality, to

Approach B: 1 quality, 2 value per dollar, 3 JIT delivery

Companies that use Approach A tend to be looking for suppliers continuously. These companies are always reevaluating the price differentials. Occasionally, they are dissatisfied with delivery or quality.

Companies that use Approach B tend to be looking for long-term relationships with suppliers. They want as much information as possible about the supplier's processes and quality competence. They consider the size of suppliers' organizations as well as the supplier's customer.

In this question, we wanted to know the basis of selecting suppliers by the companies in the region. Is there a trend towards long-term relationships? How is the supplier-buyer relationship? Are they using Approach A or B?

4. How does your firm implement quality programs?

Inspection of raw materials and finished goods

Training of workers on quality

Employee awareness programs

Formal system for obtaining employee suggestions

To achieve the full benefits of improving quality, programs are needed to be implemented which are mostly geared towards worker involvement.

Inspection of raw materials and finished goods - This is primarily concerned with determining the degree of which production output or purchased materials conform to the established technical specifications of the products. The resulting information is used to control manufacturing operations and product quality characteristics and to prepare quality audits to generate feedback information to the quality-planning operations and upper level management.

Training of workers on quality - This is a very important factor in actually improving quality, once commitment to do so is present. For training to be effective, however, it must be planned in a systematic and objective manner. Quality training must be continuous to meet not only changes in technology, but also changes involving the

environment in which an organization operates, its structure and the people who work there.

Employee awareness programs - Quality awareness can be defined as a continuous communication process which informs everyone associated with the product from concept to sale, of customer expectations in product quality and where the current product falls short. It stimulates total involvement of everyone to upgrade the quality of the product to meet these expectations.

Formal system for obtaining employee suggestions - An employee suggestion system provides an organization with another way to utilize its employees' potentials. A suggestion system is the formal means which individuals, groups or quality teams contribute their ideas to the company. The suggestion system is the vehicle whereby process improvement ideas are evaluated and moved to implementation. All individuals or quality teams are expected to implement any change in processes over which they have responsibility. The suggestion system is a mechanism by which individuals or teams present solutions that are not within their own job responsibility to implement. In this question we wanted to know whether quality is not only preached but also being implemented in the companies.

5. What are the three most serious problems encountered in implementing quality improvement programs in your firm?

Lack of top management support

Lack of employee awareness

Lack of communication within the company

High cost of implementation

Process limitation

Improving quality in the company is not an easy task. It needs commitment from top management to support it. It also needs the involvement of every employee and every department. Thus, problems are a natural occurrence. However, knowing what the problem is could lead to possible solutions. We wanted to know what are the common problems being encountered in these developing countries in order to suggest possible solutions.

Lack of top management support - Top management commitment to quality has been the key factor in its success in Japan. Without the active enthusiasm from the top, quality management cannot succeed on a company wide basis. If it is delegated to staff assistants, the movement invariably loses steam. Quality management conducted by assistants cannot guarantee the level of quality needed for company survival in today's competitive international environment.

Lack of employee awareness - Quality management has always meant the full participation of the workers at the front line in the factory. However, if there is not enough information given to these workers, they would not be able to participate in these programs. Thus, it is imperative that employees be made aware and be involved in quality improvements.

Lack of communication within the company - The essence of changing attitudes to quality is to gain acceptance for the need to change and for this to happen it is essential to provide relevant information, convey good practices, and generate interest, ideas and awareness through a two-way communication process. Failure to communicate effectively creates unnecessary problems resulting in confusion, loss of interest and eventually in declining quality through apparent lack of guidance and stimulus.

High cost of implementation - The upfront cost of implementing quality improvements may appear to be costly. However, quality and cost tradeoffs must be explored. Quality may be free or may be costly depending on the situation. For example, when the number of defectives produced is decreased, cost is reduced and quality is improved. To reduce the number of defectives may require no out of pocket expense. If there is an initial investment, then the per unit cost of quality improvement decreases as the output volume goes up. With flexible process technology, high variety and output volume can be achieved at a negligible unit cost. On the other hand, there are cases when the quality level of the output cannot be improved, except by fundamentally altering the system. To improve quality may require substantial investment in new equipment and retraining the workforce. It can become costly to improve upon the quality that an existing well-run system can produce. Quality improvement is costly when it requires changing the system with better materials, facilities training and skills.

*Process limitation*_- Process capability describes the best effort of a process in the sense that assignable causes of process variation have been minimized. The remaining variation is, for the most part, due only to random causes inherent to the process. Quality improvement may not be effective because of limitations in the capability of the process due probably to design or age of the process machines.

6. How does your company determine customer satisfaction?

Review competitor's product quality

Customer surveys

Telephone hot lines or complaint registrations

Customer focus groups

Employee attitude surveys

One of the objectives of a company is to satisfy the customer because a satisfied customer becomes loyal to the product. And loyalty can take the form of quick repurchase if the product's purchase cycle allows. It can also take the form of "word of mouth" praise or criticism about a particular organization's goods or services. Therefore, it is important for the company to know whether its customers are satisfied with the product or not. There are many ways of knowing customer satisfaction and we wanted to know which is the most commonly used. This would indicate how the firms perceive customer value as strategic variables.

3.2.4 Automation and Computerization

The Industrial Revolution was based on the fact that for certain kinds of operations, machines can do things that people cannot. Now we find that mechanical and electronic control systems can be substituted for many mental activities formerly done by people and at the heart of this change is the computer. Computers have a lot of advantages over humans such as ability to store massive information without distorting it, speed of computation of complex but routine operations and indifference to the number of repetitions that must be furnished. Variability is one of the most important factors. The essence of process management is recognition and control of variability and humans do not work at a constant rate. the distribution of times required by a human operator has substantially greater variance than applied to a machine or a computer-driven machine. However, humans have also some advantages over computers such as creative thinking and the ability to devise intricate rules of logic.

Automation can be defined as a system or method in which many or all of the processes of production, movement and inspection of parts and materials are automatically performed or controlled by self-operating machinery, electronic devices, etc. Automation is not a desirable end in production design for all business firms. Some firms and industries, such as those involved with continuous processes, can be automated to a great

degree. Other firms and industries, particularly the ones involved with small production lot sizes, great variety in the product line, and rapid product design changes, may be difficult to automate.

A lot of people have rallied around automation saying that it is a necessary strategy for beating the competition, and some people may disagree with this. However, we can say that there is a link between competitive strategy and automation. Process improvement is an essential competitive strategy and automation is one tactic. However, automation is expensive and so less costly ways of improving must be sought first., Another point to consider human's inherent variability favors automation. On the other hand, human variability has its good side, namely flexibility to react to change. Also, people have the brainpower without which further process improvement would come to a halt. Thus, for most complex activities, well-coordinated combinations of people and machines are ideal.

1. Check to what extent your firm uses computers in the following areas (not at all, a little, moderate, extensive):

Sales forecasting

Production planning

Shop floor control

Inventory management

Quality management

To know the extent to which computers are being used in the different areas of production management would indicate their importance to the company. Do the companies rely so much on computers? How do the firms perceive computerization? How does computerization relate to the environment of the company?

2. Check the approximate automation level of your firm in the following areas (<50%, 50-70%, 70-90%, 90-100%):

Processing operation

Material Handling

Process control

We would want to know what role automation plays in the region. How high is the level of automation in these companies? If the level is low, has it become a major drawback? If the level is high, has it become a competitive advantage? Is the environment influential in the level of automation?

3. Which of the following automation technologies are being used in your plants?

CNC machines

Programmable logic controllers

Assembly robots

Material handling robots

Sorting conveyors

Automatic packaging machines

Customized process machines

Factory local area networks

Industrial sensors

Computer aided design

CAD/CAM for NC programming

There are various automation technologies currently available. They can range from the low grade process such as automatic tool changers and automatic loaders and unloaders to high technologies such as programmable robots and automatic guided vehicles. We would want to know which technologies are actually being used in the industry. Is there a predominant one? What could be the reason for having these technologies?

4. Who is the driving team for your automation projects?

Top management

Middle management

Department managers

Factory managers

Outside consultants

Automation projects are often costly and raises break-even points, thus, justifying them poses some problems. However, the major driving force for these projects may somehow help in justifying automation.

5. What is the dollar value (capital investment) of an automation project?

We wanted to know how expensive automation projects are for these companies. Is this a major factor for the level of automation in the region?

3.3 Mailing Databases

The study's sample consisted of manufacturing companies which were randomly selected from the directories of manufacturers from each country. The list was obtained from the trade departments of the three countries under study.

CHAPTER 4

ANALYSIS OF RESULTS

4.1 General Characteristics of Respondents

A total of 300 questionnaires were sent to Indonesia, Malaysia and the Philippines. Forty-seven responses were received, making the response rate 15.7%. The low response rate could have been affected by the deadline set on the cover letter. The relatively long mailing time was not anticipated when the deadline was set for the replies. Some of the surveys reached the companies a month after they were mailed. Also, follow-up was done only to a handful of companies due to limited resources. The breakdown of respondents is shown in Table 4.1 and a list of some of them is given in Appendix B.

Table 4.1 Breakdown of respondents by country.

Country	No. of Respondents	Percent
Indonesia	10	21%
Malaysia	10	21%
Philippines	27	58%
Total	47	100%

Figure 4.1 shows a summary of the products manufactured by the respondents. The responding companies covered a wide array of products. The highest percentage came from the electronic industry and the automotive industry (14.9%). In terms of sales (Figure 4.2a), majority of the firms were medium- (45.4%) and large-scale (36.4%) companies (sales of $20-100 million and more than $100 million, respectively).

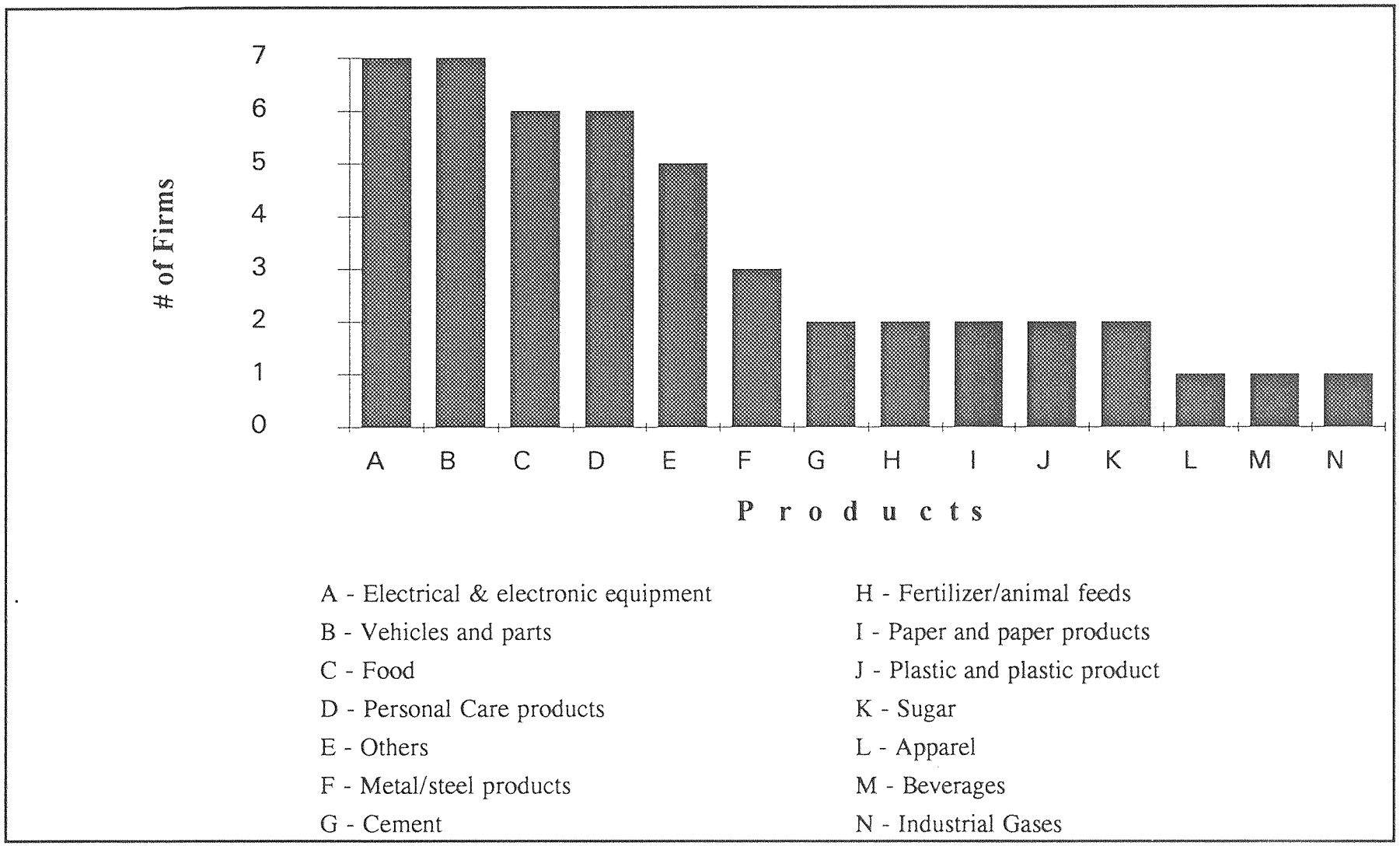


Figure 4.1 Products manufactured by respondents

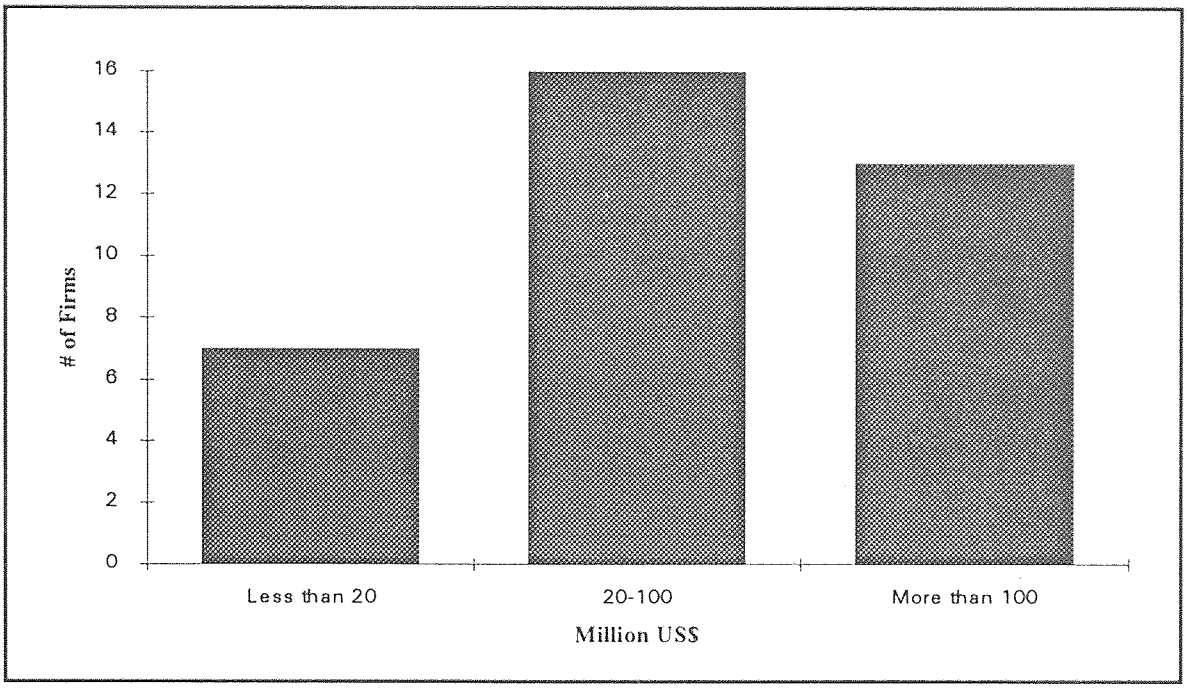


Figure 4.2a Domestic sales of respondents

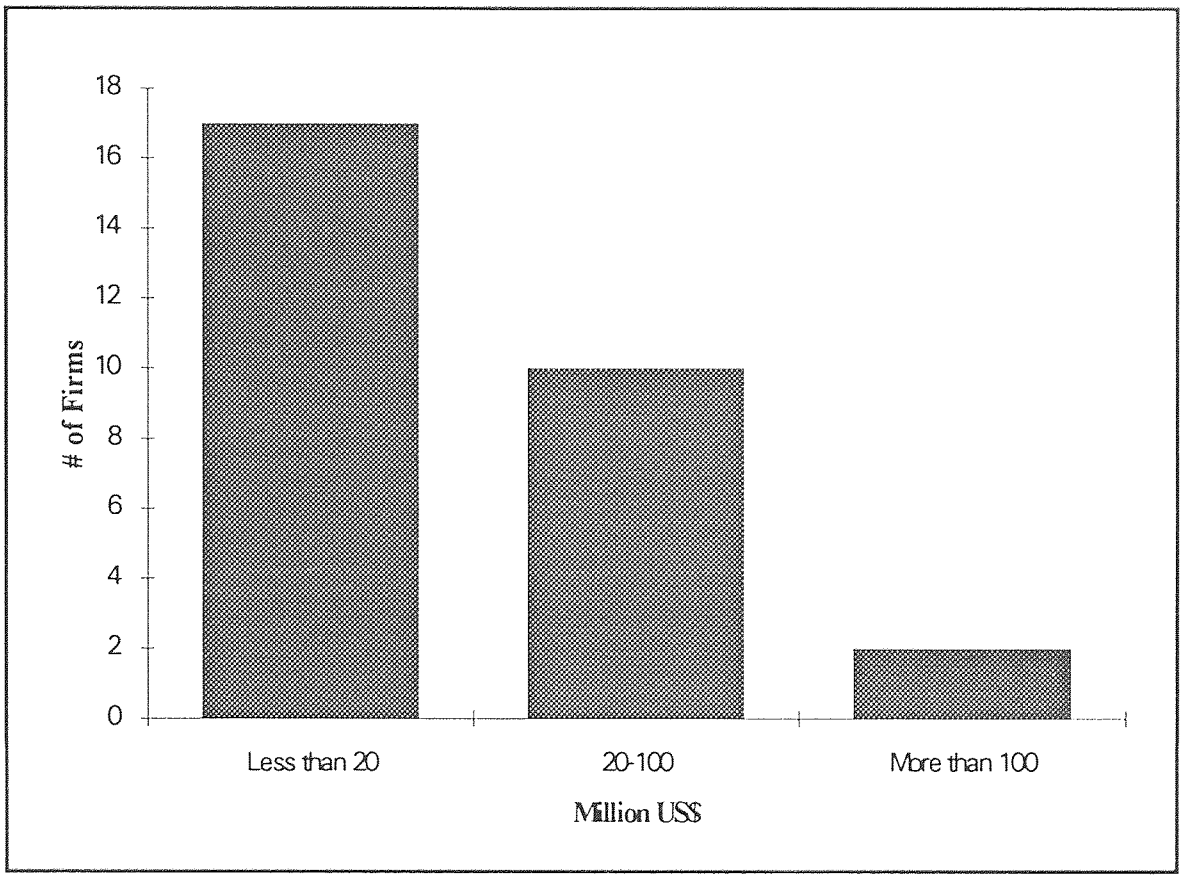


Figure 4.2b Export sales of companies in sample

However, companies who were exporting had relatively small export sales (less than $20 million), as seen in Figure 4.2b. This shows that majority of the sample was geared towards the domestic market.

Most of the companies had more than 500 employees in total company, while half of them (more than 250) were involved directly in production (Figures 4.3a and 4.3b). This high number of employees is expected because of the low labor cost in these countries. If we were to look at the products and sales volume per se, we would expect that most of the companies would focus mainly on automation rather than labor. This has not been the case as most of the firms were labor intensive rather than capital intensive. This is because of the high interest rates in the region which limits spending on capital investment. Savings on labor cost is not enough to give a justifiable return on investment. Table 4.2 shows the average interest rate in less developed countries or LDCs (such as those under study), newly industrialized economies or NIEs (e.g., Singapore) and developed countries or DCs such as Japan.

Table 4.2 Interest rates for the different countries in Asia.

	Long-Term Interest Rate	Short-Term Interest Rate
LDCs	12%	25%
NIEs	10%	20%
DCs	8%	15%

Source: International Monetary Fund, World Economic Outlook, 1991.

As can be seen in this table, the LDCs have higher interest rates compared to the NIEs and DCs. This interest rate is a major factor affecting capital investments in Southeast Asia.

Figure 4.3a Total number of employees in the company

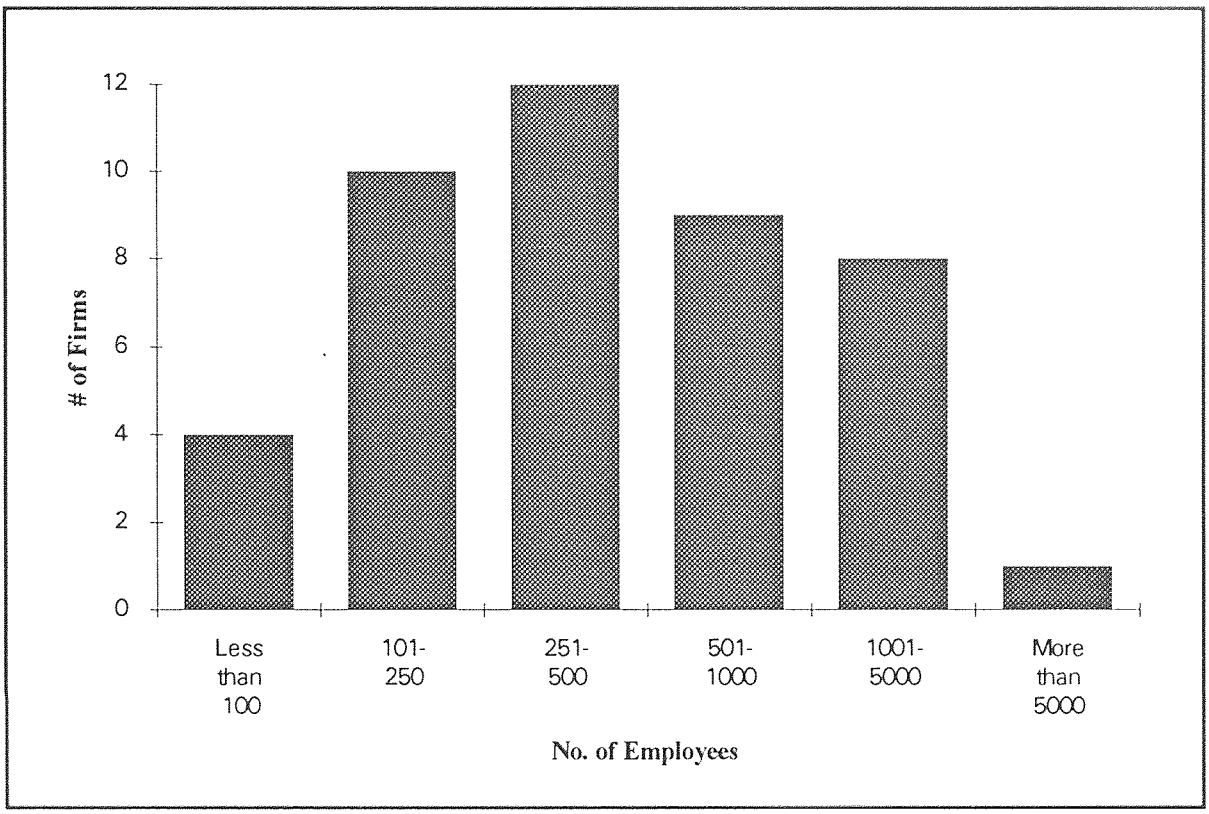


Figure 4.3b Number of employees involved in production

For the production type, most of the companies either have the flow type (38.8%) or the batch type (34.3%), as shown in Figure 4.4a. There is an almost equal number of those who produce for stock and for order (Figure 4.4b). Half of the firms (53.2%) had an average capacity utilization of 70-90% as shown in Figure 4.5, indicating that currently there is little available capacity in the region. The growth of the manufacturing sector could be supported by putting up more plants or by improving production in order to add to the capacity of the plants.

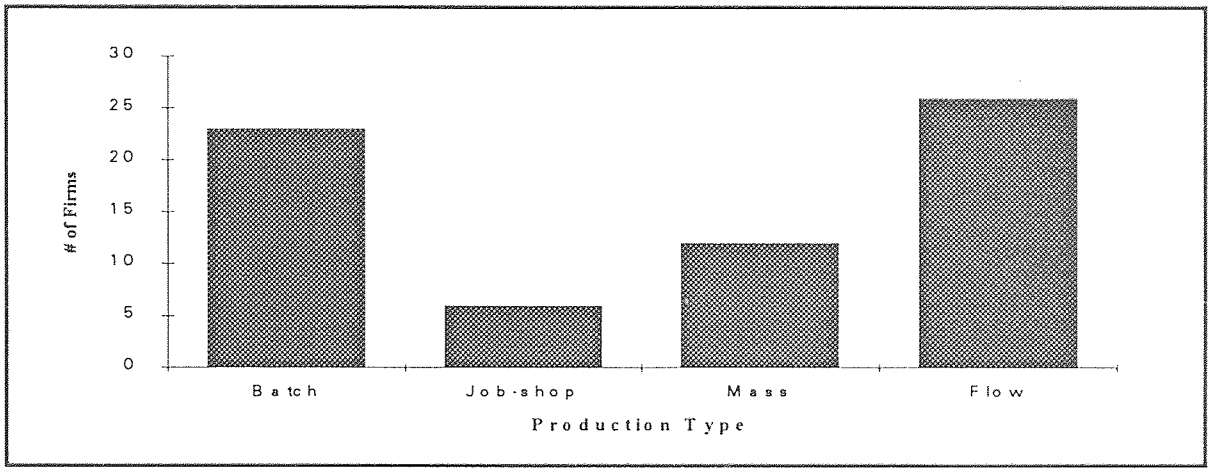


Figure 4.4a Production environment of sample

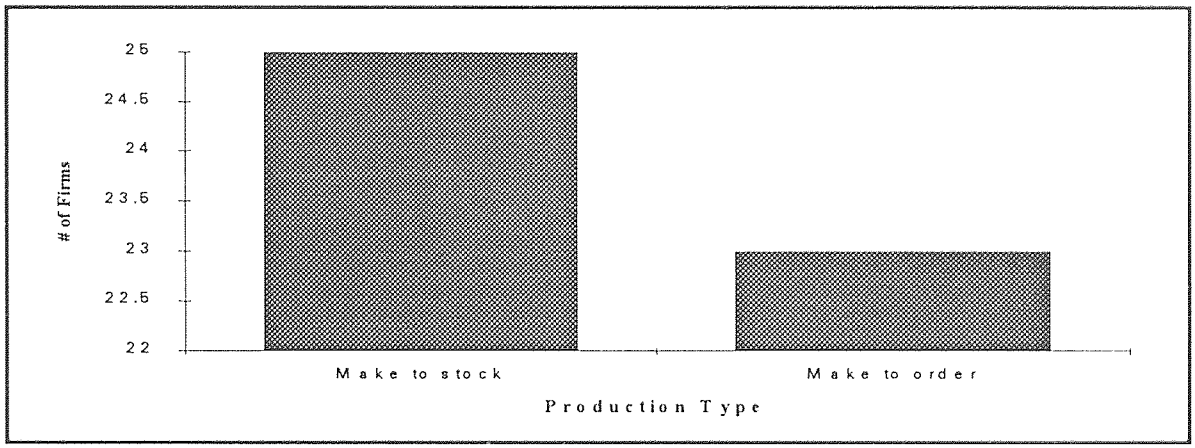


Figure 4.4b Production type of the firms

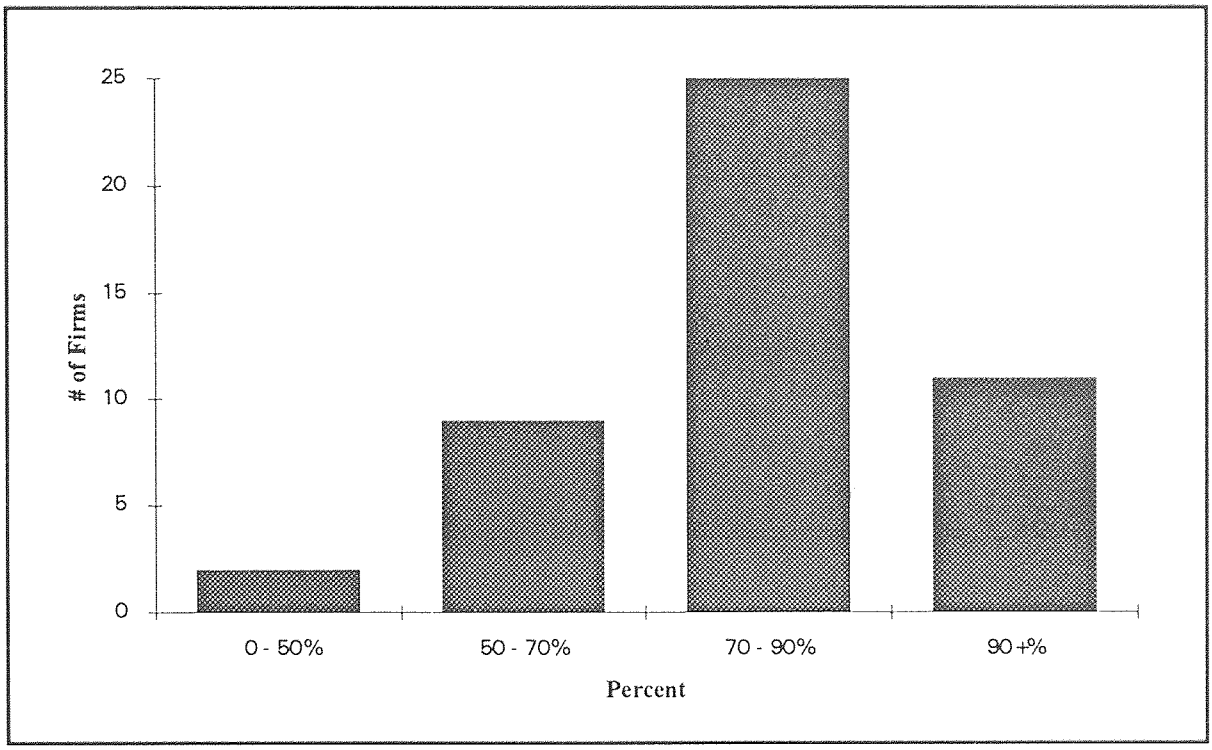


Figure 4.5 Average capacity utilization of firms in sample

4.2 Production Control and Management

4.2.1 Sales Forecasting

Figure 4.6 and 4.7 show that sales forecasting was mostly done by Sales/Marketing (88.0%) with a time frame of more than six months (72.6%). The dominant forecasting technique was the judgmental type both for short- and long-term (Figure 4.8). Forty-eight percent use the sales force composite for short term forecasts followed by the managers' opinion (24.2%) while long-term forecasts were done using managers' opinion (36.5%) and sales force composite (25.9%). This maybe related to the fact that forecasting was mostly done by the Marketing people. However, this is not a unique result as surveys done in the U.S. also showed that judgmental methods are the dominant forecasting techniques in all industries (Sanders, 1992).

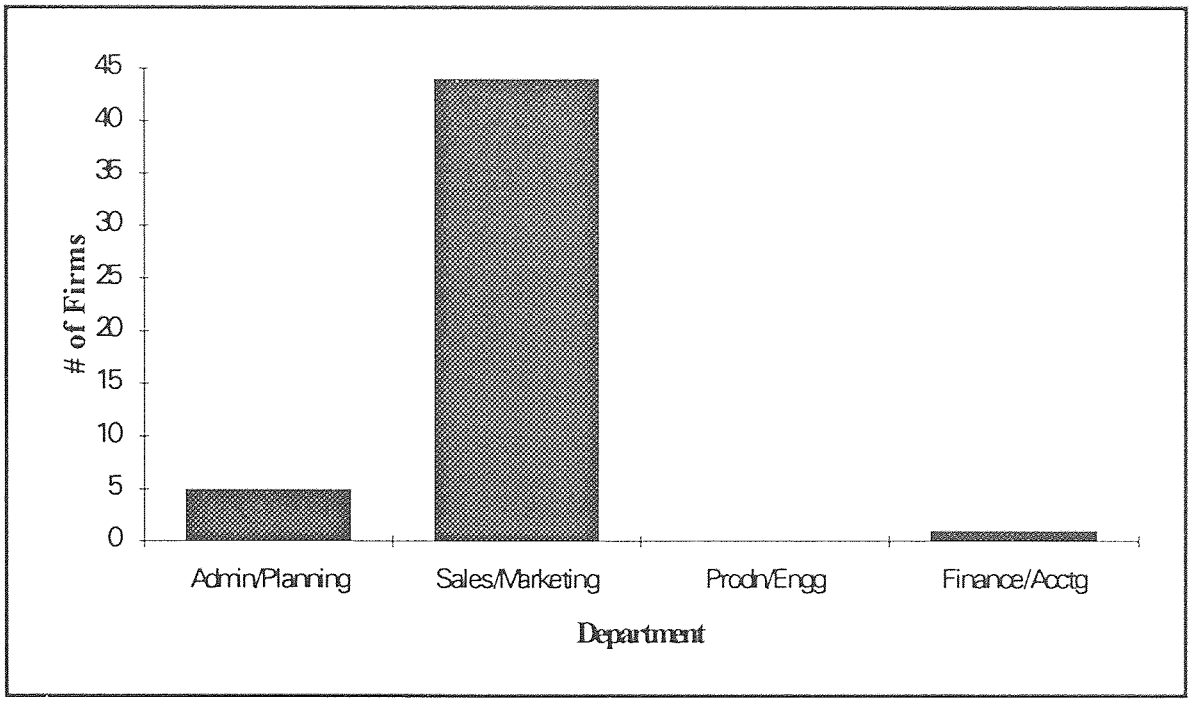


Figure 4.6 Department responsible for the sales forecast

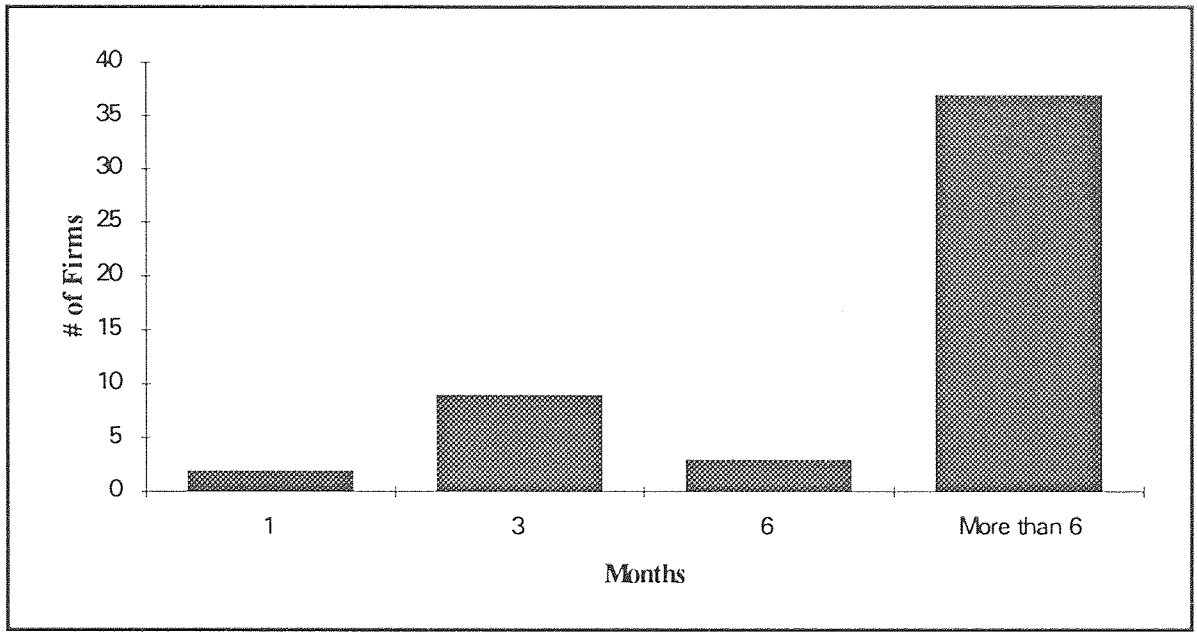


Figure 4.7 Time frame of the sales forecast

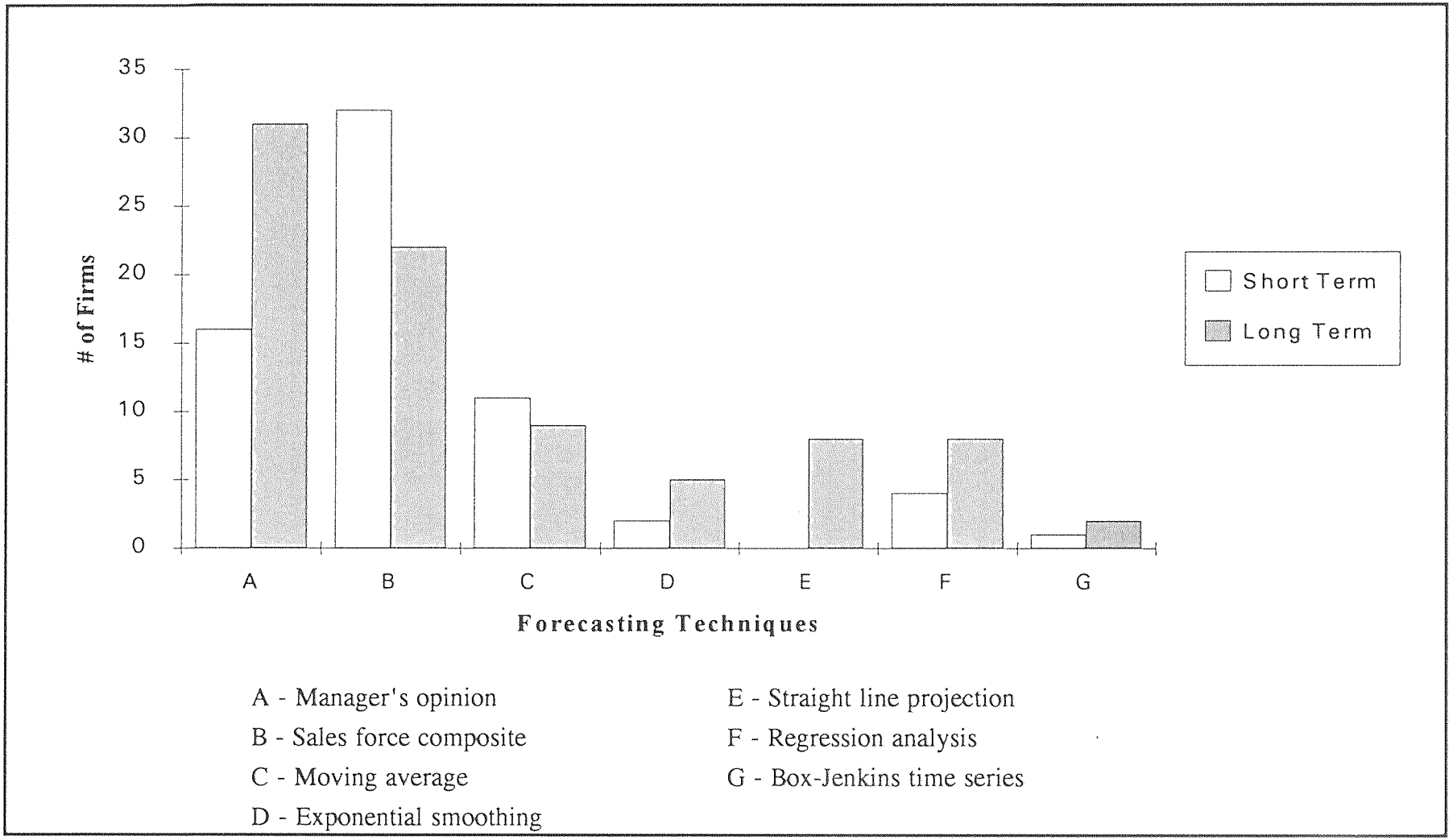


Figure 4.8 Forecasting techniques being used by the companies

In terms of uses (Figure 4.9), the sales forecast is mainly used for production planning (30.3%) followed by budget preparation and material/inventory planning, both at 23.2%. From here we could see that the forecast plays a major role in production.

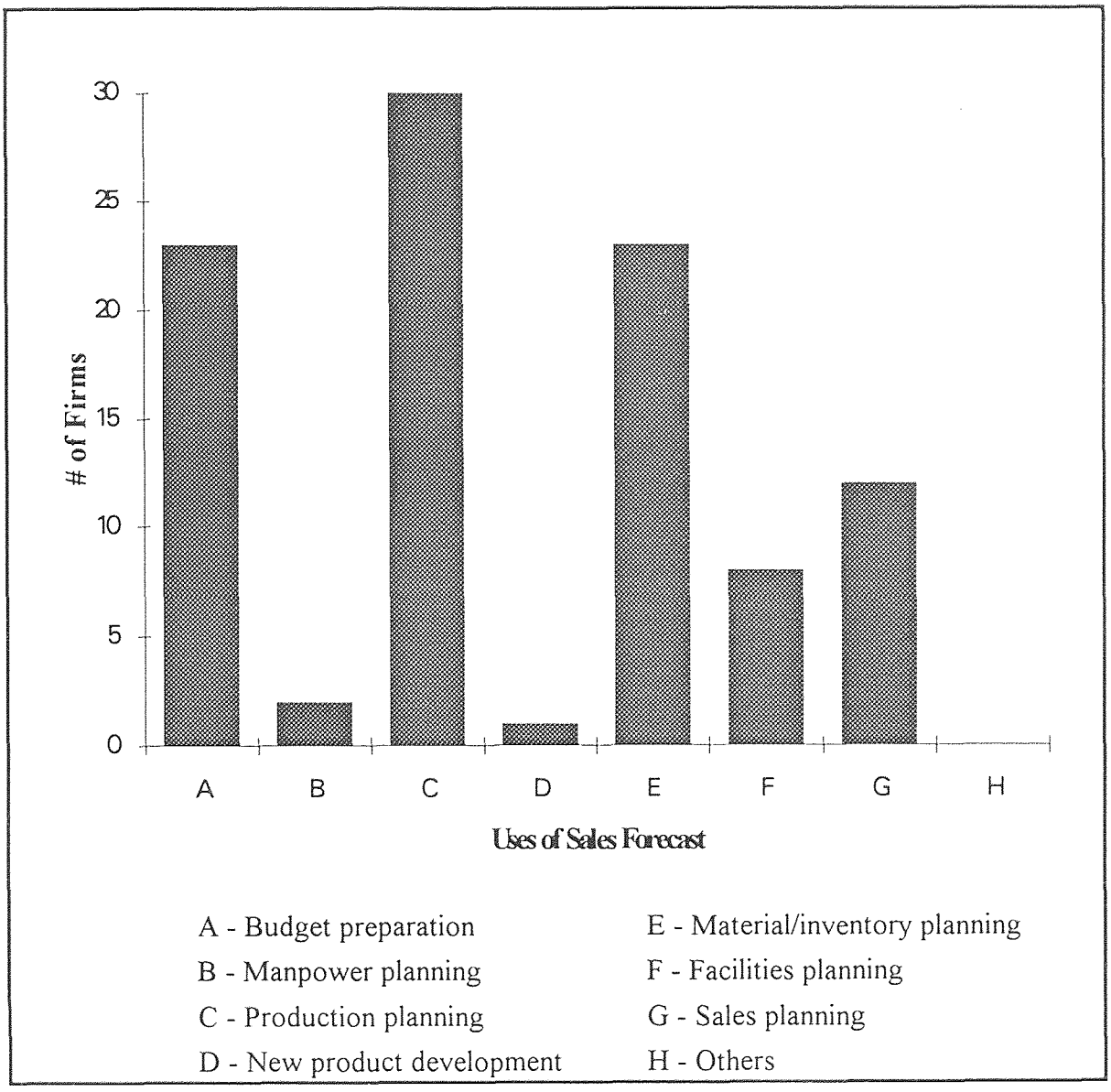


Figure 4.9 Uses of sales forecast

4.2.2 Production Planning

The production plan is predominantly done by the Production/Engineering group (70.8%) as seen in Figure 4.10. Figure 4.11 shows that it is mainly based on the sales forecast (37.6%) and the production capacity (25.8%). As previously mentioned, the sales forecast is a very important factor in making the production plan. As for capacity, since most of the companies have high capacity utilization rate, it is important that this should be taken into account in planning the production as this might pose some problems later on.

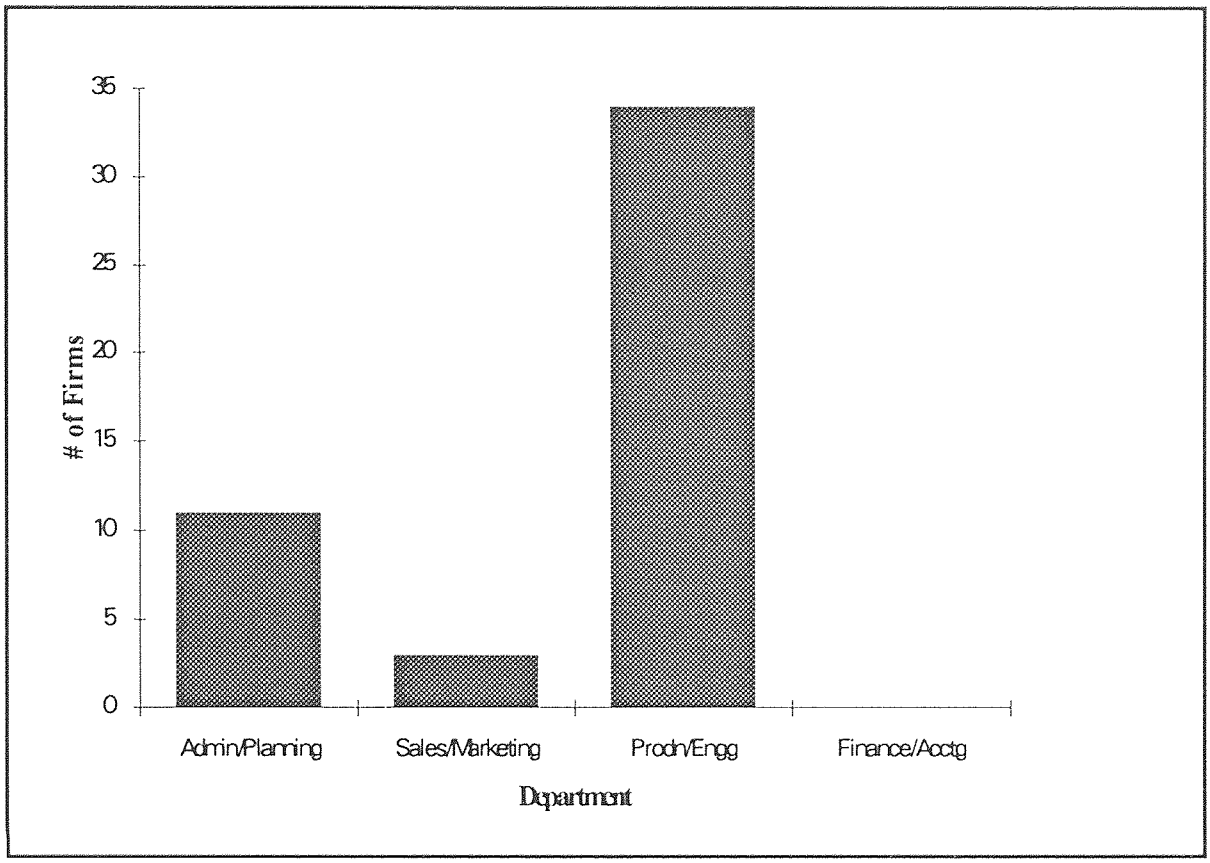


Figure 4.10 Department who does production plan.

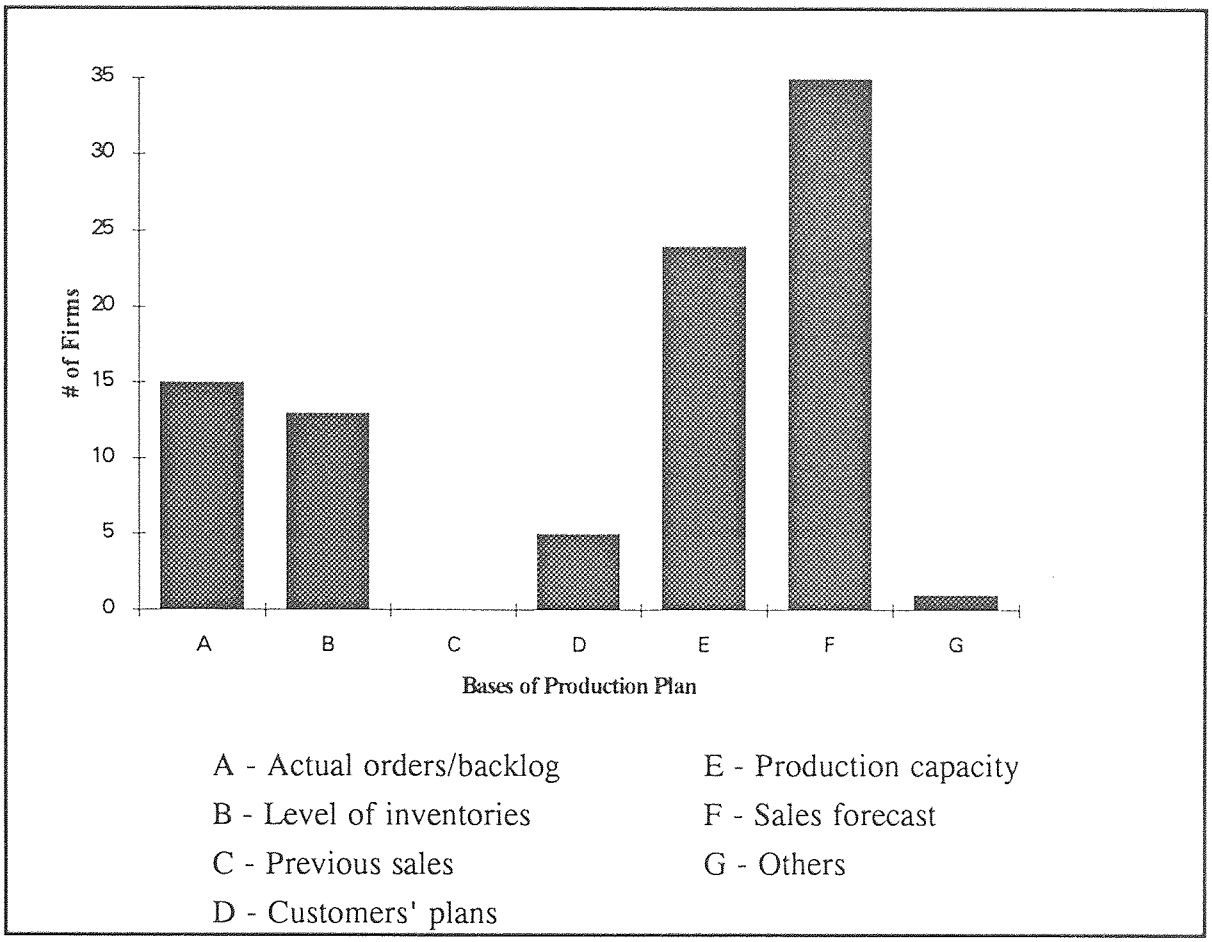


Figure 4.11 Bases of the firms' production plan

Majority of the firms make their production plan on a monthly basis (72.2%) as shown in Figure 4.12. And this plan is followed about 60-90% of the time (Figure 4.13). Considering that the plan is followed most of the time and that it is based on the sales forecast which has a relatively long time frame (more than six months) and utilizes judgmental techniques, we could say that the relative accuracy of the forecasting techniques being used dominantly is enough since the production plan is followed most of the time. On the other hand, this could also be related to the fact that a lot of the companies produce for stock and so inventory serves as a shock absorber to any changes in the demand.

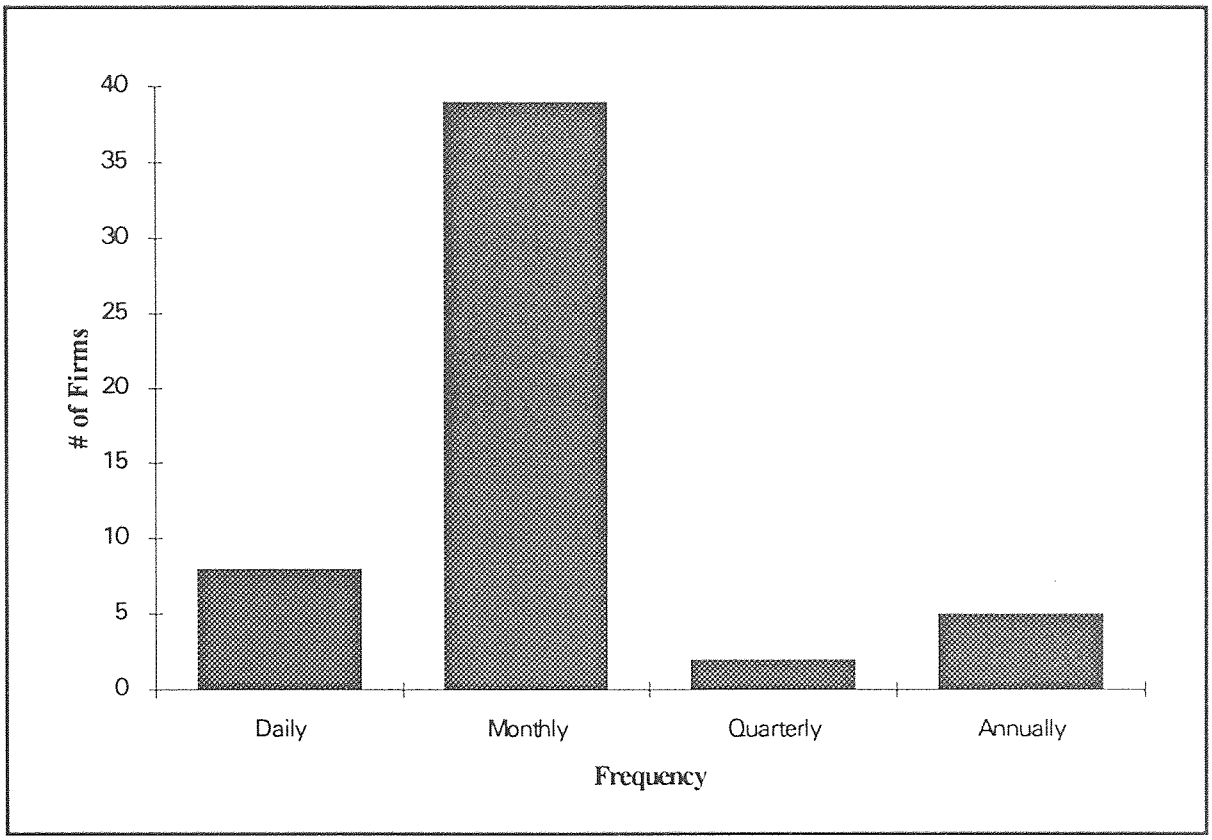


Figure 4.12 Frequency with which production plan is made

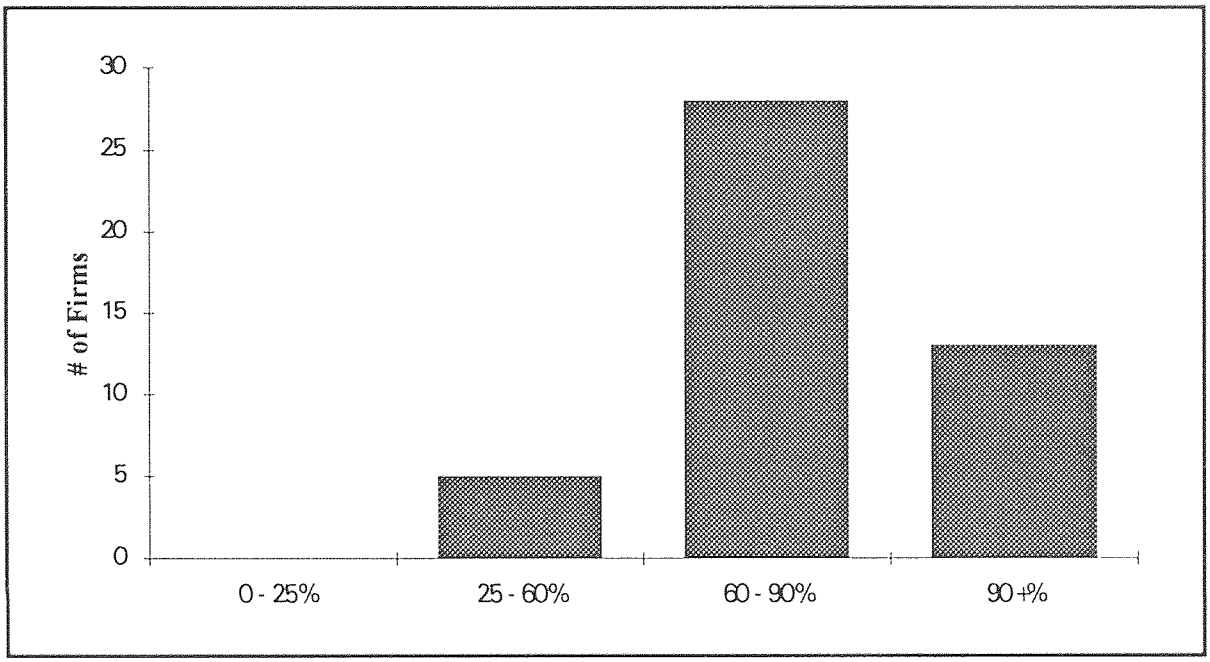


Figure 4.13 Percent of the time production plan is followed

The average lead time for most of the companies is one week to one month (Figure 4.14). This long lead time explains why products are mostly made-to-stock. In order for the firms to reduce delivery time to customers, a lot of inventory is produced. In this way, the companies could easily respond to the demands of the market. However, in terms of new or customized products and product variety, we could say that the market is not demanding. The long lead time implies that new products are introduced to the market at a slow rate and product life cycles are long. The companies rather than having high inventory levels should reduce leadtimes through other ways such as reducing setup time, having a good maintenance program for the machines to minimize failures and improving processing technology to reduce actual processing time.

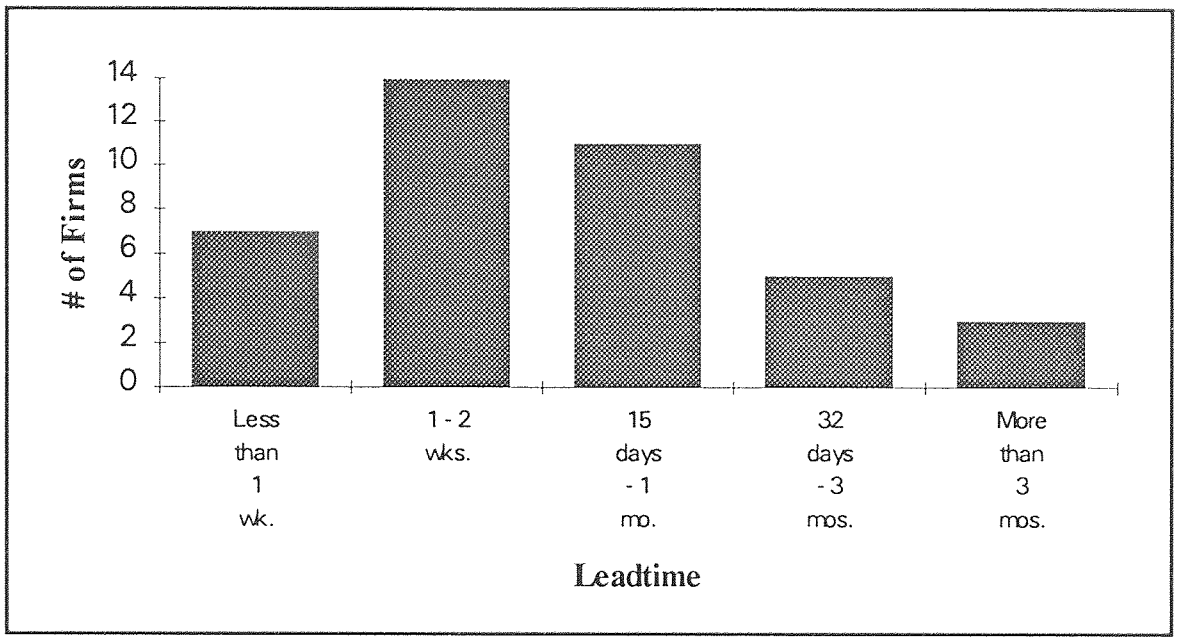


Figure 4.14 Average leadtime of the companies in the sample

4.2.3 Shop Floor Control

The dominant criteria for job sequence order (Figure 4.15) is customer order due dates (39.8%), followed by material availability (18.1%). Lateness in delivery are mostly caused by material shortages (32.9%) and lack of production capacity (27.1%), shown in Figure 4.16. The region seems to be having some problems with the raw materials. This may be due to the fact that in most developing countries particularly in Southeast Asia, suppliers are located at considerable distances. In addition to this, there usually is a less-than-efficient transportation system. These situations make deliveries infrequent and oftentimes problematic.

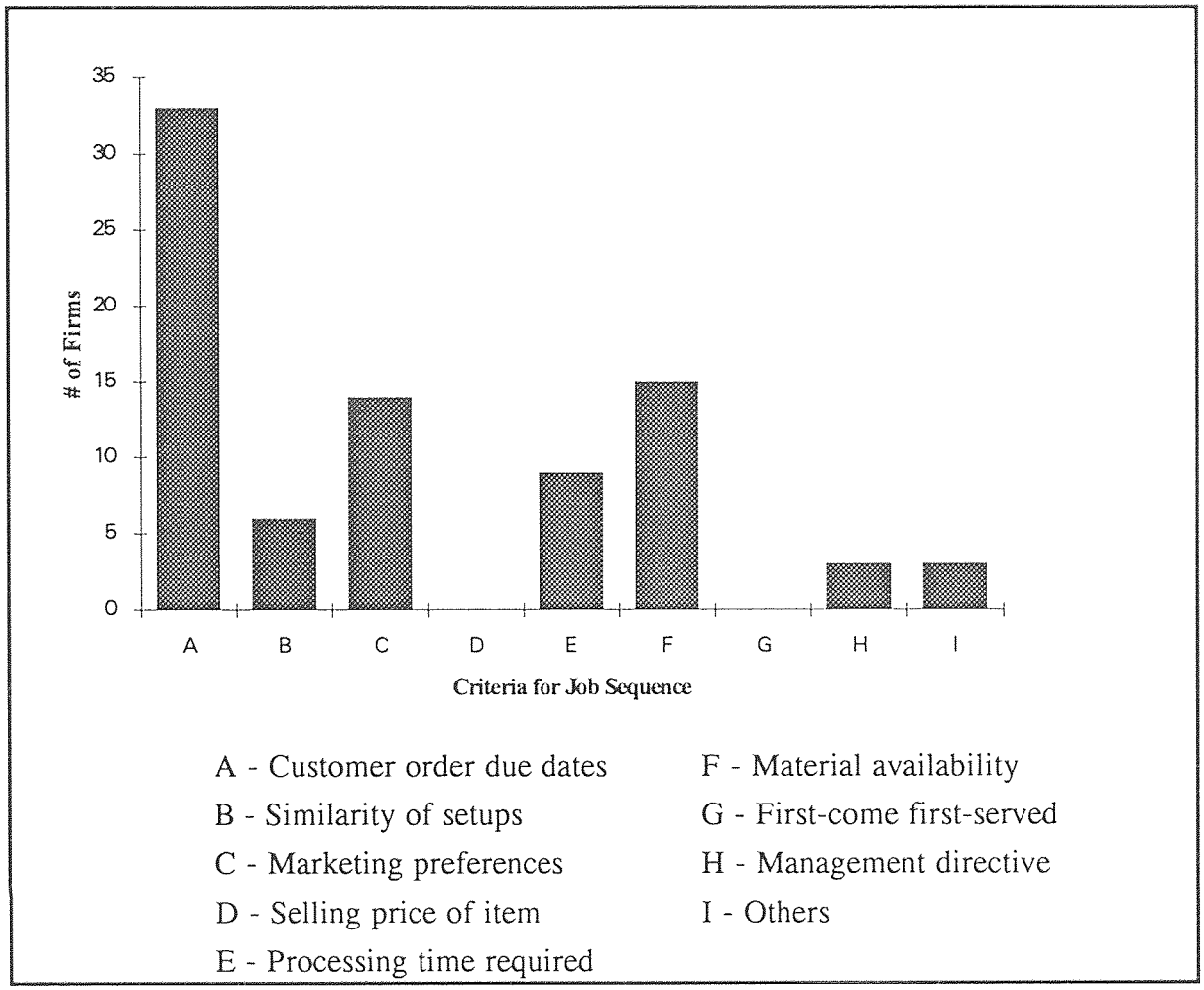


Figure 4.15 Bases of job sequence

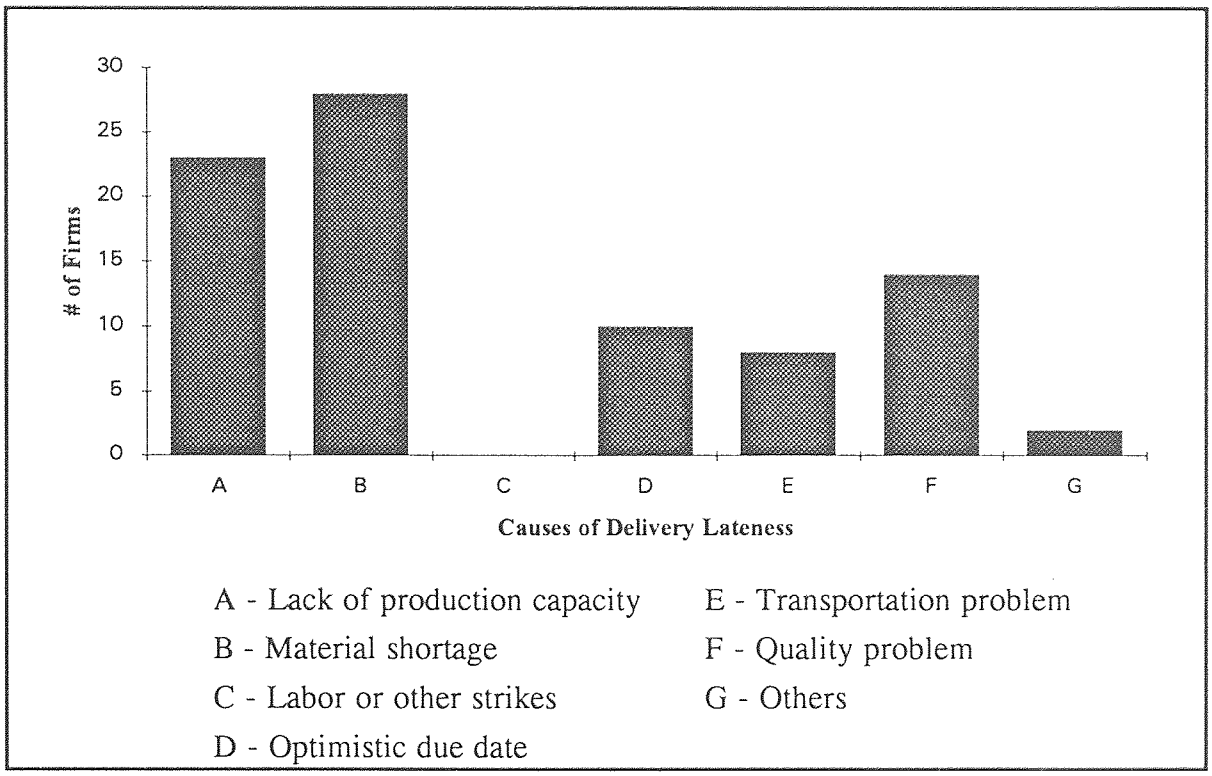


Figure 4.16 Frequent causes of lateness in delivery

The most commonly used production and control system in the sample is MRP (41.9%) followed by JIT/Kanban (24.2%), shown in Figure 4.17. MRP users were mostly medium-scale companies. There was no distinctive production type in the group, that is, all production types were represented. The JIT users were also medium-sized firms. However, almost all of them had the flow type of production system.

Figure 4.18 shows that to ensure a timely supply of purchased materials, most of the companies have multiple sources (41.8%) and long-term contracts (34.2%). The choice of having multiple sources was not surprising since most companies experience problems with the purchased materials. Thus, to ensure that they would have their materials when they are needed or at least to minimize procurement problems, companies resort to having multiple sources.

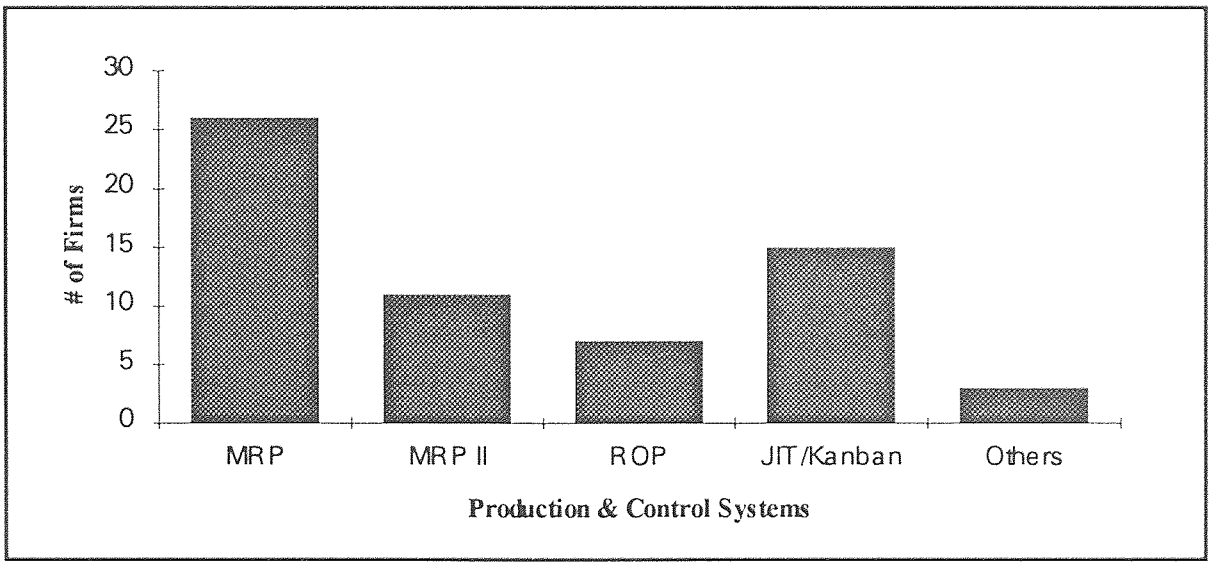


Figure 4.17 Production and control systems being used by the companies

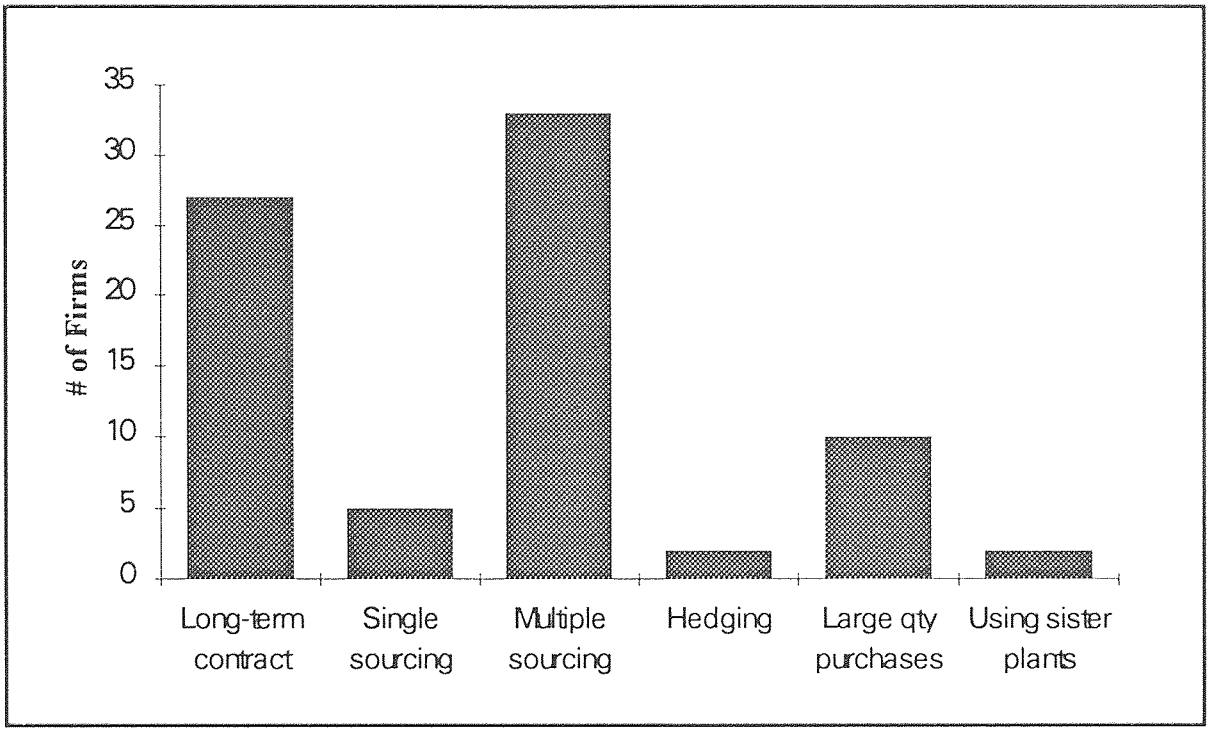


Figure 4.18 Actions to ensure timely supply of purchased materials

In terms of inventory breakdown, a large portion goes to raw materials followed by finished goods and then work-in-process (Figure 4.19). Since availability or timely supply of raw materials is a problem in the region, most companies purchase a lot for inventory. As for the finished goods, the companies respond to market demand for short delivery time by having a large inventory.

Almost half of the companies have very low inventory turnover ratio (less than 10), as seen in Figure 4.20. This means that most of the companies have a big chunk of their capital tied up in inventory which is not good. This is a reflection of a poorly controlled production. The need for a large inventory arises only when the company is not able to respond immediately to market demands. If leadtime is reduced, there is no need for a high inventory level. And leadtime can be reduced by improving processes to shorten processing time or reducing setup cost. Probably the main drawback in implementing these steps is the region's inadequate level of technically trained people and the lack of training of those involved in the processes. This is compounded by the fact that most of the manufacturing plants have imported technologies mainly from Japan, U.S. and Western Europe. A deep understanding of the manufacturing system and the involvement of the workers particularly those production are needed to be able to improve on the processes.

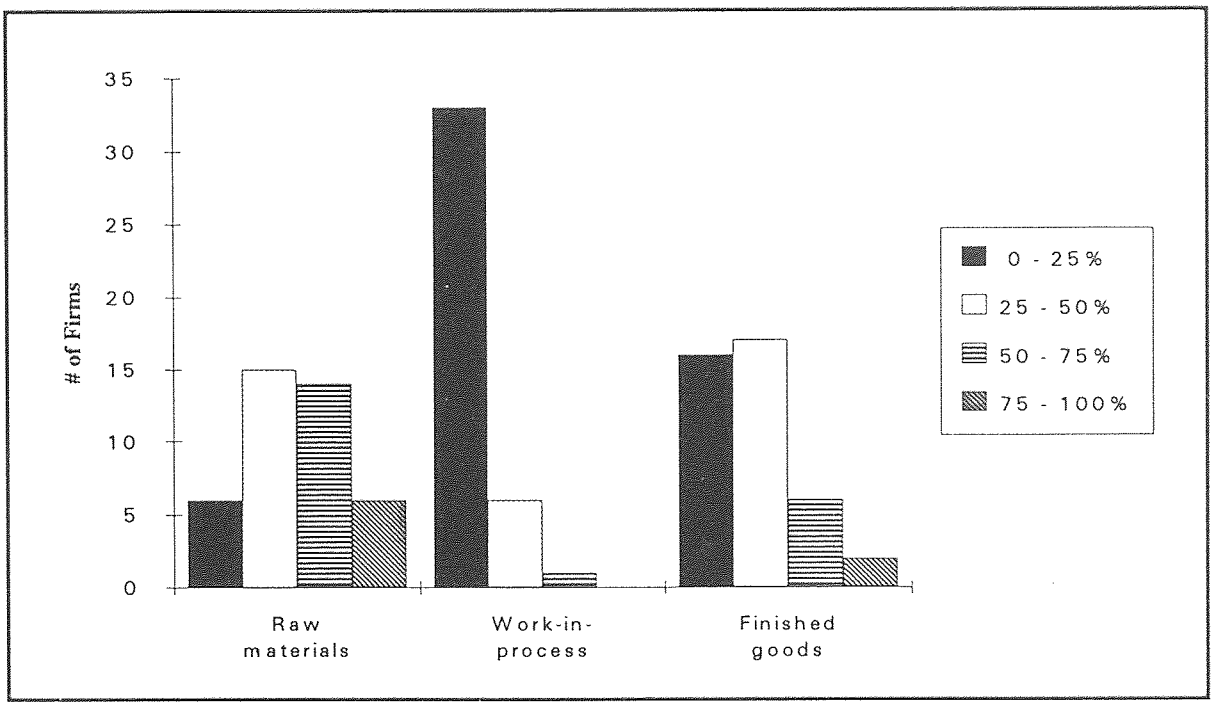


Figure 4.19 Breakdown of firms' inventories

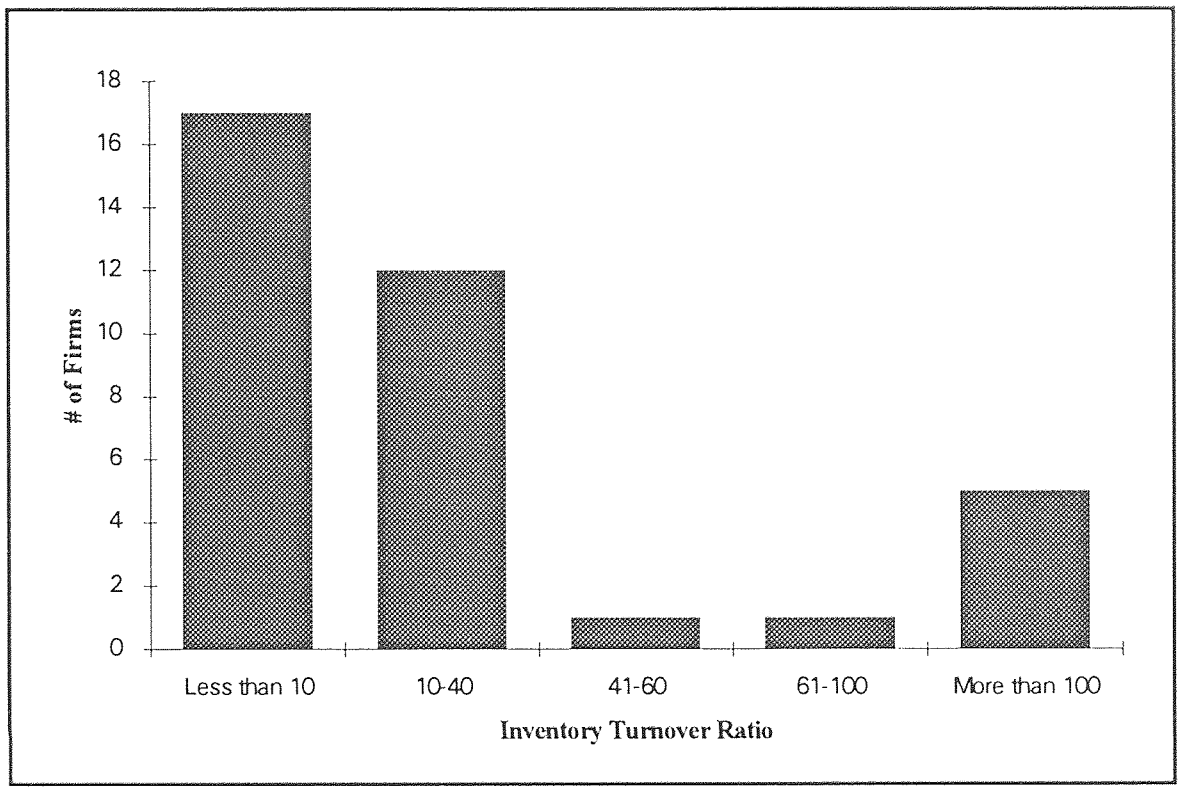


Figure 4.20 Inventory turnover ratio of the companies in the sample

4.3 Quality Management

The dominant reason for improving quality (Figure 4.21) is to satisfy the customer (32.4%) and to be competitive (27.9%). This shows that the companies perceive quality as a strategic tool in order to stay in business. They know the importance of quality in competing in today's market. The techniques commonly used to ensure quality (Figure 4.22) of the process and of the purchased materials is sampling inspection (14.3% and 30.2% respectively). As for finished goods, sampling inspection and customer surveys are the dominant ones (21.4%). This implies that most of the companies are not really controlling quality but are just determining a course of action, that is, whether to accept or reject a certain lot. However, it should also be noted that some of the companies have also been using statistical techniques and advanced techniques such as quality function deployment, analysis of variance and design of experiments (Taguchi). The region may be behind in terms of techniques in ensuring quality, but there are signs of improvements and trying to catch up with competition particularly in the international market.

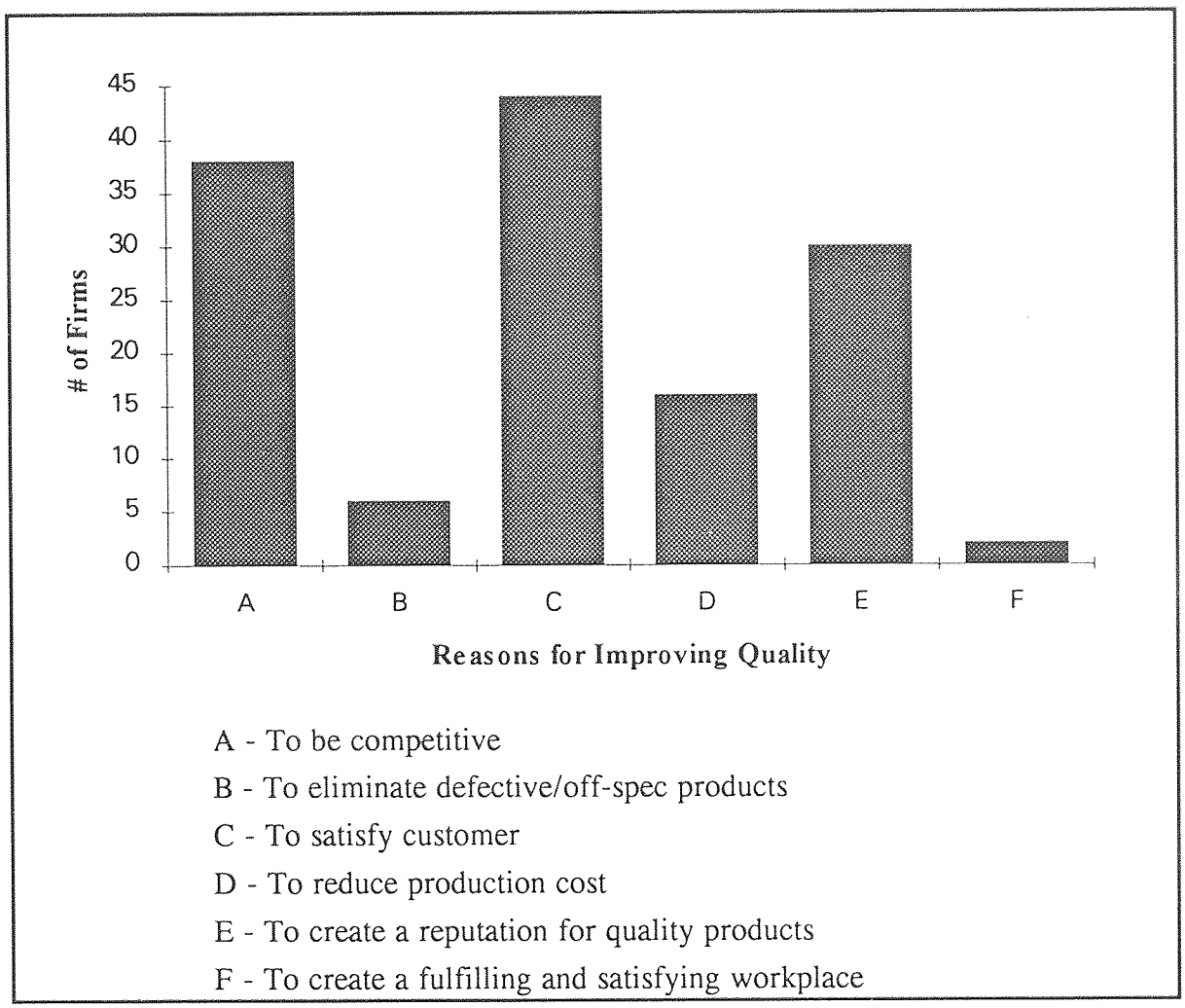


Figure 4.21 Reasons of the firms in improving quality

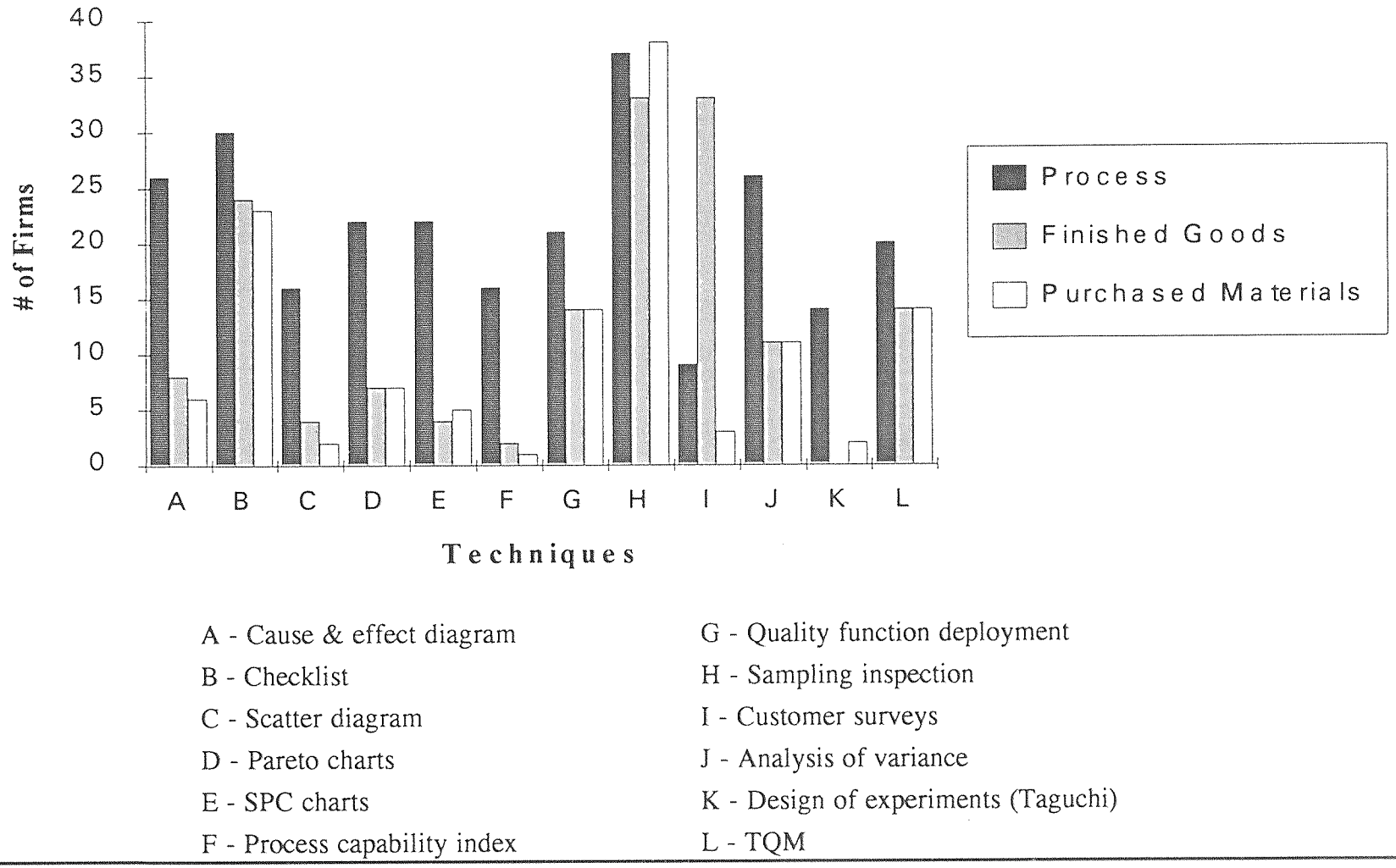
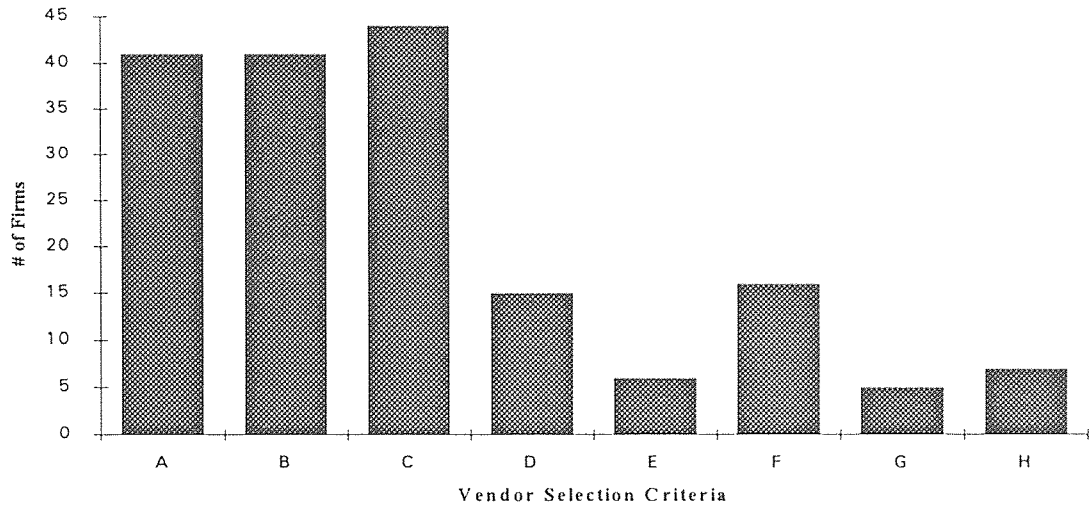


Figure 4.22 Techniques being used by the companies to ensure quality of the process, finished goods and purchased materials

With regards to vendor selection (Figure 4.23), most of the companies in the sample based it on quality (25.1%), cost (23.4%) and on-time delivery (23.4%). This indicates that the firms acknowledge quality of purchased materials as important input in manufacturing. The same holds true for on-time delivery of materials. Some companies have also started working with the suppliers in order to improve the latter's performance. The companies now also look into the capacity of the suppliers' production facilities and the financial stability of the suppliers. Some have taken into consideration the technical sophistication of the supplier's production and support facilities and the quality and level of R&D efforts of the vendor. This only shows that the region has started to implement some kind of a supplier management program.



A - On-time delivery
B - Cost
C - Quality
D - Efforts of supplier to develop long term relationship
E - Financial stability of supplier company
F - Capacity of supplier's production facilities
G - Technical sophistication of supplier's production and support facilities
H - Quality and level of R&D efforts of supplier

Figure 4.23 Criteria in selecting vendors or suppliers

Quality programs are being implemented through almost all the methods (Figure 4.24). Although most of the companies do not yet a formal system for employee suggestions, there has been training and awareness programs for the employees on quality. This is important if the companies really want to ensure quality in their plants.

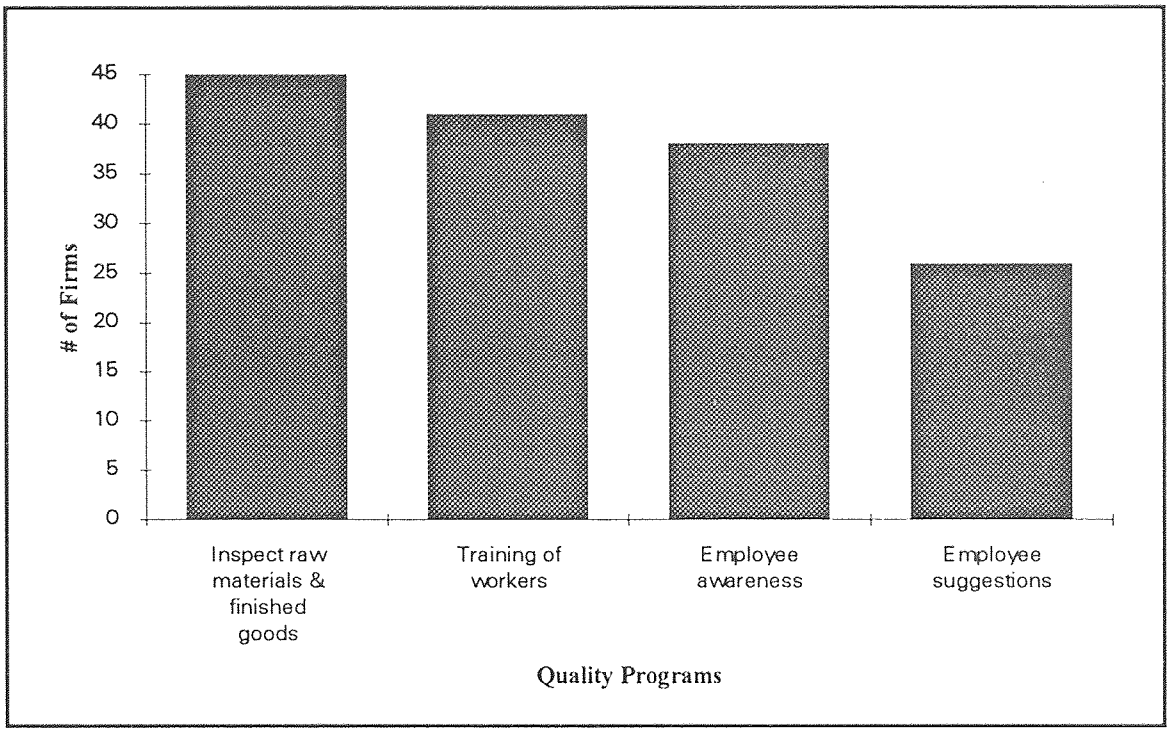


Figure 4.24 Programs on quality improvement being implemented by the companies

Problems in implementing quality are mainly caused by lack of employee awareness (31.1%) and process limitation (25.0%), as shown in Figure 4.25. Although training and employee awareness are already being implemented, these are not extensive enough to involve the employees in upgrading and ensuring quality. Process limitation might be the main drawback in implementing quality because this would entail additional capital outlay, thus, putting a price on quality. Quality in this case would not be free. There would be a substantial amount to be spent to implement

quality in the process. Customer satisfaction (Figure 4.26) are mostly determined through customer surveys (31.4%) and sales force reports (28.1%).

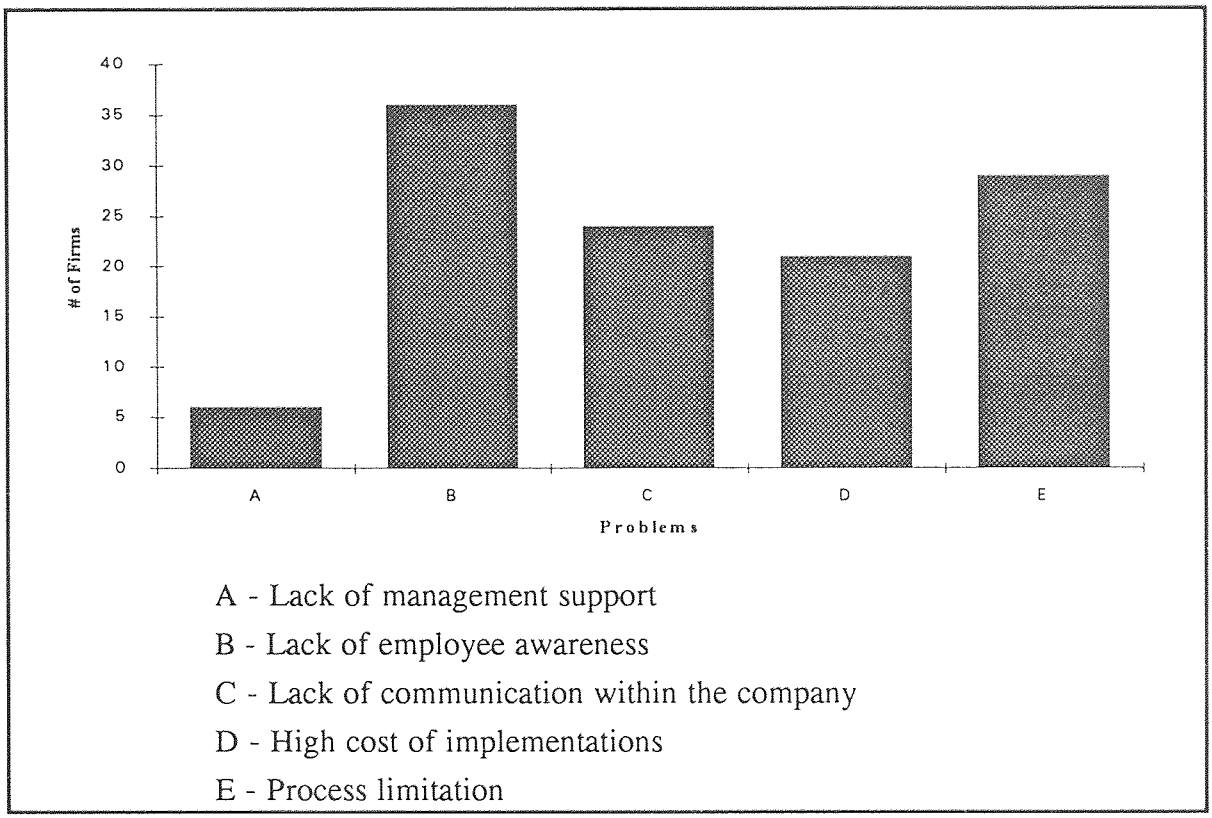


Figure 4.25 Problems being faced by the companies in implementing quality

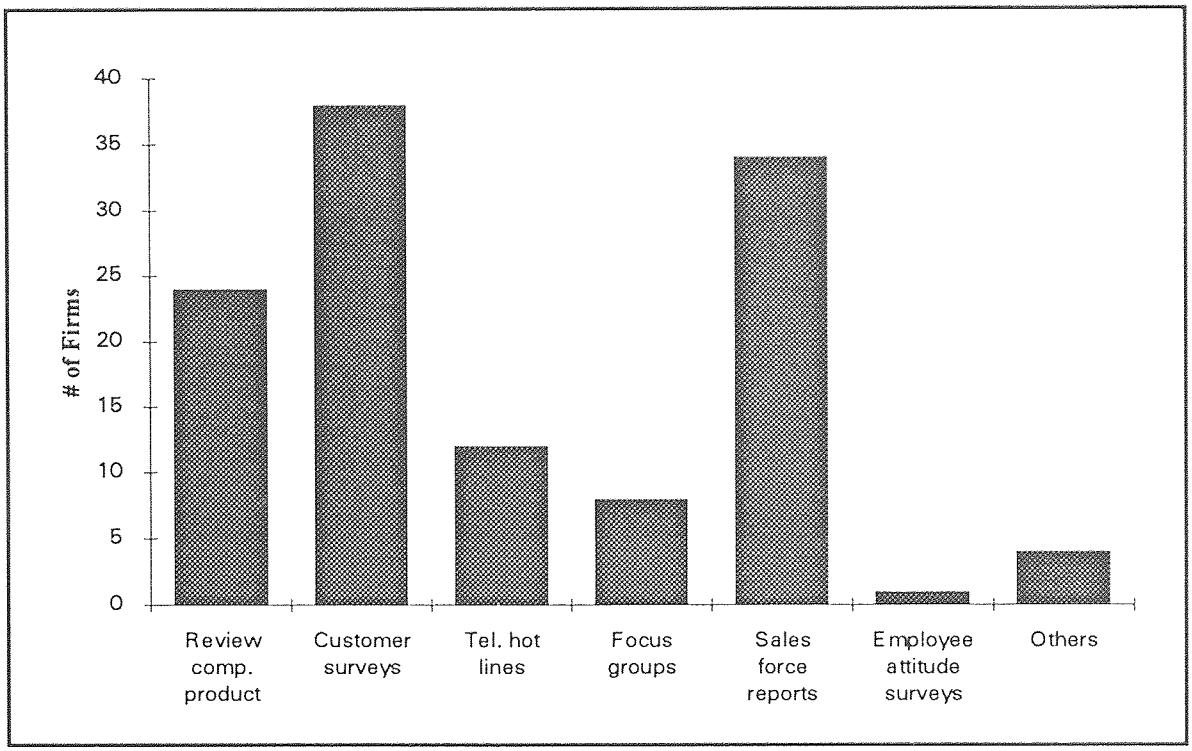


Figure 4.26 Ways of determining customer satisfaction

4.4 Automation and Computerization

A moderate use of computers can be found in sales forecasting, production planning and inventory management (Figure 4.27). Most of the companies use a little of it in shop floor control and quality management. The level of automation (Figure 4.28) is very low (less than 50%) for material handling and process control. For the processing operation, most companies have 50-70% automation level. Most of the automation technologies currently being used (Figure 4.29) are PLCs (19.6%), customized process machines (19.6%), automatic packaging machines (11.6%), industrial sensors (11.6%) and computer-aided design (11.6%). Figure 4.30 shows that the major driving team for automation in most of the companies is top management (43.3%). Most of the companies responded that the average cost of an automation project is less than one million dollars (Figure 4.31).

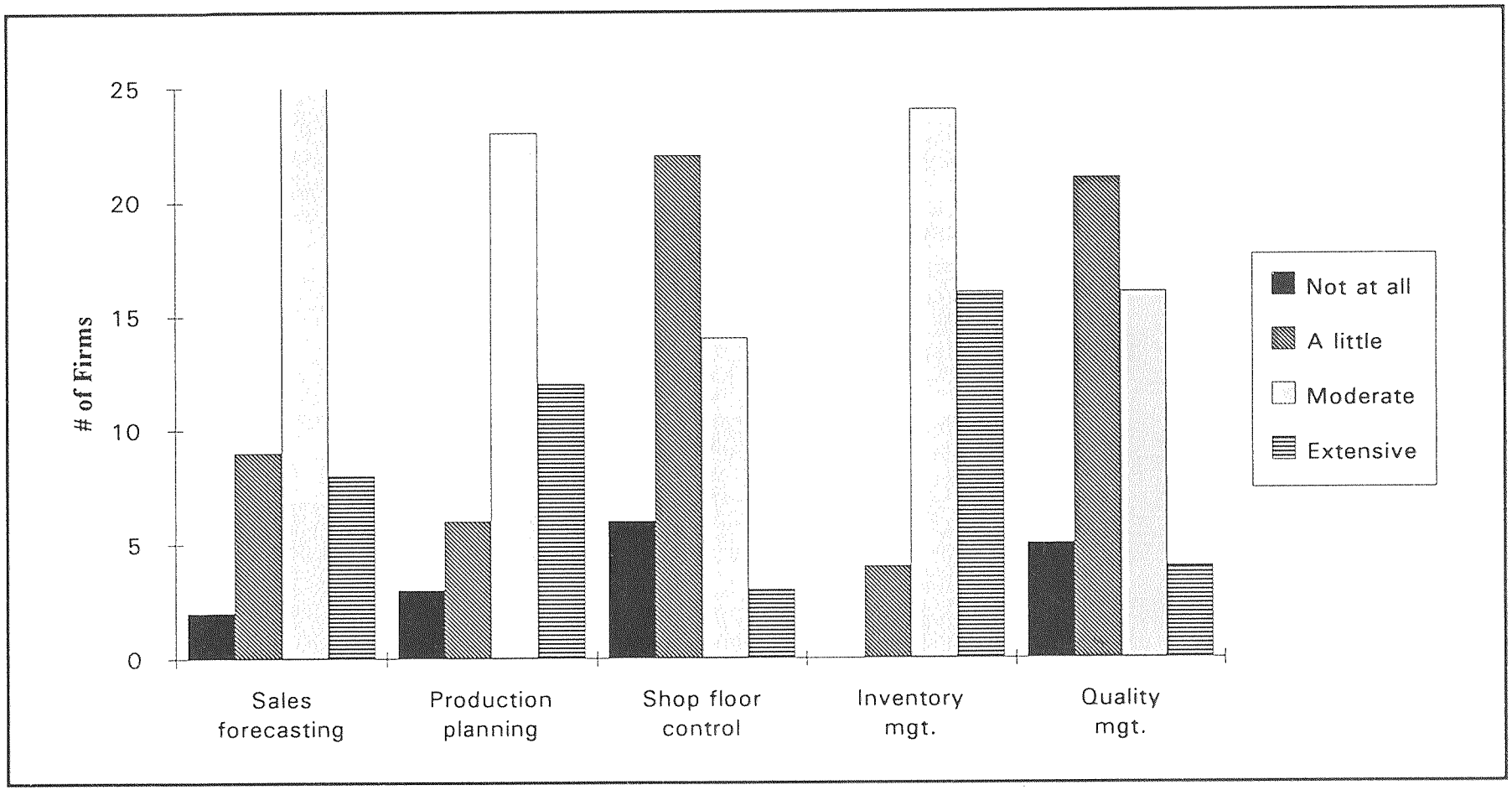


Figure 4.27 Extent of computer use of the respondents

The main reason automation and computerization is not extensively used in the region is the high cost of it in terms of dollar outlay and interest rate. The benefits from automation cannot compensate for the low labor cost in the region. Other factors that could contribute to the low usage of automation are lack of technology information systems, inadequacy of supportive technical services and the seemingly reluctant attitude of entrepreneurs toward the use of modern technology. In addition, lack of motivation from the not-so-demanding domestic market has contributed to this level. Other barriers include lack of a trained workforce, lack of technical knowledge and shortage of capital.

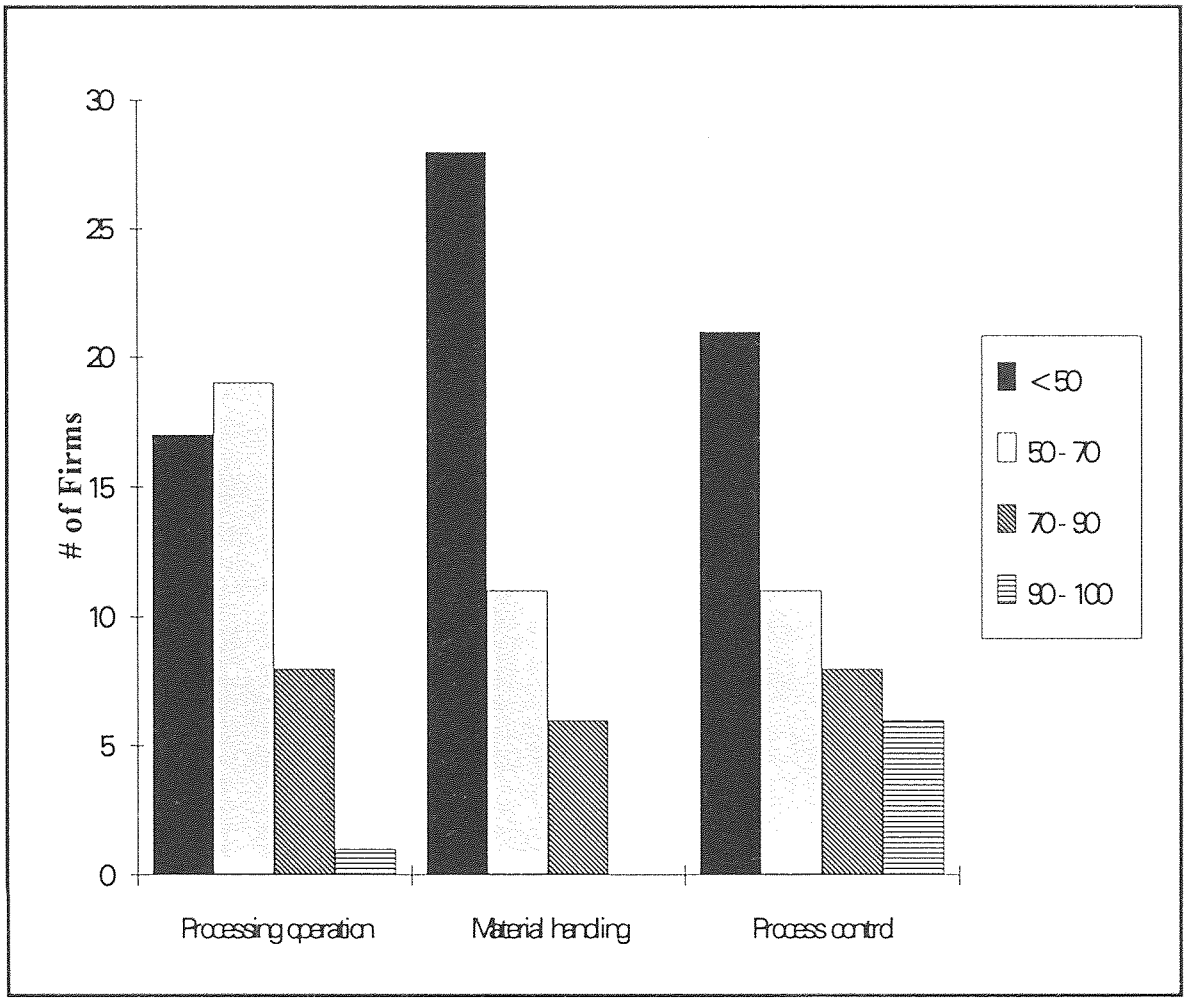


Figure 4.28 Level of automation of the firms

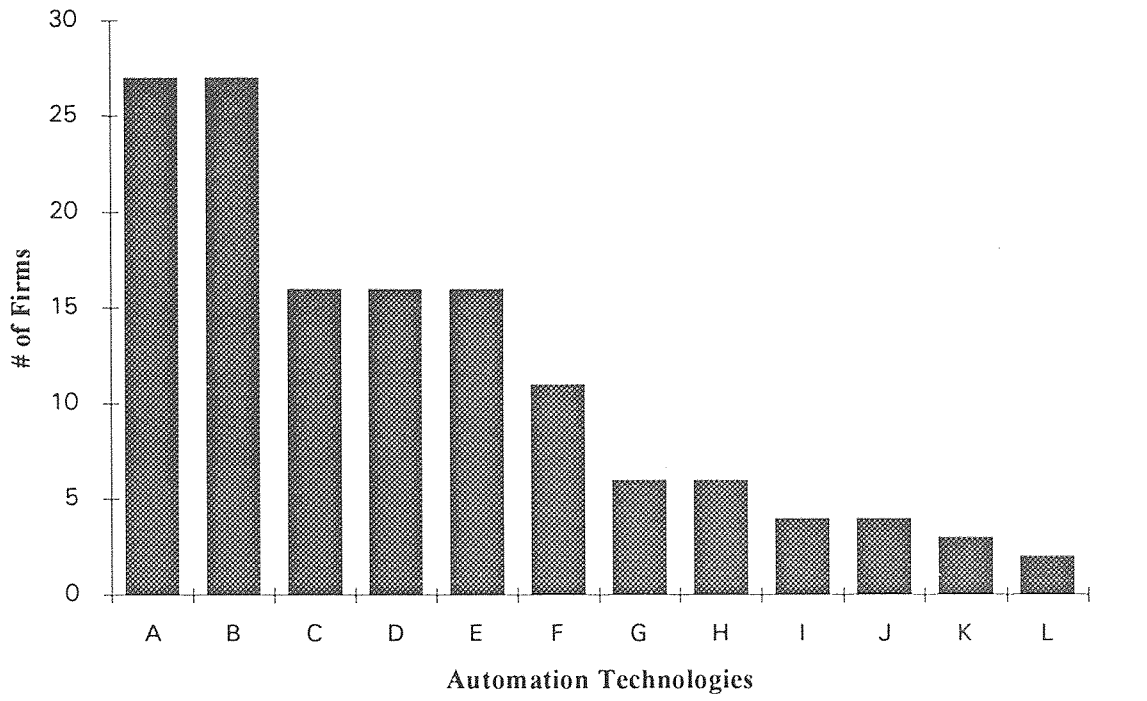


Figure 4.29 Automation technologies currently in use by the companies

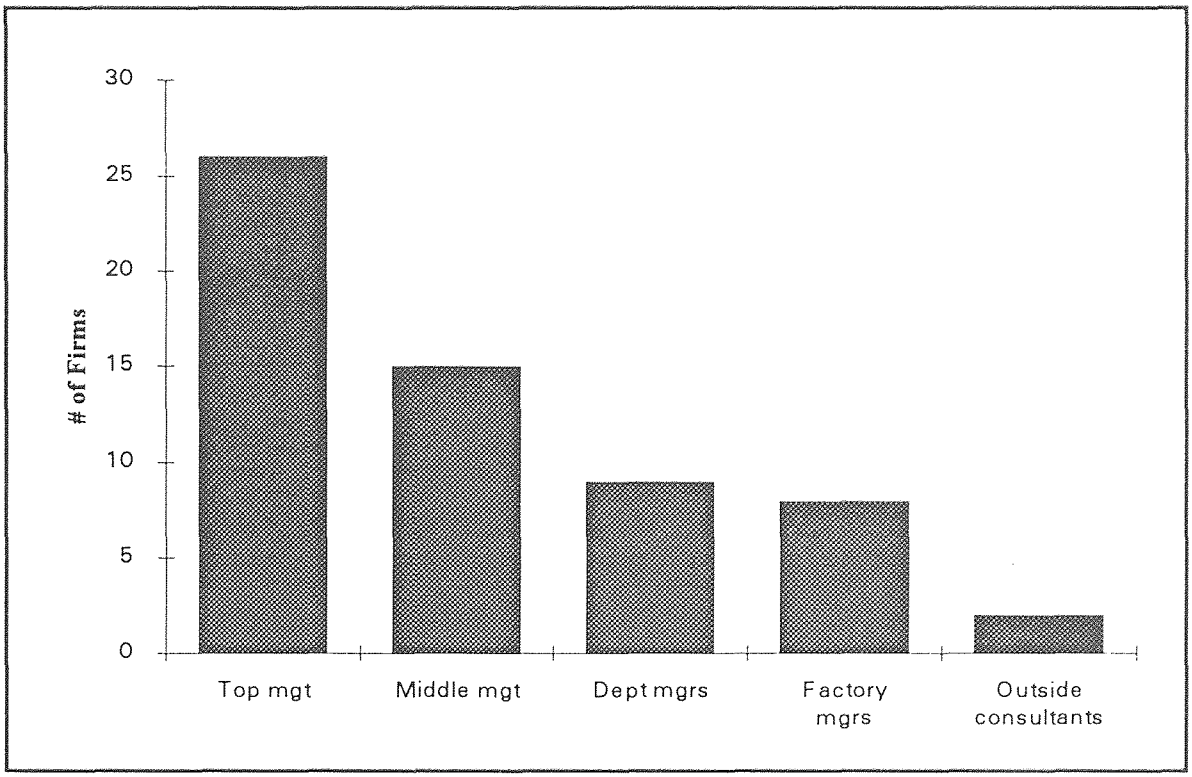


Figure 4.30 The companies' driving team for automation

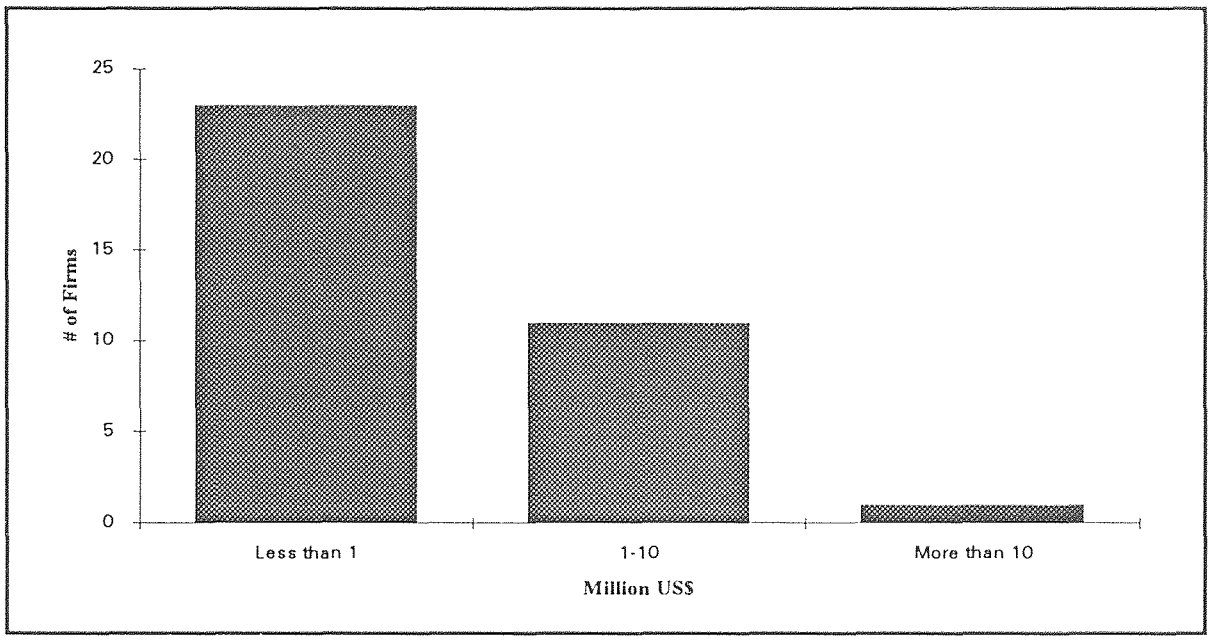


Figure 4.31 Average cost of automation project

CHAPTER 5

CONCLUSION

On the basis of the data gathered from the survey, the following are the dominant characteristics of manufacturing companies in Indonesia, Malaysia and Philippines:

- Most of the firms were labor intensive. Instead of focusing on automating the factory floor, most companies have high number of workers involved in production. This could be attributed to the high interest rates in the region that limits spending on capital investments.
- Most companies have an average capacity utilization rate of 70-90%. This indicates that there is little available capacity in the region.
- With regards to sales forecasting, judgmental methods were dominantly used.
- The firms' production plan was based mainly on the sales forecast and production capacity. It can be seen here that the sales forecast play an important role in production.
- The average leadtime of products in the region is one week to one month. This long leadtime explains why most companies produce for inventory. They respond to market demand by producing to stock. It can be inferred from the relatively long leadtime that the customers are not demanding in terms of new or customized products and product life cycles are longer.
- On the shop floor, sequence of job is mainly based on customer order due dates and availability of materials. Lateness in delivery is mainly due to material shortage and lack of production capacity. Availability of materials is a main factor to consider for most of the companies. This may be due to the fact that in the region most of the suppliers are located at considerable distances. In addition, these countries have inadequate physical infrastructure that causes transportation problems. The companies

try to minimize this problem by having multiple sources of their materials. This problem in materials is reflected on the firms' inventory. A large portion of their inventory goes to raw materials.

- Almost half of the companies are MRP users.
- Most of the companies have very low inventory turnover ratio. A big chunk of their capital is tied up in inventory. This could be resolved by reducing their leadtime. However, the main drawback to this is the inadequate level of technically trained people. Another is the lack of understanding of the technologies being used since most of these technologies were imported from Japan, U.S. and Europe.
- With regards to quality management, most companies perceive it as a strategic tool in order to stay in business. Although most of them still perform sampling inspection to check quality, some have already been using advanced techniques such as quality function deployment, analysis of variance and design of experiments.
- Most of the companies also believe that selecting the right suppliers is important to ensure the quality of their output. Not only do they look at cost, but also quality and on-time delivery.
- Regarding computers, it is used very little in the shop floor and in quality management. On the other hand, it is being used moderately in forecasting, production planning and inventory management.
- The level of automation in the region is less than 50% for material handling and process control. For processing operation, the level is about 50-70%. The main reason for this is the high cost of dollar outlay and high interest rate.

Overall, we could say that there are still a lot of work to be done for these countries to be truly competitive in the international market. Financial constraints specifically the high interest rates in these countries greatly affect the development of the manufacturing sector. Instead of investing on more efficient modern technology, most companies are labor intensive. This could be a main factor on the relatively long

production leadtimes. And leadtime is a very important competitive advantage in manufacturing.

Another problem to tackle in the region is the inadequacy of physical infrastructure. This has affected the procurement of raw materials and delivery of finished goods that are very important in manufacturing. But the most important factor that hinders the development of the region is the need to upgrade the expertise and knowledge in technology and management of the workforce. The region may boast of low cost labor but there is a shortage of technically trained people which would really push the economic development of the region.

There are still a number of issues that should be investigated in future research in this area. These may include the role of government in manufacturing since government policies can greatly affect the growth of any sector in the economy. Also, with the big push on quality, an in-depth study on various areas of quality management would be helpful particularly to the manufacturers. Another issue which can be investigated is the effect of factory automation on the businesses. The results of these studies are important to practitioners in order for them to know strategic options they could focus on for them to be globally competitive.

APPENDIX A

SURVEY QUESTIONNAIRE

A. Company Profile.

1. Company name (Optional): _____

2. Products: _____

3. Sales last year (in US$ or indicate currency): Domestic _____

   Export _____

4. Number of employees: Total company _____

   Direct in Production _____

5. Production type (check all that apply):

   a. ( ) Batch ( ) Job-shop ( ) Mass ( ) Flow

   b. ( ) Make-to-stock ( ) Make-to-order

6. What is the average capacity utilization rate?

   ( ) 0 - 50% ( ) 50 - 70% ( ) 70 -90% ( ) 90+%

B. Production Control & Management

1. Which functional group makes the sales forecast?

   ( ) Administrative/Planning ( ) Production/Engineering

   ( ) Sales/Marketing ( ) Finance/Accounting

2. How far in the future do you forecast your sales?

   ( ) 1 month ( ) 3 months ( ) 6 months ( ) > 6 months

APPENDIX A (continued).

3. Which forecasting techniques are being used for short term and long term planning?

	Short Term 1 Year or Less	Long Term More than 1 Year
Manager's opinion	( )	( )
Sales force composite	( )	( )
Moving average	( )	( )
Exponential smoothing	( )	( )
Straight line projection	( )	( )
Regression analysis	( )	( )
Box-Jenkins time series	( )	( )

4. What are the two most important uses of sales forecast?

( ) Budget preparation ( ) Material/inventory planning

( ) Manpower planning ( ) Facilities planning

( ) Production planning ( ) Sales planning

( ) New product development ( ) Others (pleas specify)

5. Which functional group makes the production plan?

( ) Administrative/Planning ( ) Production/Engineering

( ) Sales/Marketing ( ) Finance/Accounting

6. What are the two most important bases of your production plan?

( ) Actual orders/backlog ( ) Production capacity

( ) Level of inventories ( ) Sales forecast

( ) Previous sales ( ) Others (please specify)

( ) Customers' plans

7. What is the frequency with which your production plan is made?

( ) Daily ( ) Monthly ( ) Quarterly ( ) Annually

APPENDIX A (continued).

8. What percentage of the time is the plan actually followed?

( ) 0 - 25% ( ) 25 - 60% ( ) 60 - 90% ( ) 90+%

9. What is your company's average leadtime, i.e., from start of production until delivery to customer or inventory?

---

10. What are the two most important criteria for sequencing the release of jobs to production?

( ) Customer order due dates
( ) Similarity of setups
( ) Marketing preferences
( ) Selling price of item
( ) Processing time required
( ) Material availability
( ) First-come first-served
( ) Management directive

11. What are the two most frequent causes of delivery lateness?

( ) Lack of production capacity
( ) Material shortages
( ) Labor or other strikes
( ) Optimistic due date promised at start
( ) Transportation problems
( ) Quality problems

12. What type of planning and control system is being used by your firm?

( ) Material Requirement Planning (MRP) based system
( ) Manufacturing Resource Planning (MRP II)
( ) Reorder Point System (ROP)
( ) Just-in-time/Kanban
( ) Others (please specify)

APPENDIX A (continued).

13. What are the two most common actions to ensure the timely supply of purchased materials?

( ) Long-term contract ( ) Hedging

( ) Single sourcing ( ) Large quantity purchases

( ) Multiple sourcing ( ) Using sister plants

14. What is the breakdown of your firm's inventories (approximate %)?

	Approx. %
Purchased materials & parts inventories	_____
Work-in-process inventories	_____
Finished goods inventories	_____

15. What is the average Inventory Turnover Ratio of the company?

_____

C. Quality Management

1. Rank the following reasons for improving quality:

( ) To be competitive

( ) To eliminate defective/off-spec products

( ) To satisfy customer

( ) To reduce production cost

( ) To create a reputation for quality products

( ) To create a fulfilling and satisfying workplace

APPENDIX A (continued).

2. Check which of the following techniques are being used to manage quality, and where:

	Manufacturing Process	Finished Goods	Raw Materials
Cause-and-effect diagrams	( )	( )	( )
Checklist	( )	( )	( )
Scatter diagram	( )	( )	( )
Pareto charts	( )	( )	( )
SPC charts	( )	( )	( )
Process capability index	( )	( )	( )
Quality function deployment	( )	( )	( )
Sampling inspection	( )	( )	( )
Customer surveys	( )	( )	( )
Analysis of variance	( )	( )	( )
Design of experiments (Taguchi)	( )	( )	( )
TQM process	( )	( )	( )

3. Rank the following criteria on vendor selection

( ) On-time delivery

( ) Cost

( ) Quality of materials

( ) Efforts of supplier to develop long term relationship

( ) Financial stability of the supplier company

( ) Capacity of supplier's production facilities

( ) Technical sophistication of supplier's production and support facilities

( ) Quality and level of R&D Efforts of supplier

APPENDIX A (continued).

4. How does your firm implement quality programs?

( ) Inspection of raw materials and finished goods

( ) Training of workers on quality

( ) Employee awareness programs

( ) Formal system for obtaining employee suggestions

5. What are the three most serious problems encountered in implementing quality improvement programs in your firm?

( ) Lack of top management support

( ) Lack of employee awareness

( ) Lack of communication within the company

( ) High cost of implementation

( ) Process limitation

6. How does your company determine customer satisfaction?

( ) Review competitor's product quality

( ) Customer surveys

( ) Telephone hot lines or complaint registrations

( ) Customer focus groups

( ) Employee attitude surveys

D. Automation and Computerization

1. Check to what extent your firm uses computers in the following areas:

	Not at All	A Little	Moderate	Extensive
Sales forecasting	( )	( )	( )	( )
Production planning	( )	( )	( )	( )

APPENDIX A (continued).

	Not at All	A Little	Moderate	Extensive
Shop floor control	( )	( )	( )	( )
Inventory management	( )	( )	( )	( )
Quality management	( )	( )	( )	( )

2. Check the approximate automation level of your firm in the following areas:

	<50%	50-70%	70-90%	90-100%
Processing operation	( )	( )	( )	( )
Material handling	( )	( )	( )	( )
Process control	( )	( )	( )	( )

3. Which of the following automation technologies are being used in your plants?

( ) CNC machines
( ) Customized process machines
( ) Programmable logic controllers
( ) Factory local area networks
( ) Assembly robots
( ) Industrial sensors
( ) Material handling robots
( ) Computer aided design
( ) Sorting conveyors
( ) CAD/CAM for NC programming
( ) Automatic packaging machines
( ) Others (please specify)

4. Who is the driving team for your automation projects?

( ) Top management
( ) Middle management
( ) Department managers
( ) Factory managers
( ) Outside consultants

5. What is the dollar value (capital investment) of an automation project?

_____

APPENDIX B

LIST OF RESPONDENTS

INDONESIA

PT Alpha Power Technologies

PT Bostinco

PT Nipress

PT Semen Andalas Indonesia

6 Anonymous

MALAYSIA

Amalgamated Steel Mills Berhad

Associated Pan Malaysia Cement Sdn. Bhd.

Cargill Feed Sdn. Bhd.

Chemical Company of Malaysia Bhd.

Federal Flour Mills Berhad

Malaysian German Automotive Equipment

MEMC Electronic Materials Sdn. Bhd.

Nylex (Malaysia) Berhad

Sime Tyres International Sdn. Bhd.

1 Anonymous

PHILIPPINES

BASF Coatings and Inks Philippines, Inc.

Bataan Pulp and Paper Mills, Inc.

Busco Sugar Milling Company, Inc.

APPENDIX B (continued)

California Manufacturing Company, Inc.

Consolidated Industrial Gases Inc.

Francisco Motor Corporation

Intel Philippines Manufacturing, Inc.

Legaspi Oil Company, Inc.

Magnolia Corporation

National Steel Corporation

Paper Industries Corporation of the Philippines

Phelps Dodge Philippines, Inc.

Philippine Automotive Manufacturing Corporation

Pilipinas Hino Inc.

Pilipinas Kao, Inc.

Procter and Gamble Philippines, Inc.

RFM Corporation

San Miguel Corporation

Sanitary Wares Manufacturing Corporation

Silver Swan Manufacturing Company

Sime Darby Pilipinas, Inc.

Triumph International (Philippines), Inc.

Victorias Milling Company, Inc.

4 Anonymous

APPENDIX C1

SELECTED COMMODITIES IMPORTED BY INDONESIA
(Million US$, c.i.f.)

	1986	1987	1988	1989	1990
Rice	5.9	12.3	8.6	75.9	14.2
Wheat Flour	1.9	1.9	3.4	4.5	6.6
Cloves	7.8	7.0	. . .	. . .	. . .
Pharmaceutical Products	93.8	101.3	102.3	99.9	124.8
Fertilizers	23.2	48.9	81.4	117.0	115.3
Iron/Steel Pipes	136.6	144.7	172.8	262.5	340.3
Earth Movers	76.9	274.6	156.1	. . .	. . .
Internal Combustion Motors	284.5	260.8	268.7	316.8	413.4
Machines	637.7	768.6	900.5	1,041.4	1,450.1
Motor Cars	170.3	163.9	191.6	182.6	354.7
Buses & Trucks	25.3	44.2	75.4	66.7	194.5

SELECTED COMMODITIES EXPORTED BY INDONESIA
(Million US$, f.o.b.)

	1986	1987	1988	1989	1990
Fish	325.6	420.3	625.3	714.4	915.3
Coffee	818.4	535.6	550.2	489.0	378.6
Tea	99.1	118.7	125.3	163.1	181.9
Spices	209.0	239.5	221.9	182.5	152.6
Rubber	725.8	1,011.1	1,211.4	1,086.9	930.6
Wood and Lumber	418.6	578.7	810.4	1,089.2	601.3
Plywood	1,002.4	1,759.3	2,073.7	2,351.9	2,725.6
Copper Ore	170.8	159.3	231.1	305.8	374.6
Aluminum	197.1	245.8	328.6	358.6	235.6
Nickel Matte	99.0	118.5	352.1	314.4	189.5
Petroleum, Crude	4,593.3	5,040.4	4,334.5	5,140.4	6,219.9
Petroleum Products	691.0	793.1	954.5	919.9	1,183.3
Natural Gas	2,674.1	2,354.8	2,413.6	2,379.6	3,356.6
Garments	518.8	597.9	795.8	1,169.2	1,657.3
Palm Oil	112.9	143.6	275.5	244.6	203.5

Source: United Nations, Statistical Yearbook for Asia and the Pacific, 1991.

APPENDIX C2

MANUFACTURING DATA FOR INDONESIA

	1986	1987	1988	1989
A. MANUFACTURING PRODUCTION				
Wheat Flour (thousand metric tons)	1,151	1,182	. . .	. . .
Sugar (thousand metric tons)	3,887	4,196	1,800	. . .
Meat (carcass weight)	448	477	488	. . .
Beer (thousand hectolitres)	718	833	. . .	. . .
Cigarettes (millions)	114,312	124,432	. . .	. . .
Cotton yarn (thousand metric tons)	307	317	. . .	. . .
Cotton Fabric (million meters)	2,543	1,886	. . .	. . .
Wood (thousand cubic meters)	13,205	16,163	16,746	. . .
Paper (thousand metric tons)	296	406	488	. . .
Chemicals (thousand metric tons)	46	87	.	. . .
Fertilizers (thousand metric tons)	2,909	4,998	554	. . .
Petroleum Products (thousand metric tons)	28,452	29,031	28,457	. . .
Vehicle Parts (thousands)	7,254	7,110	6,564	8,028
Cement (thousand metric tons)	111,323	11,814	12,906	15,660
Steel (thousand metric tons)	1,500	1,453	2,050	. . .
Sewing Machines (thousands)	179	169	. . .	. . .
Refrigerators (thousands)	137	100	. . .	. . .
Television Receivers (thousands)	539	575	. . .	. . .
Radio Receivers (thousands)	966	997	. . .	. . .
Bicycles (thousands)	101	97	. . .	. . .
Gas Produced by Gasworks (thousand MT)	1,080	1,100	1,100	. . .

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX C2 (continued)

B. NUMBER OF ESTABLISHMENTS

	1986	1987	1988	1989
Food Products	2,892	2,857	3,218	3,192
Beverages	132	136	169	162
Tobacco	851	832	962	905
Textiles	2,028	2,031	2,137	2,160
Wearing Apparel	633	656	798	837
Leather and Products	76	71	84	91
Footwear	115	115	149	160
Wood Products	863	914	1,359	1,337
Furniture, Fixtures	297	299	350	367
Paper and Products	127	125	141	145
Printing, Publishing	475	471	497	494
Industrial Chemicals	191	190	218	212
Other Chemical Products	471	476	525	521
Rubber Products	385	378	450	466
Plastic Products	544	558	654	663
Pottery, China	42	43	53	52
Glass and Products	32	34	41	41
Non-metal Products	1,134	1,099	1,162	1,133
Metal Products	556	553	592	588
Machinery	180	175	190	198
Electrical Machinery	186	190	228	236
Transport Equipment	307	316	374	390
Professional Goods	43	46	43	44
Other Industries	175	181	230	239

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX C2 (continued)

C. AVERAGE NO. OF EMPLOYEES (thousands)	1986	1987	1988	1989
Food Products	306.1	325.7	356.6	358.7
Beverages	11.7	11.7	13.1	12.3
Tobacco	197.8	201.7	202.8	213.2
Textiles	307.8	323.9	352.8	395.6
Wearing Apparel	65.3	79	106.5	128.7
Leather and Products	4	4.2	5.7	6.8
Footwear	8.6	8.6	15.6	25.1
Wood Products	168	195.8	273.9	316.7
Furniture, Fixtures	12.5	14.1	21.6	26.4
Paper and Products	25.1	26.4	30.4	34
Printing, Publishing	37	35.2	37.7	38.7
Industrial Chemicals	36.2	36.1	39.4	41.3
Other Chemical Products	68	69.1	74.9	76.6
Rubber Products	90.5	96	119.7	128.1
Plastic Products	49.8	52.7	62.1	70.2
Pottery, China	11.9	12.5	16.2	17.7
Glass and Products	10.1	10.8	11.7	12.3
Non-metal Products	57.8	58	67.9	77.7
Metal Products	58.8	60.9	67.7	72.5
Machinery	16.2	15.3	16.6	19.5
Electrical Machinery	38.7	39.8	45.4	52.9
Transport Equipment	64.9	66.2	68.8	75.5
Professional Goods	2.4	2.7	2.8	3.5
Other Industries	13.2	13.4	19.7	22

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX C2 (continued)

	1986	1987	1988	1989
D. WAGES & SALARIES OF EMPLOYEES (million $)				
Food Products	233	218	245	297
Beverages	16	13	16	17
Tobacco	86	56	83	98
Textiles	184	160	194	231
Wearing Apparel	40	42	57	77
Leather and Products	2	2	3	4
Footwear	9	7	14	20
Wood Products	156	156	221	275
Furniture, Fixtures	9	8	13	17
Paper and Products	24	23	28	39
Printing, Publishing	54	44	48	52
Industrial Chemicals	86	73	81	99
Other Chemical Products	112	104	122	119
Rubber Products	67	84	105	110
Plastic Products	34	33	35	42
Pottery, China	9	8	11	12
Glass and Products	14	13	14	15
Non-metal Products	51	45	52	53
Metal Products	66	55	75	75
Machinery	18	16	21	26
Electrical Machinery	45	41	51	59
Transport Equipment	108	80	91	111
Professional Goods	2	2	2	2
Other Industries	9	8	10	16

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX C2 (continued)

E. ANNUAL AVE. WAGE PER EMPLOYEE ($)	1986	1987	1988	1989
Food Products	762	670	687	828
Beverages	1,399	1,140	1,191	1,403
Tobacco	434	276	407	459
Textiles	598	494	549	585
Wearing Apparel	609	537	537	597
Leather and Products	585	577	608	573
Footwear	997	846	926	798
Wood Products	928	799	808	870
Furniture, Fixtures	686	602	588	632
Paper and Products	963	872	931	1,146
Printing, Publishing	1,454	1,257	1,272	1,337
Industrial Chemicals	2,369	2,015	2,067	2,398
Other Chemical Products	1,651	1,500	1,627	1,547
Rubber Products	741	878	878	860
Plastic Products	689	621	567	595
Pottery, China	721	630	678	692
Glass and Products	1,390	1,178	1,185	1,222
Non-metal Products	890	784	766	680
Metal Products	1,127	906	1,101	1,029
Machinery	1,107	1,070	1,288	1,313
Electrical Machinery	1,168	1,020	1,132	1,115
Transport Equipment	1,670	1,208	1,327	1,467
Professional Goods	650	673	825	636
Other Industries	709	633	528	708

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX C2 (continued)

	1986	1987	1988	1989
F. GROSS CAPITAL FORMATION (million $)				
Food Products	207	190	253	582
Beverages	9	7	16	18
Tobacco	73	30	64	40
Textiles	72	112	155	790
Wearing Apparel	12	15	60	91
Leather and Products	2	2	5	25
Footwear	2	4	17	21
Wood Products	191	205	329	499
Furniture, Fixtures	5	8	10	23
Paper and Products	30	30	67	504
Printing, Publishing	23	20	32	59
Industrial Chemicals	140	91	62	234
Other Chemical Products	46	48	54	81
Rubber Products	33	44	117	142
Plastic Products	31	25	37	72
Pottery, China	18	11	16	33
Glass and Products	4	5	17	17
Non-metal Products	84	26	24	33
Metal Products	32	53	50	92
Machinery	17	8	(5)	(27)
Electrical Machinery	22	24	38	77
Transport Equipment	142	118	168	140
Professional Goods	3	5	9	1
Other Industries	9	4	9	19

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D1

SELECTED COMMODITIES IMPORTED BY MALAYSIA
(Million US$, c.i.f.)

	1986	1987	1988	1989	1990
Milk	44.1	47.9	57.2	58.7	86.8
Wheat	81.2	86.2	117.7	132.1	144.5
Rice	45.8	41.8	77.9	127.0	99.9
Corn	123.3	140.7	167.1	220.3	211.6
Raw Beet & Cane Sugar	133.7	134.1	158.7	196.8	223.0
Petroleum, Crude	211.2	197.5	147.9	117.5	153.0
Petroleum Products	607.5	635.5	595.7	807.1	1,135.5
Fertilizers	104.5	127.9	198.5	190.3	217.0
Earth Movers	29.5	45.1	160.9	281.1	291.7
Motor Cars	97.7	105.1	215.4	341.7	466.1
Tobacco	35.9	23.9	21.0	25.4	30.0

SELECTED COMMODITIES EXPORTED BY MALAYSIA
(Million US$, f.o.b.)

	1986	1987	1988	1989	1990
Rubber	1,233.6	1,572.3	1,932.3	1,461.0	1,120.9
Palm Oil	1,292.7	1,496.7	1,897.7	2,013.3	1,823.1
Cocoa Beans	192.3	274.5	260.4	192.7	166.1
Tin	251.8	336.9	334.7	430.0	334.1
Petroleum, Crude	2,093.4	2,526.1	2,248.5	2,923.3	3,940.2
Petroleum Products	245.2	300.2	250.1	337.0	430.0
Natural Gas	560.4	734.0	675.1	764.6	975.9
Sawlogs, Timber	1,565.3	2,357.3	2,150.8	2,689.7	2,631.8
Thermionic Valves & Tubes	2,246.6	2,774.9	3,204.4	3,768.7	4,327.9

Source: United Nations, Statistical Yearbook for Asia and the Pacific, 1991.

APPENDIX D2

MANUFACTURING DATA FOR MALAYSIA

	1986	1987	1988	1989	1990
A. MANUFACTURING PRODUCTION					
Wheat Flour (thousand metric tons)	409	441	500	515	539
Sugar (thousand metric tons)	768	836	823	830	801
Meat (carcass weight)	151	154	158	. . .	. . .
Beer (thousand hectolitres)	1013	988	1115	1263	1401
Cigarettes (millions)	13706	13729	15904	16169	17331
Cotton yarn (thousand metric tons)	28.5	32.6	34.3	35.8	37.7
Wood (thousand cubic meters)	6187	7091	7091	. . .	. . .
Fertilizers (thousand metric tons)	60	180	282	247	. . .
Petroleum Products (thousand metric tons)	6916	6981	7535	6677	. . .
Vehicle Parts (thousands)	10545	15585	17784	18136	18459
Cement (thousand metric tons)	3569	3316	3775	4794	5685
Refrigerators (thousands)	154	145	197	185	236
Television Receivers (thousands)	863	1240	1221	1585	2359
Radio Receivers (thousands)	11	16	21	28	36

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D2 (continued)

B. NUMBER OF ESTABLISHMENTS

	1986	1987	1988	1989
Food Products	1,276	1,295	1,298	1,329
Beverages	63	62	62	61
Tobacco	20	19	18	32
Textiles	174	178	200	204
Wearing Apparel	195	198	214	237
Leather and Products	22	18	21	21
Footwear	11	10	9	9
Wood Products	633	625	618	659
Furniture, Fixtures	323	305	299	295
Paper and Products	111	115	109	113
Printing, Publishing	249	242	238	238
Industrial Chemicals	87	89	84	86
Other Chemical Products	143	138	133	142
Rubber Products	274	283	312	331
Plastic Products	248	249	254	266
Pottery, China	20	21	24	32
Glass and Products	22	19	22	23
Non-metal Products	347	319	313	325
Metal Products	491	467	464	485
Machinery	348	347	341	361
Electrical Machinery	220	220	242	291
Transport Equipment	223	221	213	230
Professional Goods	12	14	16	18
Other Industries	115	110	114	130

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D2 (continued)

C. AVERAGE NO. OF EMPLOYEES (thousands)	1986	1987	1988	1989
Food Products	63.6	67.5	70.1	72.4
Beverages	5.4	5.1	4.8	4.3
Tobacco	4.2	4.3	3.3	5
Textiles	26.9	28.1	32.4	34.4
Wearing Apparel	34.1	39.3	46.2	55.5
Leather and Products	0.6	0.5	0.7	0.7
Footwear	0.9	0.9	0.8	1.6
Wood Products	52.4	56.1	64	74
Furniture, Fixtures	8.6	9	12	13.3
Paper and Products	7.1	9	10.1	11.2
Printing, Publishing	19.5	19.3	19.9	20.1
Industrial Chemicals	6.6	7.1	7.9	8.6
Other Chemical Products	9.6	9.7	10	11.2
Rubber Products	32.3	37.5	46.9	52.7
Plastic Products	16.2	18.1	20.3	26.7
Pottery, China	2.6	4.5	4.8	6.4
Glass and Products	2.4	2.1	2.8	3.1
Non-metal Products	18.9	17.3	18.4	21.2
Metal Products	18.3	18.9	23.7	27.6
Machinery	13.2	14.2	15.8	17.7
Electrical Machinery	86.2	100.3	131.5	161.1
Transport Equipment	15.7	14.4	14.8	20.2
Professional Goods	5.5	6.3	8	9.7
Other Industries	10	10.5	11.1	14.4

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D2 (continued)

D. WAGES & SALARIES OF EMPLOYEES (million $)	1986	1987	1988	1989
Food Products	173	192	184	202
Beverages	23	26	24	21
Tobacco	23	29	21	21
Textiles	62	71	73	82
Wearing Apparel	61	74	83	107
Leather and Products	1	1	1	1
Footwear	2	2	2	3
Wood Products	123	140	151	189
Furniture, Fixtures	20	19	22	26
Paper and Products	19	31	32	37
Printing, Publishing	76	76	75	83
Industrial Chemicals	47	53	54	59
Other Chemical Products	44	44	43	50
Rubber Products	87	100	106	133
Plastic Products	34	39	40	55
Pottery, China	6	8	9	13
Glass and Products	10	10	10	13
Non-metal Products	65	61	64	75
Metal Products	54	56	74	87
Machinery	42	51	54	65
Electrical Machinery	265	306	339	453
Transport Equipment	69	57	53	70
Professional Goods	12	15	18	23
Other Industries	18	22	21	27

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D2 (continued)

E. ANNUAL AVE. WAGE PER EMPLOYEE ($)	1986	1987	1988	1989
Food Products	2,718	2,844	2,628	2,793
Beverages	4,235	5,040	4,979	4,910
Tobacco	5,537	6,631	6,462	4,296
Textiles	2,320	2,515	2,247	2,379
Wearing Apparel	1,796	1,891	1,790	1,929
Leather and Products	1,938	2,410	1,576	2,116
Footwear	2,584	2,677	2,298	2,083
Wood Products	2,352	2,498	2,367	2,558
Furniture, Fixtures	2,299	2,097	1,808	1,921
Paper and Products	2,675	3,436	3,130	3,340
Printing, Publishing	3,916	3,933	3,769	4,109
Industrial Chemicals	7,047	7,466	6,888	6,804
Other Chemical Products	4,562	4,513	4,301	4,497
Rubber Products	2,700	2,677	2,265	2,516
Plastic Products	2,105	2,174	1,974	2,067
Pottery, China	2,236	1,696	1,838	2,083
Glass and Products	4,360	4,972	3,676	4,182
Non-metal Products	3,425	3,529	3,477	3,529
Metal Products	2,944	2,954	3,134	3,154
Machinery	3,201	3,620	3,397	3,683
Electrical Machinery	3,071	3,047	2,578	2,812
Transport Equipment	4,370	3,932	3,577	3,484
Professional Goods	2,185	2,359	2,206	2,367
Other Industries				

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX D2 (continued)

F. GROSS CAPITAL FORMATION (million $)	1986	1987	1988	1989
Food Products	122	118	111	158
Beverages	13	18	15	22
Tobacco	7	10	(4)	7
Textiles	19	29	40	81
Wearing Apparel	11	19	31	26
Leather and Products	0	0	0	0
Footwear	1	1	0	0
Wood Products	32	44	78	118
Furniture, Fixtures	5	3	12	8
Paper and Products	15	463	22	63
Printing, Publishing	21	25	20	39
Industrial Chemicals	19	22	32	61
Other Chemical Products	21	20	26	25
Rubber Products	26	52	178	168
Plastic Products	22	19	30	82
Pottery, China	2	4	8	6
Glass and Products	16	6	15	28
Non-metal Products	88	26	28	71
Metal Products	18	14	57	68
Machinery	26	67	63	50
Electrical Machinery	172	261	423	593
Transport Equipment	23	21	24	32
Professional Goods	6	15	22	54
Other Industries				

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E1

SELECTED COMMODITIES IMPORTED BY PHILIPPINES
(Million US$, f.o.b.)

	1986	1987	1988	1989	1990
Milk	85.0	130.8	163.9	180.1	220.6
Fish, Preserved	0.8	1.1	2.6	3.1	4.0
Wheat	129.0	82.1	138.5	196.9	219.8
Rice	0.3	0.0	36.8	51.4	116.9
Cotton	32.7	48.1	71.6	70.3	75.6
Fertilizers	83.4	89.2	107.7	103.7	134.1
Iron & Steel Products	119.7	193.8	280.4	379.0	354.4
Passenger Motor Cars	14.8	30.4	73.7	190.9	171.4
Trucks, Buses	5.5	14.1	12.0	37.8	47.4
Petroleum, Crude	728.0	1,061.5	919.3	1,112.2	1,582.5

SELECTED COMMODITIES EXPORTED BY PHILIPPINES
(Million US$, f.o.b.)

	1986	1987	1988	1989	1990
Pineapples, Canned	107.4	111.8	106.7	115.9	112.5
Dessicated Coconut	44.3	75.3	78.3	57.8	60.7
Bananas	130.2	121.2	146.0	146.2	149.4
Sugar	86.8	60.3	60.2	79.7	110.5
Copra	92.4	105.5	93.0	78.7	74.5
Tobacco	21.0	18.5	19.1	17.4	19.7
Logs & Lumber	129.7	154.6	157.2	137.0	18.7
Abaca	12.9	11.7	16.3	17.6	16.5
Copper Concentrates	89.9	109.2	216.2	237.4	206.6
Coconut Oil	332.8	380.5	408.1	237.4	334.4
Plywood	56.5	67.3	78.5	36.7	59.4

Source: United Nations, Statistical Yearbook for Asia and the Pacific, 1991.

APPENDIX E2

MANUFACTURING DATA FOR PHILIPPINES

	1986	1987	1988	1989
A. MANUFACTURING PRODUCTION (million $)				
Food	2,936	3,354	3,907	3,997
Beverages	779	943	1,180	1,357
Tobacco	686	746	759	757
Textiles	568	737	916	940
Footwear and wearing apparel	338	474	743	661
Wood and cork	306	374	512	389
Furniture and fixtures	72	100	181	137
Paper	385	349	480	472
Printing	143	172	195	170
Leather	10	13	25	28
Rubber Products	164	207	395	314
Chemicals	1,327	1,560	2,108	2,153
Petroleum and coal	1,881	2,144	2,108	1,916
Other non-metallic mineral	51	390	93	109
Basic metal	945	1,087	1,485	1,587
Metal product	176	210	280	269
Machinery except electrical	76	119	155	146
Electrical machinery	692	911	1,201	1,420
Transport equipment	128	210	417	798
Miscellaneous	60	68	123	115

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E2 (continued)

	1986	1987	1988	1989
B. NUMBER OF ESTABLISHMENTS				
Food Products	1,263	1,163	3,070	955
Beverages and Tobacco	113	105	135	119
Textiles	305	297	547	346
Leather and Products	41	39	120	60
Footwear and Wearing Apparel	550	525	1,997	537
Wood Products	270	254	682	383
Furniture, Fixtures	253	231	678	271
Paper and Printing	481	472	812	306
Chemicals	300	295	416	297
Petroleum and Coal	12	11	20	16
Rubber Products	112	106	174	117
Other Non-metallic Minerals	144	189	353	159
Basic Metals	138	121	162	130
Metal Products	266	258	483	227
Machinery	316	299	552	199
Electrical Machinery	159	151	214	159
Transport Equipment	160	145	230	134
Miscellaneous	141	138	385	181

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E2 (continued)

	1986	1987	1988	1989
C. AVERAGE NO. OF EMPLOYEES (thousands)				
Food Products	122.9	133.3	161.1	133.8
Beverages and Tobacco	39	40.3	44.6	42.3
Textiles	70.7	76.8	89.5	85.5
Leather and Products	2.2	2.9	5.1	7
Footwear and Wearing Apparel	100.6	108.4	151.7	121.6
Wood Products	44.7	44.6	56.4	41.5
Furniture, Fixtures	21.9	27	41.3	30.4
Paper and Printing	27.9	28.5	35.7	26.8
Chemicals	33.4	33.9	40.6	36.5
Petroleum and Coal	2.7	2.8	3	2.9
Rubber Products	18.6	22.7	26.2	24.9
Other Non-metallic Minerals	7.6	21.4	11.2	10.1
Basic Metals	18.3	17	18.1	18.3
Metal Products	16.7	18.4	21.7	18
Machinery	12.7	12.6	18.6	12.4
Electrical Machinery	40.1	43.4	54.4	55.4
Transport Equipment	11.7	11.7	14	15.7
Miscellaneous	14.6	12.7	24.4	16.2

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E2 (continued)

	1986	1987	1988
D. WAGES & SALARIES OF EMPLOYEES (million $)			
Food Products	156	213	203
Beverages and Tobacco	61	82	67
Textiles	68	88	91
Leather and Products	1	2	4
Footwear and Wearing Apparel	104	126	149
Wood Products	39	50	54
Furniture, Fixtures	16	24	34
Paper and Printing	36	43	49
Chemicals	91	114	105
Petroleum and Coal	14	21	13
Rubber Products	24	32	42
Other Non-metallic Minerals	7	9	11
Basic Metals	29	34	27
Metal Products	17	22	22
Machinery	13	16	20
Electrical Machinery	63	86	101
Transport Equipment	15	19	19
Miscellaneous	15	17	24

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E2 (continued)

	1986	1987	1988
E. ANNUAL AVE. WAGE PER EMPLOYEE ($)			
Food Products	1,268	1,595	1,261
Beverages and Tobacco	1,566	2,045	1,511
Textiles	955	1,146	1,013
Leather and Products	669	763	827
Footwear and Wearing Apparel	1,029	1,160	984
Wood Products	883	1,124	965
Furniture, Fixtures	752	876	834
Paper and Printing	1,287	1,493	1,365
Chemicals	2,724	3,371	2,598
Petroleum and Coal	5,340	7,641	4,499
Rubber Products	1,279	1,417	1,595
Other Non-metallic Minerals	878	404	950
Basic Metals	1,597	1,980	1,499
Metal Products	1,016	1,220	1,026
Machinery	1,047	1,309	1,101
Electrical Machinery	1,569	1,980	1,851
Transport Equipment	1,270	1,586	1,386
Miscellaneous	1,004	1,355	1,001

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

APPENDIX E2 (continued)

	1986	1987	1988
F. GROSS CAPITAL FORMATION (million $)			
Food Products	47.8	52.1	85.2
Beverages and Tobacco	16.7	35.6	31.2
Textiles	15.7	50.0	60.3
Leather and Products	0.1	0.9	1.1
Footwear and Wearing Apparel	6.0	8.9	12.3
Wood Products	6.2	4.4	9.2
Furniture, Fixtures	1.2	2.6	4.0
Paper and Printing	4.5	10.6	11.5
Chemicals	29.1	30.3	41.5
Petroleum and Coal	18.6	53.9	24.3
Rubber Products	21.1	4.6	4.0
Other Non-metallic Minerals	1.0	10.5	3.7
Basic Metals	79.0	35.8	157.4
Metal Products	2.2	3.9	6.9
Machinery	1.4	1.8	6.5
Electrical Machinery	34.8	66.3	74.6
Transport Equipment	2.1	4.2	9.7
Miscellaneous	1.7	1.3	2.5

Source: United Nations, Industrial Statistical Yearbook Vol. 1 1992.

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