THE UNIVERSITY OF HULL

# Impact of the Contemporary Manufacturing Environment on Cost Accounting Information Systems "An Egyptian Case Study"

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by

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**ABSTRACT**

This thesis examines the relevance of current cost accounting systems to the manufacturing environment. Egyptian manufacturing companies in the ex-public industrial sector have suffered from relatively various obstacles, with problems in production planning and control in particular. These impediments were responsible for negative effects on costs and caused low profitability for these companies in most years. Cost accounting systems were basically established for the purpose of preparing financial statements not for operational control.

The literature was reviewed to explore changes in the manufacturing environment with emphasis on the developments in production planning and control systems and also to investigate the developments in cost accounting systems.

To examine this research phenomenon empirically , a case study was conducted in an Egyptian El-Nasr automotive manufacturing company. Data were collected from published and unpublished reports and by semi-structured interviews within the case company.

The thesis is divided into two main parts: Part I to cover the literature review in this area. Part II for the case study analysis. The study covered three major areas of analysis. First is an overview of all factors which shape the old and new manufacturing environments and the developments in the systems of production planning and control. Second is a detailed investigation of the traditional and new cost accounting systems. Third is the main findings and conclusion including exposing the relationship between the different planning and control systems and the various cost accounting systems. It also includes a wide range of suggestions for improving the cost accounting systems of the studied case company.

The major findings of this study were that manufacturing environment played a significant role in designing cost accounting systems. It concluded that planning capabilities of the company and suppliers play a significant role in the process of cost reduction and improve the competitive position.

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DEDICATED TO

My Parents

My Wife

My Children

Mohamed

Ahmed

Bassant

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## GLOSSARY of ABBREVIATIONS

| | |
|---|---|
| ABC | Activity-Based Costing |
| ACS | Absorption Cost System |
| AID | Agency of International Development |
| ALT | Alternative |
| AMT | Advanced Manufacturing Technology |
| APICS | the American Production and Inventory Control Society. |
| BOM | Bill of Material |
| CAD | Computer-Aided Design |
| CAE | Computer-Aided Engineering |
| CAM | Computer-Aided Manufacture |
| CAPE | Control-Analysis-Planning-Execution |
| CAS | Cost Accounting System |
| CES | Cost Establishment |
| CFM | Continuous Flow Manufacturing |
| CIM | Computer-Integrated Manufacturing |
| CKD | Completely Knock down |
| CM | Cellular Manufacturing |
| CMN | Cost Monitoring |
| CNC | Computer Numerical Control |
| CRP | Capacity Requirements Planning |
| DNC | Direct Numerical Control |
| EOQ | Economic Order Quantity |
| ERP | Enterprise Resources Planning |
| FMS | Flexible Manufacturing Systems |
| FAS | Flexible Assembly Systems |
| GAAP | General Accepted Accounting Principles |
| GPSC | General Production Services Centres |
| GATT | General Agreement of Tariffs and Trade |

| | |
|---|---|
| IBM | International Business Machines |
| ICL | International Computers Limited |
| IDMS | Integrated Data Management System |
| IMF | International Monetary Fund |
| JIT | Just-In-Time manufacturing control |
| MDB | Manufacturing Database |
| MMS | Master Manufacturing Scheduler |
| MRPI | Material Requirements Planning |
| MRPII | Manufacturing Resources Planning |
| NLI | Nominal Ledger Interface |
| OMAC | On-line Manufacturing Control |
| PPC | Production Planning and Control |
| OPT | Optimised Production Technology |
| PROMPT | Production Reviewing Organisation of Monitoring of Performance Techniques |
| PSAs | Public Sector Authorities |
| PTP | Pull-Through Production |
| PUR | Purchasing control |
| ROP | Re-order Point |
| SCNA | Single Code Number of Account |
| SCM | Strategic Cost Management |
| SKS | Semi - Knocked Down |
| STC | Stock control |
| TCAS | Traditional Cost Accounting System |
| TMT | Traditional Manufacturing Technology |
| TOC | Theory of Constraints |
| TPA | Throughput Accounting |
| TQC | Total Quality Control |
| TRC | Lot Traceability |
| VCS | Variable Cost System |
| WC | Work Centre |
| WIP | Working in Progress control |

competitive manufacturing strategies, organisations are converging into informationally integrated systems. The primary shift in the current manufacturing trends is twofold: overall organisational structures are changing and simultaneously new information to manage them is being demanded. Management, faced with extraordinary levels of complexity and interdependency in the current information environment, has been forced to adopt new flexible strategies and structures (Kanter, 1989). Thus, the recent manufacturing trends, in response to the need for more rapid exchange of information in the design, development, supply, production and marketing of products, have changed to a new aspect of an integrated information network. Additionally, the current trends in manufacturing is increasingly information-based; information flows from the customer to the design, purchasing, manufacture of a product and storing. The constantly expanding capabilities springing from information technology improvements and innovations are responsible for this transformation. Though these effects are being felt in all organisations, manufacturing in particular is being forced (via strenuous off-shore competition) to undergo a veritable renaissance.

Providing useful and relevant information to support strategic management decisions is the primary purpose of an internal accounting system (Shank, 1989). The literature (e.g. Anthony, 1998) has found cost or management accounting systems tied to an organisation's strategy, its structure, and its environment. Further, cost accounting systems have been linked to managerial decision making behaviour and the literature has concluded that these systems should support that strategic decision making process. Thus the strategy of the organisation and its decision needs should dictate the information provided by the cost accounting systems, not vice versa.

Often decisions must be made regarding the following types of issues: which products to manufacture and in what quantities; outsourcing; price setting; cost control;

and production process changes. Because managers must make these types of decisions in line with organisational strategy, structure and environment, the information provided by the internal accounting system must be useful and relevant for each organisation's unique situation.

From a normative perspective, the cost accounting systems should be subservient to corporate strategy; not independent or in conflict with it. The system's design elements should capture the underlying technology, be consistent with the corporate commitment to total quality, JIT, and increased automation, and promote its efforts to compete on the basis of cost, quality and lead time. Therefore, one expects that the corporate efforts, particularly in the developing countries, to be leading-edge companies and to compete effectively in world markets should be redesigned their cost accounting systems. Organisations must understand the cost of each component of their value chain from product design and purchase of materials, through production and shipment, if they are to be able to effectively compete with other companies by eliminating wasteful efforts and lowering costs. Knowledge of internal costs becomes critical for competitive action and building of shareholder wealth in the current globally competitive economy. This study holds that without adequate product cost; cost control and strategic cost reduction information, knowledge is only partial and therefore, organisational chances for success in the current environment are diminished.

Cost accounting systems are the creators and providers of this critical internal cost information. However, recent research (Johnson and Kaplan, 1987) reveals that current cost accounting systems are outdated. Current systems are consistent with the manufacturing environment of the early 1900s in which competition and cost structures were quietly different in that era. Cost accounting systems have been criticised for not being designed for fitness in the new environment, in which the thinking about such systems has changed. Traditional cost accounting systems tend not to provide relevant, timely and useful information for the managers who are faced with operational and strategic business decisions on a timely basis. Today, management should adopt a new perspective of the role CASs play in such functions as product costing, control, decision making, profitability planning and special studies. The effectiveness of these systems in accomplishing these functions depends upon their relevance to the manufacturing setting in which they operate. Companies should consider this objective before designing or selecting cost accounting systems to avoid establishing irrelevant and costly systems. Therefore traditional cost accounting systems that have been designed in the old environment should be re-examined in the light of the new setting.

> During the past two decades there has been an increasing need for a systematic study to explore the role of cost accounting in the contemporary manufacturing environment. In order to remain adaptive continuously, companies have steadily used sophisticated technologies including information technology such as MRP, JIT software programs and process technology such as CNC. However, during this period of change, cost systems have stayed essentially undeveloped. Depth of manufacturing and using advanced manufacturing technologies have revolutionised the manufacturing shop floor (Kaplan, 1995, P.104).

In summary, the prevailing views are that traditional cost accounting systems in the contemporary manufacturing environment:

(1) systematically introduce cost information is less relevant which leads to inappropriate strategic decisions regarding issues such as: make or buy, production cost containment for competitive pricing etc. ; and

(2) promote and encourage behaviour that does not consistent with the recent strategies with regard to the efficient efforts of cost reduction.

These views provide the framework for this thesis which utilises the case study approach to explore CASs design issues in a single large manufacturing organisation. The focus of this study is on the information that should be provided by cost accounting systems and how they might be redesigned to support organisational strategic decision making and cost control in the globally competitive environment.

## 1.2 Objectives of the Study

Our main goal will be to appraise the effect of the development of a manufacturing environment on cost accounting systems, and especially the strategic dimension of cost accounting systems when transferring from MRP to JIT for cost reduction. To achieve this goal, this research explores CASs design issues in a single large automotive company as a representative to the Egyptian engineering industry. Also, it examines the changes in the manufacturing environments of this Case Company and their current and potential impacts on the existing cost accounting systems. Finally, the research suggests a model to guide the development in the current CASs in this company as the situation requires, to achieve the goals of effective of cost control and strategic cost reduction.

## 1.3 Background of the Study

Considerable changes which have taken place in the companies' environment as a result of increased global competition and the accelerated pace of technological change. In addition to rapid changes in management and manufacturing practices there are also a number of other important developments that have contributed to changing the competitive environment of companies. These include world-wide trends towards the removal of trade exchange barriers through international agreements, the reorganisation of industry and the trend among governments, including Egypt, to change the ownership structures of government trading organisations by incorporation as State-owned Enterprises or by privatisation (e.g. Peng, 2000). These changes have resulted in many pressures and strains on the companies and their management as well as their cost accounting systems. Whether and how cost accounting systems should be redesigned in response to these changes is now of considerable interest to both managers and management.

> The rapidly changing market demand characteristics, the increased pace of technological developments and fiercer competition has forced almost any industrial company to fundamentally rethink its manufacturing strategy (Hayes and Wheelwright, 1984).

The application of such international agreements as GATT has made the world more accessible. The competition has moved from local to global markets and the goal is to capture a market share. The world competition of the 1990s has driven companies to pursue strategies consistent with JIT and TQM to eliminate waste. Quality, flexibility and speed of innovation have become more important as sources of competitive advantage. These changes have affected industrial companies almost everywhere: in logistics (e.g. MRPI, MRPII) , marketing and product development as well as in operations on the shop-floor itself, by the introduction of CNC machining centres and, finally, of Flexible Manufacturing Systems (FMS) and Flexible Assembly Systems (FAS).

> It is realised that automation by itself does not solve manufacturing problems. The inherent versatility of flexible equipment leads to complex new problems related to the justification, to the design and layout, as well as to the planning, scheduling and control of such systems (Zijm 1988).

The amount of reported research on planning and control problems in the engineering manufacturing is much more limited, despite the very high degree of automation in this area. Indeed, the problems arising in engineering manufacturing often differ substantially (and are perhaps less familiar) than those experienced in other applications.

Egypt is an environment highly relevant for this study because it is a developing country with large ex-public sector companies that were established by the state with comprehensive development plans. Egypt is and has been for a long period faced with significant economic changes with the characteristics shown in table (1-1).

Table (1-1).

Characteristics of industrial sector in Egypt

| | | |
|---|---|---|
| Population | 66.0 | Million |
| Gross Domestic Product (GDP) | 82.7 | Billion US $ |
| Consumer Price Index (1990=100) | 223.0 | |
| Manufacturing Value Added (MVA) | 17.8 | Billion US $ |
| Constant MVA (at 1990 prices) | 15.9 | Billion US $ |
| MVA per capita | 275.0 | current US $ |
| Share of MVA in GDP | 23.5 | % at current prices |
| Manufactured Exports | 2,978.0 | Million US $ |
| Share of Manufactures in Total Exports | 76.2 | % |
| Manufactured Imports | 10,862.0 | Million US $ |
| Share of Manufactures in Total Imports | 82.9 | % |

(UNIDO National Accounts Statistics Database. 1997/98).

Egyptian industrialisation has tended to be inward-looking and since 1930 the governing strategy of industrial development has been import substitution. This strategy of industrialisation prevailed in Egypt under a variety of economic policies, which ranged from a free private enterprise economy which was revived under tariff protection in the 1930s, and gathered momentum during the Second World War, and where the state played a minimum role in economic development; to a controlled planned, centrally economy with a dominant public sector which was established after the 1952 Revolution. The policy of state control over the economy began in 1954 and was completed by the early 1960s, especially after the extensive wave of nationalisation in 1961. It was only with the liberalisation procedures of 1974 and the opening-up of the economy to foreign investment, that the Government, especially during the 1980s, attempted to change the industrial strategy from import substitution to export promotion. The emphasis was put on export - led growth with the encouragement of inflows of foreign private capital and technology and the development of the Egyptian private sector.

During the first industrial plan in the late - 1950s, the Government planned for heavy industrial projects. The state involved itself during that period in mobilising capital and constituting mega-corporations. Thus, many industries including the automotive industry were established or expanded under the control of the Government. By the mid-1980s, the Egyptian automotive industry (in particular passenger car assembly operations) was in a state of flux. Given the very low volumes of production and the continuous demands made by the industry on foreign exchange to import semi-knocked down (SKD) and completely knock down (CKD) kits, parts and components needed for local assembly, Egypt's automotive industry has been cited by the Government as an instance of inefficiency.

Thus, industrialisation is a major development strategy in Egypt, like in many other developing countries, but is confronted with a variety of obstacles and problems of an economic, organisational and technical nature and efforts are continually being made to improve the situation. In the attempts to improve industrial efficiency, computer support has been adopted for specific key functions, such as material requirements planning, capacity planning, product costing etc. It is therefore of interest to determine whether and to what extent the use of computers has contributed to improve the process of planning and controlling production and cost systems.

## 1.4 Importance of the Study

As information technology spreads in developing countries, the question about its contribution to the development process has become an issue of much concern. The advances in computer technology which underpins MRPII that are so evident in the most advanced industrialised countries have certainly not left developing countries unaffected and a strong wish to take part in a comparable evolution is frequently voiced.

This study would assist management to evaluate the effectiveness of MRPII system in a specific case. The emphasis of the case study is on the management of manufacturing resources, including costing from materials requirements specification to input for final assembly. This approach will allow the company to identify the essentials of manufacturing problems such as the fluctuation of procurement and manufacturing lead times and the existence of multi-sourced parts. These difficulties seem frequently to confront manufacturers in developing countries as Egypt. One of the key aspects in this study, therefore, is to consider the relationship between the company and its environment from some significant aspects such as financial constraints on the purchase of material and default in negotiations with suppliers due to bureaucracy and strict decision patterns. This approach would aid management to explore the real cost drivers of the overrun costs caused by not only un-necessary activities inside the company but also outside.

Therefore, this research study is targeted, through analysis of this unique company situation, to contribute to the development of theory. These study's results provide insights regarding product costing, cost control and decision making, which could be apply to similar cases.

Thus, the contribution of this study is to provide guidelines to managers in this company and others, which may help them when developing their CASs. Also, this study intends to help contribute to the development of the existing theory by adding to the growing knowledge rule in this area by analysis of the company's experience. Thus, this study will highlight areas in which theoretical assumptions are supported, or concepts which need to be further developed. Consequently, exploratory research questions are formulated in light with the field's requirement for development.

## 1.5 Research Questions

As mentioned above, the research explores the effect of the development of manufacturing environment on cost accounting systems. In order to achieve this main objective, a number of important strategic issues are explored in this study with respect to:

(1) What are the characteristics of old and new manufacturing environments?

(2) How and why were the cost accounting systems designed and applied in specific settings?

(3) What effect have changes in the manufacturing environment had on the effectiveness of cost accounting systems?

(4) What are the accounting informational requirements of management in the contemporary manufacturing environment?

(5) What are the changes either already implemented or planned for implementation in the cost accounting systems?

(6) What are the drivers of change in the cost accounting systems?

(7) to what extent have they already developed? and

(8) What developments are needed to improve the current systems?.

In order to answer the above questions, a conceptual model of the study will be developed in chapter three. The relevant areas of analysis for this study included the process of cost allocation to the products as they flow through the manufacturing process; and the process of cost control and cost reduction to explore the costs of value and non-value added activities.

## 1.6 Research Methodology

Research methodology in this study employed a case study method to collect filed data. The following main points of research methodology are discussed in this section:

(1) Selection process of the research site.

(2) Data collection methods.

### 1.6.1 Selection Process of the Research Site

The purpose of this empirical research is to explore and investigate the changes in the cost accounting practices in Egyptian manufacturing industry. Assembly and engineering industries of the ex-public sector have been selected in this study due to the fact that private sector companies have been established only recently, by individuals, so their environment has not changed remarkably, and is unlikely to have had major impact on changing their CASs. Moreover, it was not possible to get access to all of them to collect the data necessary to carry out this research.

El-Nasr Automotive Manufacturing Company which produces and assembles automotive vehicles constitutes the field study site for this research. The researcher contacted the president of the Egyptian Holding Company of Engineering Industries who informed him that the studied affiliated company had undergone some changes in their manufacturing, information technology and cost accounting practices. However, the researcher also visited three ex-public television manufacturing companies and found that they were just in charge of assembling and that their cost accounting systems had not undergone any changes.

Undoubtedly, selecting the right kind of industry for testing the viability of the substantial hypotheses of this research is very important. The following reasons explain why assembly and engineering industries have been selected in order to conduct this empirical study:

(1) Assembly and engineering industries are relatively more development than other types of industries in Egypt. The progress that Egypt has achieved in these industries is significant and therefore they are of great scientific research value.

(2) They are complex industries because their products usually consist of many components and parts. Consequently, they create a conducive environment in which sophisticated management techniques such as MRPI and MRPII can be applied. Therefore, both industries are worth researching.

(3) Egyptian ex-public sector manufacturing companies in general and engineering industries in particular suffer from relatively low inventory-turnover rates, and very low added-value inventory-turnover rates. Low inventory turnovers were responsible for low companies profitability in most years. For example, in the study of Mady of five types of Egyptian ex-public industries (textiles, food, chemicals, engineering, and metal), he concluded that:

> Manufacturing companies were turning their inventories in an overall average of 2.119 times a year with an average growth rate only 6.61 per cent every year. After an average growth rate of 8.77 per cent in the year 1981/82, the whole industry suffered setbacks bringing the inventory turnover rate (ITR) growth rate down to about 2.08 per cent in 1982/83 These growth rate figures might be misleading when compared with similar measures in other industrial nations. This is due to the fact that ITR is relatively very low in industry in Egypt. The 6.61 per cent growth rate is equivalent to an increase of only 0.094 turns every year. When compared with some industrial nations, the situation in Egyptian industry seems discouraging. It was reported that the inventory turnover rate averaged about 5.41, 6.75 and 7.86 times in Western Germany, USA, and Japan, respectively, during a period of 15 years starting in 1966. He indicates that the average growth rate during the same period was 5.45 per cent in Western Germany and 6.80 per cent in the USA. Japan was at the top with an average growth rate of 8.11 per cent every year. The recent statistics

show an improvement in the overall manufacturing sector in the USA, where inventory turns increased to 7.7 times in 1988 (Mady, 1990, PP. 24,25).

However, the significance of inventory in this type of industries is relatively higher than in the other groups. In another study, he indicates that among all inventory categories the raw materials and purchased components category deserves most attention in these industries. This creates a real need for more effective production planning and control systems. He also concluded that material-intensive companies tend to achieve a relatively low ITR. While it is hard to generalise, a close look at the distribution of inventory categories indicates that poor material requirements planning might be the reason behind the relatively low ITR in Egypt. Raw materials inventory accounted for about 62.75 per cent of the total inventory investments in the whole sample. Raw materials to total inventory ratio (RMR) was always more than 50 per cent in all industry groups ( Mady, 1991).

In the engineering industry group, he claimed the situation is even worse, averaging only about two inventory turns a year, although this type of industry was the one which achieved really remarkable progress of inventory performance development in most industrial nations during the last two decades.

In the automotive industry, while the average is about eight turns per year, most Japanese producers are doing above average with a considerable margin (Sodahl, 1983). Toyota achieved remarkable progress, with turnover rates reaching 38 times in 1985 and 1986 (Cusumano, 1988). These findings suggest that inventory and materials cost management might have a positive effect on profitability and productivity in the Egyptian industrial ex-public sector companies.

(4) The products manufactured by these industries are subject to development innovation and continuing modification to their designs and models. These products, especially automotive, face strong competition in the local and international markets,

particularly after the privatisation of these Egyptian industries in the light of market economy restructuring. While the products' environment is changing continuously, companies apparently use both advanced products and process technology, such as NC, CNC, CIM, FMC, and FMS in order to compete in the world markets.

(5) Any assembly and engineering industry depends on several other supplier industries. Therefore, the importance of this industry lies in the establishment of other supply chain industries. As a result, organising the material, parts and components flow is very important and requires a high degree of information flow in every part of the organisation.

(6) There are differences in profitability and cost, not only for each of the different types of finished products, but also for every kind of manufactured part or component. Due to the fact that there a lot of parts and components, companies need to know immediately the profitability and cost of each manufactured part for decision making purposes.

(7) These industries play a major role in the economic development of any state. They support development plans in Egypt through sparing foreign currencies which would be used to pay for importing alternative goods. On the other hand, the state gains revenue through foreign currencies by exporting the surplus of these products.

In order to determine the relevant case for this study, the researcher conducted a pilot study based on some Egyptian manufacturing companies in June 1997. Then, the researcher visited the research site for three months starting in June 1998. The formal permissions were issued by the Egyptian Education Bureau through the Egyptian Embassy in London. The researcher got formal permissions from the following Egyptian authorities in order to be able to collect field data: (see Appendix A)

(1) The Central Agency of General Mobilisation and Statistics;

(2) The National Security Agency;

(3) The Holding Company of Engineering Industries;

(4) Ministry of Higher Education (Missions Department);

(5) The president of the studied affiliated Company;

(6) The security director of the studied affiliated company.

The help of the Department of Human Resources, whose role is to guide and arrange for research students to visit the places from which data can be collected and to organise tours to the various plants and sites, was sought. This department then issued formal letters, based on the permissions obtained by the researcher, to the relevant departments in the studied company to facilitate the data collection process.

### 1.6.2 Data Collection

The research employed two substantial methods to collect the required data for preparing this study. Field data collection method (including documentary sources and personal interviews) and literature review method, both are explained below.

#### 1.6.2.1 Field Data Collection

This case study used the following resources for field data collection: (1) Semi-structured interviews, (2) field tours in the company's factories; the manufacturing processes in the factories were observed and understood through plants tours, (3) organisational charts of the company and factories layouts, (4) technical manual and conceptual design manual of the old-established cost accounting systems, (5) magazines issued by the company, (6) annual balance sheets and financial statements, (7) performance reports prepared for the Board of Directors and the Holding companies, (8) production and selling reports, capacity and cost reports, diagrams, statistics tables, brochures, bulletins and leaflets issued by the information centres at the companies.

The study was conducted in two phases. The first phase involved semi-structured interviews by using a questionnaire. The purpose of this phase was to pre-test the study's assumptions and to get feedback from Egyptian manufacturing companies visited, to select a case for detailed study. The results of the first phase were used to revise the questionnaire for use in the second phase. The case was selected in the Assembly and Engineering industries with different activities. The semi-structured interviews of the second phase were carried out for two purposes. First , they afford insight into actual company practices. This insight is often invaluable in the interpretation, conclusion and recommendation portions of research. Second, the semi structured interviews can be used as validation, or pilot test, taking into account the feedback and experience from the first phase. All interviews were recorded in writing and subjected to in-depth analysis. Several meetings and interviews were held at the case company during the field visit. These included the directors and the managers in different departments, with an emphasis on the General Administration of Supply and Planning, Factories Management and the General Administration of Accounts including the Cost Accounting Dept. Those interviewees were able to provide extensive information about the different systems that needed to examined.

The interview questions contain exploratory questions (see Appendix G). The spent time, in meetings with different interviewees, to discuss the interview questions, varied. The time was about six hours at one visit a day and repeated visits. The interview questions were discussed with all interviewees in the case study organisation during the field visitation. The questions were used to collect background data about the company and data of manufacturing environment, including data on characteristics of the manufacturing environment, for example assembly methods, engineering or manufacturing factories, products, layout type, production lines, production planning and control systems, and problems facing production. Also the semi-structured interview questions were used to collect data about cost accounting practices, including the current cost accounting system features: cost structure of the product, product costing methods, cost allocation methods and bases, the role of cost data for pricing and make or buy decision making and cost control systems, the relationship between the CAS and the other sub-systems in the company and is the relevance of the system in the new environment. Semi-structured interview questions were used to collect data about the new system including its components, subsystems, the conceptual framework, the new cost concepts, methods and the preparations preceding implementation, like using the computerised communication network. It is worth mentioning that unstructured and informal talk with various individuals, inside as well as outside the company, elicited information of great significance, helping to develop the researcher's awareness and understanding of phenomena related to the study.

#### 1.6.2.2 Literature Review

A review of literature review on operations management was conducted to explore the changes and the characteristics of the manufacturing environment with emphasis on the developments in the systems of production planning and control. A review of literature on cost accounting was conducted, covering the developments in cost accounting systems. Thus the following main topics were reviewed:

- Characteristics of the old manufacturing environments

- Production planning and control (ROP, MRPI) in the old manufacturing environment
- Difficulties of production planning and control (PPC)
- Characteristics of the new manufacturing environments
- Customer-oriented manufacturing systems
- Advanced manufacturing technology (AMT)
- Production planning and control (MRPII, JIT, TOC) in the new manufacturing environment
- Understanding factors leading to change CAS
- Traditional cost systems (ACS, VCS) in the old manufacturing environment
- Effect subservience of the traditional cost accounting system to financial accounting
- The traditional general model of cost accounting
- The sophisticated cost accounting systems (ABC, TA)
- Developing cost accounting systems for MRP and JIT settings
- JIT; value chain and strategic cost management

## 1.7 Case Study Approach

### 1.7.1 Why is a Case Study Approach Used in This Study?

This research uses a case study approach to conduct the empirical study. This method is the suitable approach for this study, because this study is, by nature, exploratory. Undoubtedly, the case, written from an actual company's experiences, explores the properties of cost systems and how the design of the system determines the type of information management received about products and production processes.

> Because management accounting information is created to plan, co-ordinate, motivate, and evaluate activities in complex organisations, research in the field must start with an excellent understanding of the management accounting processes in actual organisations. Since management accounting phenomena exist only in complex organisations, with their rich interaction of people, products, processes, markets, technologies, and cultures, it becomes extremely difficult to study the subject except in actual organisational settings; management

accounting systems must be studied in the settings where they have been developed and where they function. (Bruns and Kapaln, 1987, PP. 1, 2).

A case study approach has been adopted to explore the old and new manufacturing environments; also, to explore the current cost accounting system and any changes implemented or planned. Although a given company's situation may be unique, some of the findings may be generalisable to other companies in similar conditions, but the goal is not to make statistically valid generalisation about the population.

Because this study seeks to describe and explore reasons for current cost accounting practices, the objective of the researcher goes beyond pure description to involve interpretation and explanation the reasons for the observed practices. The practices studied may be existing practices or new and innovative practices developed by the company.

#### 1.7.1.1 Benefits of Case Study Research

The researcher selected a case study to examine the research phenomenon for the following reasons as mentioned by Simon et al., (1996, P.38,39):

(1) A case study can incorporate several different methods, including participant observation, formal and informal meetings and examination of documentary material. These have enabled the author to obtain information on company policies and strategies. The use of interviews allows the researcher to gain rich insights to issues with which are normally not amenable to questionnaires. The interviews enable people to tell "real" problems, and observation permits the researcher to see, analyse and interpret real activities.

(2) Often, much of the information to which the researcher has access in case study research is confidential.

(3) A case study research is characterised by flexibility. Mail questionnaire questions can not be modified or clarified once the questionnaire is sent. The personal interview allows the researcher to explore additional questions that could be related the topic. He becomes very close to the people and activities and he can ask questions in another way to obtain clarification.

(4) Case study research leads to a higher degree of reliability than can be obtain by survey questionnaire particularly in developing countries such as Egypt. Respondents in such countries do not have awareness of the importance of scientific research, due to weakness their cultural and educational background and may not care to reply or have difficulty interpreting and understanding the questions in a survey. The researcher heard this from some managers in some companies visited in the pilot study.

(5) Analysis of case study data is guided by research propositions or questions. In the author's own case, the material has been largely exploratory, with subsequent analysis focusing on conceptual development.

(6) A case study research enables the researcher to get the 'feel' of what people really think about and what it has done for them personally. It also allows the academic to acquire ideas for future work.

(7) Case study work is a method of learning. It helps bridge the gap between academia and industry. Each side has the opportunity to learn from the other. Some definitions and terminology do not have the same meaning for both academicians and practitioners.

(8) Personal contact enables long-term relationships to be maintained, permitting longitudinal material on organisations to be documented and observation of the development of the phenomenon over a period of time.

(9) Case research enables varying perspectives from a range of organisational personnel on selected research focuses to be developed. Questionnaires usually reach only one

person, whereas an extensive case study programme can involve many interviews with a cross-section of people.

(10) Case studies often unearth new issues, insights, rich picture and directions in the research focus which can then serve as the basis for further work. Thus, they can be exploratory in nature and can help generate theories.

#### 1.7.1.2 Difficulties Associated With Case Study Research

However, there are some challenges with case study research, which the researcher could face:

(1) It is difficult to communicate the wealth of information and understanding acquired. It also may suffer if there numerous interpretations for the problem investigated.

(2) Conclusions may be statistically limited in that often only a handful of cases are used to generalise about certain research questions. This problem is compounded where host organisations for the cases are considered to be at the forefront of the particular phenomenon investigated. Alternatively, where several cases in different organisations focuses on a similar theme, more reliable conclusions can be drawn. For example the current research involved seven small plants of a large organisation located in the same city/region, enabling comparisons and contrasts to be made.

(3) Cases capture the experience of an organisation only at a particular period in time. Changes take place which make conclusions reached in a case dated.

(4) Caution needs to be exercised in gaining the trust and support of host organisations. The researcher is given a high degree of access to company documents and personnel based on a formal permission from the authorities. People at lower levels in the organisation, when interviewed, might be reluctant to be open with comments. They

might consider those comments likely to reach management. Dealing with this difficulty requires tact.

(5) Selection of a suitable time period to carry out the research is very important. Companies are very busy at some times of the year, particularly when preparing the financial statements, so, people can not spare enough time to hold discussions and meetings with the researchers.

### 1.7.2 Case Study Categories

Some authors (Spicer, 1992) classified Case studies into two major groupings. The first grouping includes those studies that have a descriptive and/or exploratory purpose. In cost or management accounting these are case studies that seek to describe and/or explore reasons for particular accounting practices. In many cases the objective of the researcher will go beyond pure description to involve the generation of ideas and hypotheses about the reasons for the observed practices. The practices studied may be existing practices or new and innovative practices developed by particular companies. The second grouping is made up of those studies which have an informing and/or explanatory purpose. In cost or management accounting these are case studies that are used either indirectly to help inform other forms of non-case empirical research or directly to explain the reasons for observed practices. However, it is important to note that the separation between these two groupings is not a rigid one.

The distinction between exploration and explanation can be quite ambiguous, because an exploratory study may be concerned with generating ideas to inform the basis for an explanation of accounting practices. However, a case study approach is a valid method not only for explorative studies but also for studies aiming at explanation and prediction, understanding and change (Scapens, 1990).

The discussion of how theory can be induced through case study research also makes the overlap and interaction between these two groupings apparent. Still, in the final analysis, it is the intention of the case researcher which determines which classification is most appropriate for a particular study (Eisenhardt, 1989).

Case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context. Such 'exploratory' case studies also can be complemented by two other types -'exploratory' and descriptive' case studies. Regardless of the type of case study, investigators must exercise great care in designing and doing case studies, to overcome the traditional criticisms of the method. Some types of 'what' questions are exploratory, the goal being to develop pertinent hypotheses and propositions for further inquiry. In contrast, 'how' and 'why' questions are more explanatory likely to lead to the use of case studies (Yin, 1989).

Yin stated that if the case study is an explanatory one, the patterns may be related to the dependent or the independent variables of study (or both). If the case study is a descriptive one, pattern-matching is still relevant, as long as the predicted pattern of specific variables is defined prior to data collection.

## 1.8 Organisation of the Thesis

The study is organised in two parts: Part One, the theoretical study contains two chapters. Chapter Two discusses changes in the manufacturing environment, while Chapter Three investigates the traditional and innovative cost accounting systems. Part Two, the empirical study, includes seven chapters. Chapter Four deals with the background of the transition effect of Egyptian economy on the ex-public sector's manufacturing environment and of the competitive setting of Egyptian automotive industry. In Chapter Five we discuss the manufacturing environment and the production problems facing at the company in their relation to the manufacturing and cost. In Chapter Six the author investigates the current cost accounting practices at the company and evaluates the relevance of the existing systems. Chapter Seven explores how the company has installed an integrated cost and production system, in order to overcome these production and cost problems. Chapter Eight presents measurement and analysis of the production capacity and highlights the importance of make or buy decisions. In Chapter Nine, the author presents suggested a model to develop the OMAC system by filling the gaps left by it, to assist the company to be successful. Chapter Ten is concerned with the summary and conclusions, including limitations and recommendations for developing cost accounting systems.

## 1.9 Limitations of the Study

External validity does not exist in this study, because the results of the study can not be statistically generalised. The goal is not to make statistically valid generalisation about the population. Although a given companies' situations may be unique, some of the findings may be generalisable to other companies in similar conditions.

This study was at the company level with a comprehensive survey in the different departments and plants inside the company. Data were gathered through interview with the key individuals in the different departments and plants at the company. Data were also collected formally from published and unpublished sources. Personal relationships played a significant role to overcome some difficulties that faced the researcher during the process of collecting from un-published sources.

# PART I

# LITERATURE REVIEW

# Manufacturing Environment

The manufacturing environment is undergoing many significant changes. The mass production model is being replaced by a flexible multi-product enterprise that emphasises quality and quick response to market demands while utilising technologically advanced equipment and managerial philosophies. Approaches like Material Requirements Planning (MRPI), Manufacturing Resource Planning (MRPII), Theory of Constraints (TOC) and Just-In-Time (JIT) are quite clearly, like process technology, change the way the factory can be managed.

In this chapter, the developments in the manufacturing environment will be discussed. In addition, the distinction between the old and new manufacturing environments will be addressed. The aim of this comparison is to explore the characteristics of such environments and their implications for cost accounting systems.

## 2.1 The Old Manufacturing Environment

### 2.1.1 Production Systems in the Old Manufacturing Environment

Types of production system can be used to distinguish between the old and the new manufacturing environments. The origins of the currently used typologies of manufacturing processes can be traced back to the work of Woodward (1965). Woodward used three primary categories: small batch and unit production; large batch and mass production; and process production. Hayes and Wheelwright (1979a, 1979b) used four categories: job shop, batch, assembly line, and continuous flow. In this classic categorisation, many of the characteristics of productive units are a function of two primary dimensions with complementary life cycles - process structure and product structure.

In the manufacturing literature, the relationship between the process structure and product structure is often expected to provide a basis for exploring some of the strategic options from a manufacturing perspective. Accordingly, it might be used as a basis for the distinction between an old and a new manufacturing environment. Thus, job shop and batch systems would presumably be considered old technologies, while assembly line and continuous flow would be regarded as new technologies (Dirks, 1997).

The two 'old' production systems are discussed below.

#### 2.1.1.1 Job Shop System

A job shop manufacturing business contracts to make order custom products in accordance with designs supplied by the customer. A make-to-order producer completes the end item after receipt of the customer's order for the item. If the item is a unique, custom-designed item, the customer will probably have to wait for many of the materials to be purchased and for the production work to be performed, because the producer cannot anticipate what each customer might want and have the necessary raw materials and components on hand to shorten the production lead time. If components or materials are frequently used by the business, however, the producer may keep some of them in stock-particularly if the lead time to purchase or produce these items is long.

Typically the volume of each product is low, so these companies must contract to make a wide variety of products in order to achieve a sufficient level of sales. To increase the chances of making sales and to maintain a sufficient volume of business, these factories need to general-purpose equipment that can perform a broad range of operations and employees who have a broad range of skills. Job shops are generally classified as high-variety, low-volume manufacturing.

Each job may be unique, requiring a special set of production steps performed in a particular sequence (a 'routing') to convert the raw material into the desired finished item. The next item may require a totally different sequence of production steps from the previous one. Consequently, there is no standard path of material flow through this type of facility. Materials-handling equipment should be flexible, with the capability to move various sizes and shapes of objects along widely varying paths. Flexibility is important in this business. These companies face a big challenge in planning, scheduling, and co-ordinating the production of numerous components of a wide variety of unfamiliar products. Job shops may carry an inventory of some raw materials that they use frequently, but often the largest percentage of their inventory is work in process that accumulates between process stages because of the sporadic material flow. Examples of job shops might be a drapery shop, a woodworking shop, bespoke tailors, shipper builders, and a metal fabrication shop. A process layout is best suited to a job shop manufacturing environment (Dilworth, 1992; Singh and Rajamani, 1996).

The term 'process' (or sometimes 'functional') is applied to layouts where facilities of a similar type are grouped together in a recognizably separate work area, or department. This type of layout is well known, and widely used in engineering. The use of the term 'shop' (and sometimes 'department') in such words as 'press shop', 'welding shop' and 'machine shop' serves to indicate the grouping of similar facilities in one area (Evans and Ford, 1984). These areas usually formed the basis of cost centres in the traditional CAS.

#### 2.1.1.2 Batch Production System

A batch manufacturing facility makes some intermediate variety of products and produces intermediate volume of each. The volume of any one item is not sufficient to justify dedicating a set of equipment to its production, so a few or several products share the production resources. The company will make a batch (production run), which may be less than a hundred or up to a few thousand of one product, then switch over the equipment and make a batch of another item. Eventually it will repeat production of the items (Dilworth, 1992). Batch production systems have in common one special characteristic: all the items or components in a particular batch are put through a specific operation before all are moved on to the next operation. Each batch thus assumes a separate identity, and is often individually labelled or ticketed (Ibid).

Intermittent production systems consisting of small batch and large batch operations represent a large proportion of all manufacturing activity in industrialised countries. Bessant and Haywood (1985), for example, estimate that up to 70 percent of all components in the engineering sector are made in batches of less than 50; and Gerwin (1982), suggests that batch production accounts for over 35 percent of the manufacturing base of the U. S. Although batch production is usually considered in the context of engineering establishments, it should not be forgotten that it is also prevalent in many other areas such as the clothing, plastics, ceramics, and woodworking industries. Small batch manufacturing typically emphasises obtaining and filling individual orders for varied products in lots of 100 or fewer per year. These are typically produced using general-purpose machines controlled by highly skilled workers. Large batch operations involve production runs of the order of 100-10, 000 units per year with frequent product-line changes (Wall et al., 1987).

Production equipment in batch manufacturing must be capable of performing a range of tasks, but the variety of possible operations is much narrower than in a job shop. Attachments and tooling may be installed (that is, the equipment is 'set up' ) to run one type of item. After a batch is completed, the equipment may be set up anew to run some other item. The ability to change back and forth quickly is important in this type of production system. A company may achieve a high degree of focus (that is, reduce the range of changes it must make) if it runs families of items that require the same or nearly the same processing steps. The paths of material flow may vary if the company does not have a high degree of focus. If there is focus, however, the flow paths may be identical and the materials-handling equipment can be more specialised, perhaps automated (Reeve, 1991). Batch production system requires extensive in plant co-ordination, inspection, balancing, and change activities.

### 2.1.2 Characteristics of the Old Manufacturing Environment

#### 2.1.2.1 Using Hard Automation in the Old Factories

In the old manufacturing environment, technological and market opportunities were the major environmental factors driving the evolution of manufacturing from craft shops to industrial systems using hard automation. The old manufacturing was primarily driven by technological opportunities for mass production; mass markets for standardised products were an important enabling factor. The old manufacturing was technology driven and market enabled. The old factories were an efficient means of producing a narrow range of products, but they had problems achieving continuing innovation in products and processes (Doll and Vonderembse, 1992).

Initially, industrial entrepreneurs with an integrated view of product and process technology organised and built high-volume manufacturing facilities designed to use inflexible resources in a sequential work flow to produce low-cost standardised products. These high-volume production facilities required customer acceptance of low-cost, standardised products. In the transition from a craft to an industrial environment, product-oriented long-linked technologies, with their superior efficiency in the production of standardised products for mass markets, became the dominant manufacturing pattern. Using a command and control approach, these systems excelled in substituting capital for labour, achieving economies of scale in mass markets, and controlling increasingly complex manufacturing systems A pattern of task-specific innovation improved the productivity of labour. However, as direct labour was reduced, further improvements in productivity required more integrative innovations (i.e. innovations that involve simultaneous changes in a variety of activities across the value chain).

The physical processes, methods, techniques, tools and equipment of production evolved in ways which improved efficiency, but resulted in a more inflexible manufacturing system which could not respond effectively to customer needs. Organisations that continued to employ long-linked industrial systems lost market share as competing firms segmented the market. However the saturation of mass markets, intense international competition and changing consumer tastes threatened mass-production during the 1970s, resulting in a growing mismatch between the marketing requirements and manufacturing capabilities. Many manufacturers responded by increasing their product range and the number of options available. This satisfied market demands but increased the cost and complexity of manufacturing (Hill, 1985). As a consequence in the 1980s many American and European manufacturers reduced their product ranges in order to simplify production and facilitate automation:

Companies, including manufacturers of appliances, auto, copiers, and cameras are following this approach of simplifying and focusing product offerings (Schonberger, 1986). Technological economies of scale have never been strong in industries that produce highly differentiated products.

### 2.1.2.2 Complexity of Process (Functional) Layout

> The layout of multi-product batch manufacturing systems is traditionally designed on a functional basis, with the machine park divided into a set of work centres, where a work centre is a set machines functioning similarly. In a typical functional system, batches of various parts flow between different work centres for the processing of their operations (Zahran et al., 1992, P. 24).

Products are produced in large batches so as to minimize the set-up times when machine settings are changed between processing batches of different products. Batches move via different and complex routes through the various departments, travelling over much of the factory floor before they are completed. Each process normally involves a considerable amount of queuing time. In addition, much time is taken travelling units from one process to another. The effects of this complex routing process are high work in progress levels and long manufacturing lead times.

A functional plant layout requires products to be moved from one group of like machines to another, often across the manufacturing plant or even to another building. This results in extensive material handling costs as well as increased work-in-process inventory (Howell and Soucy, 1987). In addition, the independence between workstations mean that the work in each one is independent from the work in the other workstations. Independence streams from the traditional philosophy that says that it is necessary that each workstation is busy all the time. So a manufacturing organization is planned to hold inventory buffers between the workstations. The objective of this is to make the work inside the workstation continuous. One of the consequences of independence is that communications between all work teams in a company are non-existent. This means that the production does not flow smoothly and lead times are long. Therefore, this system is unresponsive to demand and can not be changed quickly.

Companies that have higher work-in-process inventories than their competitors are at a serious disadvantage for a variety of reasons. Cycle times and lead times decrease almost automatically with reductions in excess work-in-process inventories. In addition, large work-in-process inventories make it difficult to track down the causes of defects and correct them before further damage can be done. Quite often defects are caught only at the final inspection point, after the last operation. If work-in-process is high and cycle times are long, a defect may be undetected for weeks or even months. To remain competitive in the market, a company with higher work-in-process inventories than competitors probably also will have to expedite orders more frequently. This may involve additional spending for items such as overtime, to meet the delivery date. (Noreen et al., 1995).

### 2.1.3 Production Planning and Control (ROP, MRP) in the Old Manufacturing Environment

In traditional manufacturing, an item is released for production at a specified time, with an associated due date. The item moves through a sequence of operations. When one operation is finished, the item is "pushed" to the next operation. Finally, the product is pushed to inventory, to meet forecast demand. Two types of push system of production planning and control are used, in practice, in the old manufacturing environment: the reorder point (ROP) system and the MRPI system. The ROP system, also known as an order point or replenishment system, attempts to:

> plan a replenishment time by forecasting the average rate of demand during the standard lead time, and calculating a 'Reorder Point' or an 'Order Review Point' including both this expected demand and a 'safety stock' (Plossl, 1973, P.66).

ROP is deficient because the order point is determined based on historical demand, resulting in orders being placed regardless of known or expected changes in future demand (Schonberger, 1980). In addition, ROP suffers from the same problems noted for MRP below.

MRPI attempts to correct the deficiencies of ROP by taking known and expected changes in demand into account and uses back scheduling (also referred to as 'lead time offsetting') to develop production plans.

> An MRP system consists of a set of logically related procedures, decision rules, and records designed to translate a master production schedule into time-phased net requirements, and the planned coverage of such requirements, for each component inventory item needed to implement this schedule. An MRP system replans met requirements and coverage as a result of changes in either the master production schedule, or inventory status, or product composition (Orlicky's 1975, P21).

MRPI was considered such a significant improvement in operation management that in 1971 the American Production and Inventory Control Society (APICS) undertook what it called 'The MRP Crusade.' By 1980, however, and in spite of some degree of success, disillusionment was starting to set in: '...never in the history of manufacturing control has so much been proclaimed and expected and so little actually delivered' (Plossl, 1980). Plossl criticised the fact that most users manage operations by focusing first on MRPI, which is only priority planning, and then work on developing a valid master production schedule and plan capacity, both of which should logically be done before priority planning (Ibid). Other criticisms include "system nervousness", i.e. the fact that minor changes in the master production schedule can cause significant changes in MRPI plans (Vollmann and Berry, 1992); lack of adequate methods to check the capacity feasibility of MRPI plans; and long planned lead times, resulting in excess inventories (Hopp and Spearman, 1996).

The underlying causes for the failure of MRP to deliver promised benefits in many cases are discussed by a number of authors. Plossl (1980) states that bad plans are common. Master schedules are overloaded or front-ended, records are inaccurate, and real limitations on capacity are ignored. He suggests that MRPI cannot be expected to work until basic problems such as late vendors, tooling and equipment breakdowns and excessive scrap are addressed. Schmenner (1993) cites the need for accurate forecasts of demand (with no last minute changes allowed), precise bills of material, accurate inventory records, accurate standard times, accurate routings, restricted access to storage areas, and realistic understanding of what production capacities are. (It should be noted that both ROP and MRPI answer the questions of when to order and how much to order; however, they do not address detailed sequencing of jobs or loading of work centres. These functions are addressed by shop floor control, also known as production activity control. In many cases, the terms MRPI and ROP are taken to include some form of shop floor control.)

Plossl and Wight stated the three major aims of the manufacturing management of profit-seeking firms as: (i) efficient plant operation, (ii) maximum customer service (i.e., on-time delivery), and (iii) minimum inventory investment. The implication is that a properly functioning ROP or MRPI system should accomplish these objectives. It might be argued that an assumption underlying the first and third of these objectives is that savings at the plant or inventory level translate into increased profit for the firm, or, in other words, that achieving local optima would result in a global optimum. Other significant criticisms of ROP/MRPI are this focus on local optima and the fact that MRPI, while it considers more information than does ROP, still does not consider the existence of constraints in the development of production plans (Goldratt, 1990).

#### 2.1.3.1 Difficulties of Production Planning and Control (PPC)

Production control is concerned with determining the need for components and materials and planning orders to fill these needs. Capacities that will be required at the various work centres to carry out this load of orders must be determined in order to find out whether the schedule is feasible and whether adjustments should be made in these capacities by authorising overtime, subcontracting, hiring, layoffs, or other means. Once job orders are released, their progress must be monitored, and priorities must be updated with changes in demand forecasts, customer orders, and schedules for final products (Smith, 1989).

The complexity of production control is dependent on the number of production operations and moves that have to be planned and controlled. Production control is very complex in a plant that manufactures products with thousands of components, such as automobiles. Several thousand production orders may be open at one time, and a separate routing must be provided for each order. The number of operations to be performed may average a dozen or more per order. So each of tens of thousands of production operations and moves must be planned and controlled.

A discrete part manufacturing system, in contrast to continuous process manufacturing where the product is in disjunctive, produces parts in different lots to orders. PPC for discrete part manufacturing processes is difficult for a variety of reasons: many different parts may be processed at the same time; these parts may require different processes, tools, fixtures, technological routes etc.; even identical parts may take different routes through the system due to dynamic scheduling problems; perspectives of monitoring may change in time (e.g. between orders and resources). The scheduling objectives and constraints can be characterised as dynamic and time varying in nature. For discrete part manufacturing it is hard to visualise a steady-state equilibrium which is naturally assumed in the case of controlling a continuous process plant (Szelke, 1998).

> In the discrete-product manufacturing industries, complex problems are encountered in achieving the same level of automation because of the difficulties in processing, assembling, handling, and inspecting a diverse mix of products. What makes manufacturing difficult in the multi-product situation is the huge amount of information that must be processed for each different product made. Each component in the product has its unique geometry specification (i.e., an engineering drawing or a geometric model in a CAD data base), material definition, and processing route sheet. For the product itself, there are parts lists, operating specifications, assembly drawings, and so on. Production schedules must be formulated, materials must be ordered, labour and equipment must be planned, and so it goes. Multiply these data by the number of different products manufactured in the plant, and the amount of information that must be generated and managed in the plant is substantial. It has been estimated that only about one-eighth of the people in the factory are directly concerned with processing the product, while the remaining seven-eighth are handling and processing information. It is the information system in the future factory that will implement the control function in manufacturing (Groover, 1987, P.779).

Scheduling is used to co-ordinate purchasing, manufacturing and sales. The nature of the production flow, however, leads to significantly different scheduling uncertainties. For example, flow shops possess sequentially linked machine centres and less varied production, and are easier to schedule than job shops. For most flow shops, an easily identifiable fully loaded (bottleneck) department determines short-term scheduling capacity. Job shops, on the other hand, present a more difficult problem as they produce a variety of products. In these situations, bottlenecks float (i.e. move among departments) as the demand for products changes. The traditional solution - a push system - 'pushes' more jobs i.e. Work-in-progress (WIP) on to the shop-floor to ensure that all work centres are busy. This strategy leads to many other problems, including long due dates and job expediting. As expedited jobs are pushed through the shop, economies that could be realised by batching are lost.

## 2.2 New Manufacturing Environment

### 2.2.1 Customer-Oriented Manufacturing Systems

Manufacturing has entered a new era, created by the convergence of two important forces: (i) increasingly complex, changing, and uncertain markets and (ii) the rapid spread of manufacturing capabilities world-wide. The market and competitive forces of this new era are changing our concept of manufacturing. Manufacturing is increasingly viewed as an enterprise, i.e. a complex chain or network of interdependent value-adding activities starting with the preparation of raw materials, through fabrication and assembly, to distribution and after-sale service. The successful competitors are becoming service- or customer-oriented (Chase and Garvin, 1989). These firms seek continuous improvement by co-ordinating a continuing stream of product and process innovation across their value chain. (Tidd et al., 1997).

Thus, the perspective of manufacturing has changed to include structures and processes which are appropriate for a new environment which place new demands on manufacturing. Increasing market variety and uncertainty, rapid developments in product and process technology, advances in information technology, and increasing global competition will require work and control systems that enable manufacturing to be innovative as well as efficient (Baden and Pitt, 1996). Early developments focused on process control in continuous-flow industries and the automation of specific tasks (i.e. islands of automation) in discrete-part manufacturing. Over time, the emphasis has shifted to the design of flexible and integrated systems for discrete-part manufacturing.

In the new environment, rapidly changing customer requirements and increased competition are forcing manufacturing enterprises to be more customer oriented. The effectiveness of the new manufacturing will require continuing, innovative and holistic responses to multiple measures dictated by shifting customer expectations and competitive alternatives. As the value to customer orientation encourages a swifter response to customer desires, the new manufacturing develops norms focusing on shorter product development and throughput time. This is often referred to as time-based competition (Schmenner, 1988; Stalk, 1988). In this environment, the work system is characterised by flexible capital intensive resources, and information-intensive intellectual work. Success in a new environment depends upon the enterprise's ability to anticipate markets and respond quickly and efficiently with products that provide high value to customers. Responding quickly to changing markets would be difficult without enabling technology. If applied correctly, computer and communications technology can help create an information-rich environment for reducing product development and throughput time (Day et al., 1997).

Advanced manufacturing technology is permitting the design of flexible manufacturing systems that can respond quickly and efficiently to shifting customer requirements. To be competitive, the enterprise must be innovative as well as efficient. Indeed, it must be innovative to be efficient. Innovation must be customer oriented (i.e. driven by a value system that emphasises value to the customer). The enterprise seeks efficiency quite differently than does an industrial system. First, it focuses on economies of scope (Goldhar and Jelinek, 1983) rather than economies of scale. Second, it encourages learning and improvement in self-directed work groups across the value chain rather than task-specific cost savings. Innovation focuses on collaborative efforts within the firm and with suppliers to identify interdependent activities across the value chain that can be changed in ways that add value to the customer and/or reduce cost. A shared understanding of customer needs and applications enables participants to consider the value of the activities to the customer as well as their cost. Trade-off decisions are made in accordance with customer preferences.

Customer demands for new and different products have increased product variety and accelerated the rate of market change. Changing customer expectations and competitive alternatives have also made markets more uncertain. The customer-oriented systems of the new manufacturing era tend to adopt a technology pull approach to innovation, where an assessment of changing customer needs drives the selection of product and process technologies. In the enterprise, product design and process selection are often approached simultaneously to shorten product-development time. In this advanced manufacturing environment, organisations can often compete effectively by focusing on customers and satisfying their needs by successfully implementing readily available generic technology.

However, this technology pull strategy depends upon the work force's intellectual ability to identify and implement technologies that enhance the value of the firm's activities to the customer or reduce cost.

### 2.2.2 Advanced Manufacturing Technology (AMT)

AMT defined as:

> any new technique which, when adopted, is likely to require a change not only in manufacturing practice, but also in management systems and the manufacturers approach to the design and production engineering of the product, this is invariably computer-related (Coulthurst, 1989, P. 30).

AMT will result in establishment of many new industries structures and/or restructuring of many existing industries structures, in general restructuring the internal and external relationships of manufacturing organisation. Also it will change bases of competitive advantage by making significant improvements in product, process, and shop-floor capabilities. AMT are rapidly expanding into most functions of manufacturing, including design, fabrication, assembly, planning and control. They can basically alter how manufacturing organisations produce products, the relationships with suppliers, customers, and support personnel. (Berliner and Brimson, 1988).

#### 2.2.2.1 Process and Product Technology

Process and product technology provide a basis to distinguish the new manufacturing environment. Product technology requires making changes in existing structures. For instance, advances in product technology, resulting from expanded features or new materials, can make companies unable to produce new products with their existing manufacturing facilities. As these products replace the current product line, firms which do not upgrade their manufacturing capabilities cannot compete in the marketplace. Process technology, on the other hand, enables companies to gain a competitive advantage through excellence in manufacturing (Ibid).

For some authors, product technology is more important than process technology.

> The process technology include the machines, equipment and devices which help the operation to transform materials, information and customers in order to add value and fulfil the operations strategies objectives. All operations use process technology, even the most labour-intensive. If product and process technologies can sensibly be separated in an operation, they will not always receive equal attention. Sometimes developing product technology will be seen as more important than developing process technology and sometimes vice versa. One factor which influences this is the stage of the product on its life cycle, that is the maturity of the product. (i.e. how the relative rates of product and process technology innovation vary as a product matures (Slack et al., 1995, PP. 293,294).

### 2.2.3 Flow Line Production System

The term 'product' (or sometimes 'line') is applied to layouts where all the facilities applicable to one product are laid out in a line, or sequence. If a company produces a high volume of one or a few items, the facility can be arranged to achieve efficient flow of materials and lower cost per item.

The drawbacks of the Functional/ Process-type layout were indicated in the section on the old environment. Imagine the problems associated with increasing the size of batches from, say, 100 to 100 000: handling between departments, storage and work in progress become serious and expensive matters to cope with. More and more space would be required, but, particularly in urban areas, it is not only expensive but often impossible to expand the total floor area. One answer lies in adopting better work-handling methods-conveyors, lifting tackle, quick-action work clamps, etc. Second, machines can be placed closer together, avoiding the waste of time, effort and money in trundling partly finished items round the factory. Not only is space saved, but the WIP is greatly reduced (Howell and Soucy 1987).

Special-purpose equipment that quickly and reliably performs a specific task is purchased for each production step needed to convert the input material to the desired end item. Internally produced components or subassemblies should be made near the locations where they are used in the process. Purchased items should be delivered to the locations where they are to be used. If items must be stored, they should be stored close to their point of use. Since the sequence of work tasks required by the product dictates the layout, this arrangement is sometimes called layout by product. It is also called a flow line, production line, or assembly line. The flow path does not have to be a straight line; it might be one of several shapes, if one of these arrangements better fits the situation (Dilworth, 1992).

In product layouts, facilities are arranged in the sequence of operations required. Depending on the type of product, these layouts may be flow-type or line-type. Flow-type layouts are related to continuous production, such as in the chemical industry. Line-type layouts, however, are associated with discrete manufacturing such as in the automotive industry. Product-type layouts require special-purpose equipment, and investment in this equipment is high. If the product changes, it may require changes in the layout, which may be costly. This one of the reasons why flexibility is very low in such layouts. The labour skill requirement is low as most of the tasks are simple and repetitive. Sometimes this can result in motivational problems.

Since there is a fixed path of travel and a large volume of items to move, an investment in automated materials-handling equipment is often justified. Material flow is smooth, simple and logical. Production control is therefore simpler for product layouts. Accordingly, material handling requirements are reduced; manufacturing lead times are shorter and inventories lower. However, the systems requires highly reliable equipment since failure at one workstation may cause the stoppage of the whole line (Singh and Rajamani, 1996).

#### 2.2.3.1 Flexibility in Production Lines:

Factories, in the new manufacturing environment, install a flow line production system. Traditionally there has been a great deal of mechanisation and fixed automation in production lines. A high volume of standard items will often provide sufficient utilisation of dedicated equipment. Special purpose equipment might be designed and built if the volume to be produced is very high. For lower volumes or where standard production equipment will serve the purpose, special tooling is installed on a machine to enable it to perform a specific operation. It would be a lengthy task to change such a line to make a slightly different item. Each machine would have to be stopped, the tooling would be unbolted, then new tooling would be installed and adjusted to perform a new operation. Traditional production lines had little flexibility to change products.

In the new environment, programmable automation has improved the flexibility of machine tools and has made possible flexible production lines that can be changed over ('set up') much more quickly (Dilworth, 1992). Flexibility of product line means the ability to produce more products. This means that no manufacturing process will be assigned to a specific product. For example, traditionally discrete parts manufacturing was generally done in batch or assembly line environments. However, with the introduction of flexible manufacturing system (FMS) concepts, these structures now share some of the same characteristics of continuous flow environments and some of the characteristics of job shop environments (Kotha and Orne, 1989; Dirks, 1997).

However, rapid developments in manufacturing and information technologies will require planning and control systems that enable manufacturing to be efficient.

### 2.2.4 Production Planning and Control in the New Manufacturing Environment

#### 2.2.4.1 Using Computer Technology in developing Production Planning and Control (PPC)

Conventional scheduling and control approaches have severe limitations when implemented in live shop floors. This is because they lack abilities to address the multifaceted goal structure and the transient/dynamic nature of live shop floor processes (Szelke and Kerr, 1994), i.e., to achieve the required level of fidelity in modelling the controlled manufacturing environment.

> In complex multiple-product, multiple-product-stage settings, with continually changing demands and product characteristics, companies are finding it necessary to implement computer-based inventory management systems such as Materials Requirement Planning (MRPI) and Manufacturing Resource Planning (MRPII) systems....Management accountants should master these more sophisticated, and computer-based, production scheduling and inventory management procedures if they wish to provide relevant cost information (Kaplan, 1995, PP. 105,106).

The first attempt to improve production planning and control on the shop floor was

Manufacturing Resource Planning (MRPII). MRPII was developed by using computer technology in planning and control not only for material requirements but also for all manufacturing and non-manufacturing activities.

> In the new environment, production planning and control (PPC) has virtually become unthinkable without computer-aided information technology. As the increase in manufacturing competitiveness forces companies to use more sophisticated and complex software, system performance depends on clever system design and efficient real-time scheduling and control of the related processes on the shop floor. Companies with advanced manufacturing systems operate in complex environments rife with uncertainties. Some external/environmental uncertainties arise from changes in customer request dates/qualities/quantities or some late deliveries by suppliers. Many internal/executing uncertainties occur due to the breakdowns of machines/equipment, operator absence and erratic production yield (Szelke and Markus, 1994b).

Success in meeting the actual targets of production will depend on the reliable performance of processing equipment. In today's manufacturing systems, these technologies will not work as stand-alone units but depend on each other's behaviour in a complex manner. Manufacturing systems of such complexity have unfortunately in many cases shown unsatisfactory performance. It is an observed fact that many companies have to re-schedule a high percentage of their scheduled and prepared manufacturing activities (Na, 1990) due to the rapidly changing production goals and constraints on the factory floors. Good performance depends on clever system design, on efficient scheduling and on competent real-time running of the system.

A wide variety of real-time scheduling and control systems are used in manufacturing practice today (Villa, 1991; Harmonosky and Robohm, 1991). For example, MRPII, first introduced by IBM in 1970, essentially substitutes better information systems for excessive inventories. MRPII schedules production through the factory so that managers no longer require excessive WIP to compensate for scheduling problems between work centres. MRPII co-ordinates the flow of materials by releasing work orders for parts to the factory based upon a master production schedule, and the current number and location of parts in the factory.

(Maskell, 1989; Mackey and Thomas, 1995; and Singh and Rajamani, 1996).

The MRPII program records the number of inventory components in each subassembly along with time standards for moving, waiting, setting-up and running each component. This information allows production to be time-phased, or co-ordinated, so that at the final assembly, all components are available. Additionally, the aim of meeting the due dates for component arrivals in specified departments encourages shop-floor discipline. Because missed due dates result in idle departments, however, minimum WIP levels may still be maintained (Mackey and Thomas, 1995).

In a survey conducted by Smith (1989) of 1,123 companies using MRPII, the results revealed the benefits that can be achieved. Focusing on the 8 percent of respondents classified as Class A users (those with comprehensive systems in place and strong management backing), the average results were as follows:

Table (2-1)

A survey benefits of using MRPII in manufacturing companies

| Benefit | Percent |
|---|---|
| Increase in productivity | 16 |
| Improvement in customer service | 28 |
| Reduction in purchase costs | 11 |
| Reduction in inventory | 25 |
| Annual return on implementation investment | 200+ |

(Smith, 1989).

It was claimed by 66 percent of all MRPII users and more than 97 percent of Class A users, that MRPII equalled or exceeded their expectations. The size of the company was not correlated with success in using MRPII, with small, medium, and large companies all reaping the benefits. Ninety-nine percent of all MRPII users said that improved control of the business was a major benefit.

Initially, the MRPI system could generate only the first step in the planning process (parts ordering/ manufacturing). The next problem is ensuring sufficient capacity in each work centre. MRPII incorporates the MRPI schedule into a capacity planning system, and outputs integrated production, purchasing and machine use schedules. It should be clear, however, that MRPII does not change the production philosophy. It merely attempts to reduce WIP which is non-value-added activity through improved information flows. The JIT philosophy strives to remove non-value adding co-ordinating activities (e.g. the substitution of WIP and expensive control systems with general manufacturing flexibility and quality improvements). These ideas simultaneously decrease the response time required to adapt to market changes and reduce costs.

#### 2.2.4.2 Just-In-Time (JIT)

So far our discussion has progressed from a system based on historical data, ROP, to one that uses both historical and future data, i.e., MRPI and MRPII. In addition to historical and future data, the next two systems also use information about the physical system, the manufacturing plant, to develop production plans. Just-in-time (JIT), the third of the production planning and control systems we will consider, was developed concurrently with MRPI but is based on significantly different principles. The most significant difference between MRPI / MRPII and JIT is that MRPI and MRPII accept the current value of manufacturing variables (such as lead time, lot size, scrap rate, set-up time, required labour time, queue time, move time, and so on) and generate plans which are appropriate for these values. JIT, on the other hand, seeks to change the values of the manufacturing variables (Miltenburg, 1990).

Although the MRPII system provides an integrated information system for the entire manufacturing organisation, it is criticised for being too complex, for formalising bad habits

> instead of eradicating them and for being top-heavy with data-entry and paperwork. The primary criticism of the MRPII approach is that by modelling the reality of a manufacturing plant, it builds in all the bad habits. It takes account of long lead-times, shop-floor queues, large batch sizes, scrap and quality problems. Instead of accommodating these things, it should be driving towards their elimination. Poor productivity is built into MRPII and planned into the production process (Maskell, 1989, PP., 8, 9).

Many of the concepts that are now grouped under the heading of JIT were developed at the Toyota Motor Company by Taiichi Ohno and Shigo starting in the 1950s (Shingo, 1987). JIT is defined by the APICS Dictionary (1995) as:

> A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product, from design engineering to delivery and including all stages of conversion from raw material onward. The primary elements of just-in-time are to have only the required inventory when needed; to improve quality to zero defects; to reduce lead times by reducing set-up times, queue lengths, and lot-sizes; to incrementally revise the operations themselves; and to accomplish these things at minimum cost. In the broad sense, it applies to all forms of manufacturing, job shop and process as well as repetitive.

The overall objective of JIT manufacturing is to reduce manufacturing lead times, and this is achieved by drastic reductions in WIP. The result is a smooth, uninterrupted flow of small lots of products from suppliers to production to customers with no delays. Most successful JIT applications have been in repetitive manufacturing, operations where batches of standard products are produced at high speeds and high volumes with materials moving in a continuous flow. The Toyota automobile factories are perhaps the best example of the use of JIT in repetitive manufacturing. In these factories, the continuous flow of products makes planning and control rather simple, and JIT works best in these shop-floor situations. Successful use of JIT is rare in large, highly complex job shops where production planning and control is extremely complicated. Smaller, less complex job shops have used JIT, but these companies have taken many steps to change operations so that they behave somewhat like repetitive manufacturing (Gaither, 1996).

JIT does not come free, certain changes to the factory and the way it is managed must occur before the benefits can be realised. Among these changes are:

(1) Stabilise production schedules.

(2) Make the factories more focused.

(3) Increase production capacities of manufacturing work centres.

(4) Improve product quality.

(5) Cross-train workers so that they are multi-skilled and competent in several jobs.

(6) Reduce equipment break downs through preventive maintenance.

(7) Develop long-term supplier relations that avoid interruptions to material flows (lbid).

JIT only works when much of the variability inherent in manufacturing systems has been removed. Thus, a significant part of a JIT implementation is problem solving as discussed by Plossl (1980), to improve vendor performance and quality, to reduce scrap rates, to reduce equipment breakdowns, to reduce employee absenteeism, etc. Because variability is reduced, managers in a JIT environment have more information available to create a workable production plan. In other words, a production planner in an MRPI / MRPII system does not know whether material will arrive from vendors on time, whether it will be usable when it does arrive, whether machines will break downs, whether a large amount of scrap will be produced - he does not have the same information about these factors as a production planner in a JIT system would have, because in a JIT system the variability in these factors would have been reduced or eliminated.

While JIT has had many significant successes and receives much of the credit for the resurgence of the Japanese economy following the Second World War, it has also been criticised. Many articles in the business press (e.g., Hutchins, 1986; Shahabuddin, 1992) note the difficulty many U.S. firms have had implementing JIT due to lack of necessary discipline, and also the long-term nature of JIT implementation, which is incompatible with the short-term focus of many U.S. firms. JIT has also been criticised for its lack of focus: rather than addressing specific problems that inhibit throughput, JIT seeks improvement everywhere (Goldratt, 1990).

#### 2.2.4.2.1 Kanban Control System

The Kanban production control system is one of the major elements of JIT philosophy and pull mechanism. Kanban is the Japanese word for visual record card that is attached to a storage and transport container. It identifies the part number and container capacity, along with other information. Also it is used to authorise production or transportation of a given amount of material. This system is the information processing and hence shop floor control system of JIT philosophy. While kanbans are being used to pull the parts, they are also used to visualise and control in process inventories. The system effectively limits the amount of in process inventories, and it co-ordinates production and transportation of consecutive stages of production in assembly like fashion. Therefore, Kanban system is a manual method of harmoniously controlling production and inventory quantities within the plant..

> Kanban is used to control processes so that every process will produce a single unit of product within a predetermined cycle time. Therefore, the ability to produce a one-piece conveyance is viewed as the ideal state of this system. From this fundamental viewpoint, the production of large lot sizes and the holding of large inventories between processes are redundant. in such a situation, the number of Kanbans required is also increased Unless the various prerequisites of this system are implemented perfectly (i.e., design of processes, standardisation of operations, and smoothing of production, etc.), then JIT will be difficult to realise, even though the Kanban system is introduced (Monden, 1998, P.313).

The Kanban system appears to be best suited for discrete part production feeding an assembly line. There are a number of variants of kanban system. The dual card Kanban system has two main types of kanban cards;

(1) Production Kanban (P-kanban): signals the need to produce more parts

(2) Conveyance Kanban (C-Kanban): signals the need to deliver more parts to the next work centre (also called a "move Kanban" or a "withdrawal Kanban")

Each card circulates between two stages only; the user stage for the part in question and he stage which produces it. Production Kanban, on the other hand, defines the quantity of the specific part that the producing stage should manufacture in order to replace those, which have been removed. To operate Kanban system in effective way, very strict discipline is required. This discipline relates to the usage of the Kanban cards. Even though the dual-card Kanban system provides strong control on the production system, due to its strict assumptions and prerequisites, it is difficult to implement it. Therefore, a variant of this system, called single-card Kanban system, is sometimes used as a first stage to develop a dual-card Kanban system. In single-card Kanban system, the transportation of materials is still controlled by transportation Kanbans. However, the production Kanbans to control the production within cells is absent. Instead, a production schedule provided by the central production planning is used. Hence the system has a strong similarity to a conventional push system, with pull elements added to co-ordinate the transportation of the parts. One of the advantages of single-card push-pull system is its simplicity in implementation.

#### 2.2.4.3 Theory of Constraints (TOC)

The fourth production planning and control system to be considered is the theory of constraints. TOC includes not only measures throughput, inventory, and operating expenses, but also the following rules for managing production operations (Golderatt, 1990a): (i) Identify the system's constraint(s); (ii) Decide how to exploit the constraint(s); (iii) Subordinate everything else to the above decision; (v) Evaluate the system's constraint(s); and (vi) If in the previous steps a constraint has been broken, go back to step 1 but do not allow inertia to cause a system's constraint. Although the rules are very general, Goldratt (1984, 1990b) and Goldratt and Fox (1986) have shown how they can be applied in production situations in various publications and graphical computer simulations. The rules, combined with the measures of throughput, inventory, and operating expenses, are designed to focus management's attention where it can have the greatest impact on throughput, i.e., on the system's constraints.

Like JIT, TOC uses information about the plant to create a production plan. Specifically, TOC uses information concerning the existence of constraints which ROP and MRP do not consider. TOC, however, unlike JIT, assumes that it is not possible to eliminate all sources of variability in production operations and therefore focuses instead on protecting constraint resources and the shipping schedule from the effects of variability through the use of inventory buffers.

TOC has been criticised as being mainly of use when there are internal capacity constraints, and for being focused on short-term decisions (Schonberger and Knod, 1994, P.255).

## 2.3 Assessment of the Systems of PPC Used in the Old and New Manufacturing Environments

ROP and MRP suffer from: (i) failure to consider resource constraints including capacity, (ii) inability to create feasible plans unless many underlying problems are first addressed, (iii) focus on local optima, and (v) they are not aimed at reducing costs by reducing inventory; rather, they maintain 'an optimal level' of inventory that maintain 'an optimal level' of total costs.

JIT, while seeking continuous improvement throughout the system, does not have a mechanism for identifying and focusing management's attention on the conditions that most limit the firm's profitability.

TOC has been criticised (e.g. Kaplan and Atkinson, 1998) for having a short-term, inward focus that does not fit situations in which a firm has adequate production capacity. It is concerned with reducing costs by holding low inventory to the extent of maintain the constraint. In fact, TOC tends to reducing costs inside a system only.

Obviously all production planning and control systems are interested in providing answers to the questions of <u>how</u> and <u>when</u> to produce products. The question of when to produce the product, once the decision is made to produce it, is addressed by the scheduling aspects of the production planning and control systems. For example, a reorder point system would release an order for a part when the inventory level reaches a certain point; an MRP system would release an order for a part based on the shipping date for the finished product, offset for lead time and adjusted for inventory of the part on hand; a JIT system, through MPS, would schedule production to match the customer's rate of use; and a TOC system would schedule production based on the constraint schedule and the customer due date. The question of how to produce the products, while also answered by the production planning and control system, is not addressed on a product-by product basis but is embedded in the way the production facility is arranged and managed. For example, a facility managed using ROP or MRP would generally follow a philosophy of maximising utilisation of labour and equipment, while a JIT facility would generally only produce what is needed by the customer, regardless of utilisation of labour and equipment. A TOC facility would attempt to maximise utilisation of the constraint resources but not non-constraints.

However, JIT and TOC are largely compatible because JIT focuses on throughput, which is also the most important measure in TOC, and because one of the major methods of continuous improvement and increasing throughput in JIT is reduction of inventory, which JIT views as the absolute evil. JIT adopts a comprehensive and strategic perspective of cost reduction. It is interested in reducing costs not only inside the system but also outside. While TOC is not a zero-inventory system like JIT, it is a low-inventory system, recognising the significant negative impact of high inventories on throughput.

In addition, ROP or MRP systems are typically associated with some type of shop floor control system that ensures that all work centres are utilised as much as possible. Such systems typically use utilisation or efficiency by work centre, department, or plant as control measures. TOC measures of throughput, inventory and operating expense would conflict directly with utilisation and efficiency: for example, minimising inventory would result in reducing the utilisation of non-contrast resources.

However, companies that successfully implement MRP report improvement in their results compared to their results under ROP, and companies that have implemented JIT or TOC report improvement in their results compared to their results under MRP. Of these production planning and control systems, ROP takes the least information into account. MRP is an improvement on ROP in that it considers future demand and orders, and both JIT and TOC take additional information into account, JIT by reducing the variability of the system and TOC by considering constraints in making decisions.

## 2.4 Summary

Traditional production systems and managerial philosophies have become obsolete and they are an obstacle to successfully competing in the markets today. If a company wishes to continue and compete, it must adopt advanced technology. The old environment focused on efficiently producing standardised products. In contrast, the new environment emphasises value to the customer and seeks to improve product development and throughput time. Implicitly, if not explicitly, top management's strategies for adapting to the challenges posed by the new era in manufacturing are often influenced by their choice of paradigm. As we move towards advanced technology, these challenges are expected to continue, and even accelerate.

Production planning and control have evolved to cope with the development in the manufacturing. For instance, MRP, as a push system, is used to describe the old manufacturing environment. Traditionally, MRP is implemented to plan and control all the items. As discussed earlier in this chapter, this has resulted in a very complex but rather poorly performing MRP system. No system can be designed to cope with all the dynamics and complexities of the real world. With products becoming even more complex and customers demanding shorter lead times, it becomes even more difficult to control everything by MRP. Furthermore, modern competitive pressures will force rapid and continuous business change. For this reason it is essential to have systems which are simple to use and easy to modify as the business needs change.

Such change has been largely spurred by competitive influence from abroad by companies establishing JIT concepts. For some, MRP systems are still the only way to run a manufacturing operation successfully. Others quote the poor success rate of companies who have implemented MRP and put their total faith in the JIT manufacturing techniques.

Table (2-2) compares characteristics of the old and new manufacturing environments. The next chapter deals with the implications of the different manufacturing environments to cost accounting systems.

Table (2-2)

Comparison of manufacturing environments

| OLD ENVIRONMENT | NEW ENVIRONMENT |
|---|---|
| **PRODUCTION STRATEGIES** | |
| 1. Manufacturing's role--operational seek economies of scale | 1. Manufacturing's role--strategic seek economies of scope. |
| 2. Cost leadership | 2. Cost and Differentiation leadership |
| **PRODUCT TECHNOLOGY** | |
| 1. Marketing emphasis on product Availability and price | 1. Marketing emphasis on product features |
| 2. Few products | 2. Many products |
| 3. Standard products | 3. Product families |
| 4. Few product design changes | 4. Frequent product design changes |
| 5. Derived demand | 5. Customer demand |
| 6. High sales volume | 6. Low sales volume |
| 7. Low unit value | 7. High unit value |
| 8. Relatively high transportation costs | 8. Relatively low transportation costs |
| 9. Non-Discrete units | 9. Discrete units |
| 10. Long product life cycles | 10 Short product life cycles |
| **PROCESS TECHNOLOGY** | |
| 1. Similar machines are grouped with common supervision. | 1. Machines are located according to the sequence of operations required to produce a product. |
| 2. Equipment failure shuts down a machine | 2. Equipment failure shuts down a plant |
| 3. Labour intensive/Hard automation | 3. Capital intensive/Programmable automation |
| 4. Long manufacturing cycles | 4. Short manufacturing cycles and delivery dates are early. |
| 5. Work loads are unbalanced, so that machines may be idle for days. | 5. Work loads tend to more balanced and every effort is made to keep the machines functioning all of the time. |
| 6. Capacity is difficult to define | 6. Capacity is well defined |
| 7. Machine operators have extensive skills, frequently setting up their own machines | 7. Machine operators are highly skilled, but in only one type of operation |
| 8. Raw materials inventories may be high because of the many kinds of materials kept on hand | 8. Raw materials inventories may be high because of the quantities of material consumed. Ideally, the material is scheduled to be delivered as used. |
| 9. Late receipt of a purchased part delays a customer order | 9. Raw material shortage for a basic raw material shuts down a plant |
| 10. Because of the long manufacturing cycle, in-progress inventories are high. They are also high because the material is handled in batches. | 10. In-progress inventories are generally small in comparison to the large quantities produced. |
| 11. Materials handling is more extensive in a job shop | 11. The purpose of the production line is to reduce the materials-handling costs. |

Table (2-3)

Comparison of manufacturing environments

| OLD ENVIRONMENT | NEW ENVIRONMENT |
|---|---|
| 12. Because there is more material handling, there must be wider aisles and other provisions for ready access to the machines | 12. Space may be utilised more efficiently |
| **PRODUCTION PLANNING AND CONTROL** | |
| 1. Push systems (ROP, MRPI, MRPII) | 1. Pull System (JIT) |
| 2. Planning -oriented -systems | 2. Control-oriented-system 'Kanban control' |
| 3. Depending on historical and future demand 'dependent and independent demand' | 3. Depending on present demand |
| 4. Production control in MRPII tends to be more complex because many jobs are in process at one time. This requires many instructions, time cards, and other forms needed to maintain schedules | 4. Production control will not be as complex because emphasis will be placed on supplying the lines with materials |
| 5. Focusing on efficiency | 5. Focusing on effectiveness |
| 6. Assuming that the manufacturing variables are fixed | 6. Assuming possibility changing the manufacturing variables |
| **PRODUCTION CHARACTERISTICS** | |
| 1. Complex, uncertain, unreliable and rigid | 1. Simpler, reliable and continuous improvement |
| 2. Low flexibility | 2. High flexibility |
| 3. Static flexibility is costly | 3. Static flexibility is feasible |
| 4. Dynamic flexibility is incremental | 4. Dynamic flexibility is continuous |
| 5. Workers as individuals | 5. Workers as teams |
| 6. Workforce problems | 6. Motivated Workforce |
| 7. Quality control (SQC - defects probably exist) | 7. Quality assurance (i.e. quality certificate, zero defects) |
| 8. Balanced flow of production | 8. Linked production |
| 9. Unreliability suppliers (multi suppliers, delivery delay) | 9. Reliability suppliers (close relationships, reduced number) |

Chapter Three

# Cost Accounting Systems

Although there is some recognition in the literature that cost accounting system choices depend on physical production characteristics, the key physical characteristics are not specified (Karmarkar, Lederer and Zimmerman, 1990). Therefore, manufacturing environment characteristics and their relation to developing cost accounting system deserve additional research attention. As manufacturers are faced with the challenges of the advances in technology, they are usually operating with cost accounting systems designed years earlier to measure different processes or products (Kaplan, 1984). Because the changes to the production system are sometimes subtle, the necessary changes to the cost accounting system are either deferred, or even worse, the need for change is not recognised. In order to recognise the changes that should be made, it is essential that accountants fully understand the existing production and cost accounting systems. The requirements of the emerging system can then be documented and the change process can be better managed.

Thus, this chapter aims to investigate the developments in cost accounting systems in relation with the changes in manufacturing environment explained in chapter two. Therefore, both traditional and new cost systems are explained in this chapter.

## 3.1 Traditional Cost Systems in the Old Manufacturing Environment

Traditional cost accounting systems were developed to serve two main objectives: product costing for financial reporting and providing information for controlling costs. To achieve these purposes, two commonly used and accepted practices were developed. First, product costing systems emerged to provide measures for inventory valuations and income determination. Second, standard cost systems were developed to support the objective of cost control.

### 3.1.1 Traditional Product Costing

The product cost - period cost classification is essential to the traditional product cost system. Product cost consists of the components of manufacturing process: materials, labour and factory overhead. Period costs are the organisation's selling and administrative expenses. Product costs are the only costs which are attached to the inventories; therefore they are commonly referred to as 'inventoriable costs'. The focus of the traditional cost accounting system (CAS) has been on the accounting process that attaches product costs to the three types of inventories, Direct materials, Work-in-progress, and Finished goods, as they flow through the various manufacturing processes to completion and sale.

Materials and labour costs are easily assigned to the various stages of manufacturing as these are specifically identified to batches of product or to departments producing the products. Most of the overhead, however, is not specifically identifiable to batches of product or departments. By its nature, overhead is indirect, and must be allocated to production by estimation techniques. First, overhead costs are combined into cost centres. These cost centres frequently are quite large and often plant-wide (Cooper and Kaplan, 1988, Howell, et al., 1987).

The next step in overhead allocation consists of allocating this pool of costs to the production departments to determine an approximate split between the costs which apply to the inventories of production in process and completed units. Overhead allocation to production departments has traditionally been accomplished by using direct labour hours or cost as an allocation basis.

### 3.1.2 Traditional Cost Control System

A standard cost system is the principal method of cost control in traditional CAS. In a standard cost system, 'standards' or 'norms' are set for the accounting process. All manufacturing costs are then recorded at the standards. This practice facilitates inventory valuation and income determination for interim financial reporting purposes. In a standard cost system, standards are set for both usages and prices for materials, labour and overhead. At the end of an accounting period, variances are reported. These variances are principally used to alert management to potential cost control problems. The overhead variances reflect whether or not the overhead was under- or over-absorbed into the inventory valuations. Also, these variances reflect whether or not the actual overhead costs were greater or lesser than the budgeted amount.

Conceptually, the focus of an accounting control system is to assure the effective utilisation of an organisation's resources in the attainment of its goals. A control system should alert management when problems emerge, and corrective actions need to be taken, to bring the company back into alignment with strategic plans. However, the goals defined by the standard cost system are the standards based on the budgeting process. Therefore, in traditional CAS the budgets are viewed as the primary goals, rather than the organisational strategies. Standard cost systems, though well defined from an analytical perspective, have been questioned as causing undue management emphasis on attaining budgetary goals rather than strategic goals.

> The budget is a guide to operations, but for many reasons departures from this guide may be warranted. The responsibility centre's fundamental purpose is to implement the organisation's

> strategies effectively and efficiently, and if the manager discovers a better way of doing this than is assumed in the budget, it should be acted upon. Conformance to the budget is not necessarily good, and a departure from it is not necessarily bad (Anthony and Govindarajan, 1998, P. 7).

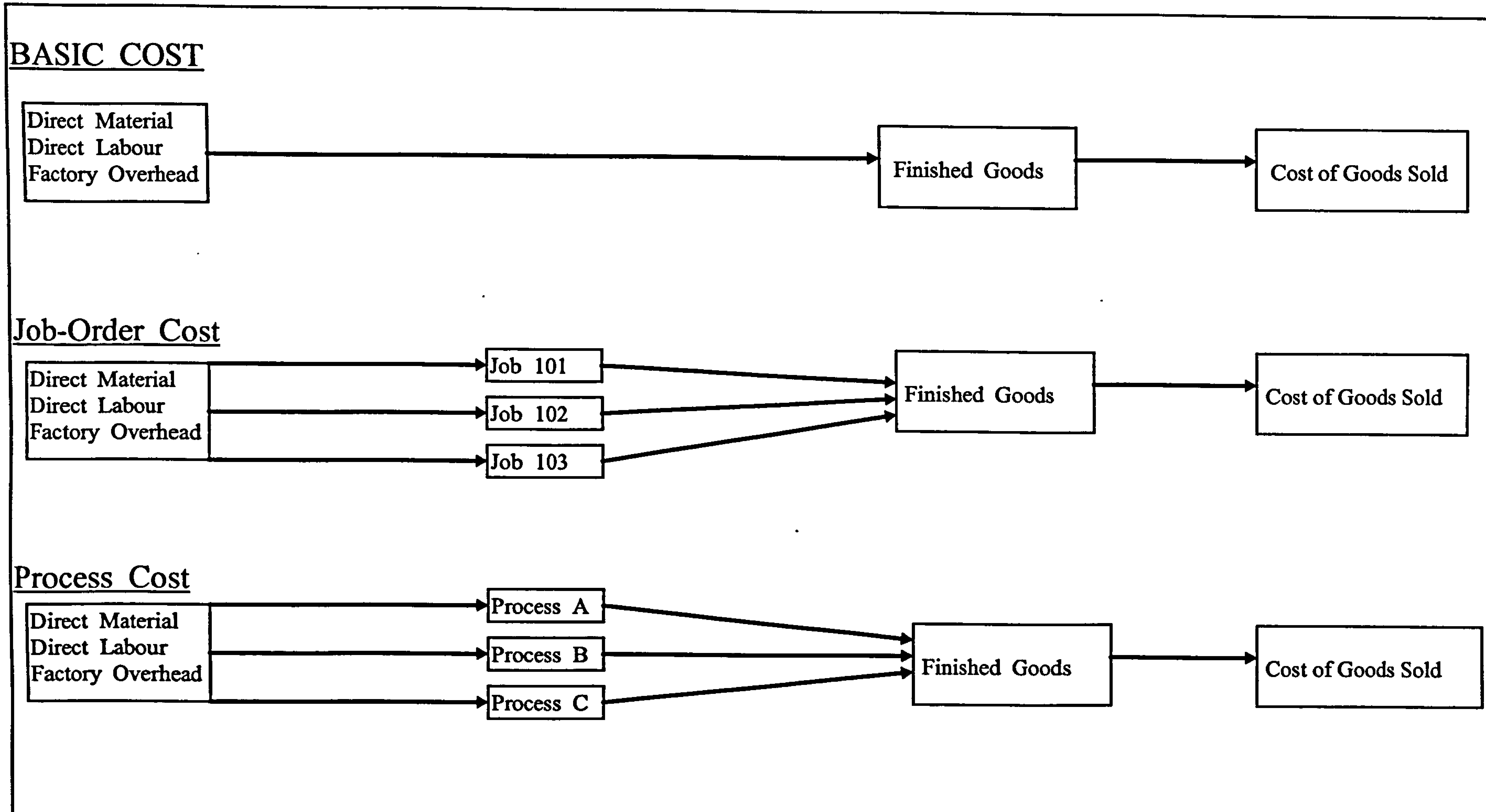
Considering that the purpose of control system information is to alert management to the need for corrective actions, the focus of the system should be on factors critical to strategic success.

### 3.1.3 The Traditional Generic Model of Cost Accounting

Cost accounting systems should facilitate the collection of data in a timely, accurate, and meaningful way. The traditional generic model described by Foster and Horngren (1987, P. 508) facilitates data collection appropriate to the needs of the intended user. In this generic model shown in Figure (3-1), direct materials and direct labour are charged to WIP as they are used in the production process. Factory overhead is charged to WIP as it is incurred. The basic model can be extended in one or more of the following ways: (i) factory overhead is allocated on some basis, instead of being charged directly to WIP, (ii) WIP is subdivided into either job numbers or specific processes (Figure 3-1), and (iii) standard costs are used as a basis for cost allocation.

Figure(3-1)

A traditional generic cost accounting model.




(Adapted from Foster and Horngren, 1987, P. 508).

Allocation of costs is required when the costs are indirect; that is, when those costs cannot be identified specifically with a single cost objective in an economically feasible manner. In this context, a cost objective is "any activity for which a separate measurement of cost is desired" (Foster and Horngren, 1987, P. 411). Factory overhead is an indirect cost that is allocated to WIP on a number of bases.

WIP exists in both job-order cost systems and process cost systems. In a job-order cost system, direct materials and direct labour are charged to individual job cards, and overhead is allocated to each job-order. As each job-order is completed, the total accumulated cost for that job-order is transferred to the finished goods inventory. Any incomplete job-orders represent WIP. In process costing direct labour and direct materials are charged to individual processes, and overhead is allocated to each process. As units are transferred to each successive process, the equivalent unit cost is transferred to the WIP account for that process. This 'transferred in' WIP represents part of the cost of production for the later process.

Standard costs are estimates of the cost of production, either for a product or for a process. Standards usually include standard direct materials, direct labour, and overhead. These standards are used to determine costs when products are transferred between processes or to finished goods inventory. Any discrepancy between actual cost and the 'transferred out' cost is accounted for either by charging it to cost of goods sold, or alternatively by pro-rating it between WIP and cost of goods sold.

The vehicle for collecting costs in a job-order environment is called the work order, shop traveller, or job-order cost sheet. The work order is essentially a cost summary sheet that includes information regarding the labour and materials applied to the job at each station in the manufacturing process. Overhead is sometimes accumulated on the sheet also. When the final operation is completed and charged to the work order, the costs for material, labour, and overhead are summed up and compared to standards. Variances from standards are then analysed to determine their underlying causes. This process requires a great deal of discrete tracking of information and it is difficult to obtain the cost accounting information until the work order is completed, which may not be timely. Also, information integrity is often suspect due to the tremendous amount of discrete tracking of information that is required (Costanza and Wagner, 1986).

Cost accounting can be extremely difficult in complex production settings like those of an integrated manufacturing company, where it is difficult to associate costs with products or segments of the production process. In such cases, inaccurate product costs often lead to weak analysis, while inaccurate costs for production areas can lead to weak control (Sepehri and Raffish, undated, P. 98). Equally serious is the familiar problem of allocating fixed overhead costs to products, which reduces the benefit of cost information for analysis. The most technically difficult setting for cost accounting is discrete-part production by batch or by assembly process with numerous component parts.

> Manufacturers of complex products, such as automobiles, often encounter an equally difficult problem. Material and labour used by production departments are not recorded as expenses; they become part of the cost of a product. Associating costs with products is hard to do because most production costs are first associated with parts or subassemblies, and these components can be used in many different finished products. The complex transaction details needed to describe such a process can lead to major errors in product cost and in inventory cost. Integrated manufacturing companies, however, usually produce parts and subassemblies for inventory. As it is not known at the time of production which finished product will use which part or subassembly, associating costs with products is hard. (Sandertto, 1985, PP. 111,113).

Discrete-part products produced by batch or assembly process are not well suited to job-order costing or to determining actual costs. The manufacturer usually assembles customer orders from parts and assemblies that have been produced *before* the order is received, so the cost of the order cannot be recorded by job. Actual product costs are also difficult to calculate since they require a record of actual costs for each part and subassembly. Standard cost systems provide satisfactory results for a batch process. Companies can record variances either for each batch produced in a department or for each operation or work station. The latter method provides more detailed control but is far more expensive.

### 3.1.4 Traditional Cost Systems for Decision Making

Despite the importance of cost information, there is still disagreement as to whether product costs should be measured by absorbent/full or by variable cost. Each of these systems was designed to assist managers in a very specific environment. Those who designed them made some assumptions that seemed appropriate in their environments and helped them to simplify the systems. The old cost accounting methods were developed for measurement of mass production of a few standardised items with a high direct labour content. The goal was to watch direct labour activities and costs closely, since typically direct labour was the largest cost determinant. The cost accounting systems designed for use in such environments worked well and were accurate. The Absorption Cost System (ACS) was invented in a very specific environment where the variable costs were much larger than fixed costs, so they could be allocated per product and the approximations were valid. Direct labour hours input were used as the basis for applying overhead costs because these costs typically were consumed in proportion to direct labour input. Also, one overhead application rate was utilized throughout the plant because these costs were so small that it was uneconomical to accumulate more accurate costs at each cost centre level (Boltin and Tietjen, 1985). But when fixed costs were much larger than variable costs, the assumptions of cost allocation were questionable. The Variable Cost System (VCS) was introduced in the

1930s as an alternative by Harris and Harrison. They discovered that the approximation made by cost allocation was no longer helpful to operational managers. Their main argument was that the fixed production costs have a close relation with the installed capacity, which in turn is related with a given period and never with the volume of production. The VCS works under the assumption that a clear distinction can be made between fixed and variable operational costs. The VCS concentrates on contribution margin per product. Also, inventory valuations are different value to WIP only when there are variable operational costs involved (Arnstein and Gilabert, 1980; Dominguez, undated).

The increasing use of manufacturing automation has made fixed costs the dominant part in the cost structure and direct labour costs have been diminishing as well as trending to become fixed. Such an environment, gives rise to a VCS in which the only variable costs involved in calculating the contribution margin are the raw materials, and inventories will be valued only at raw materials' costs. Supporters of the VCS argue that we must face the fact that allocation does not work anymore-and we may forget some tiny variations in some costs and just concentrate on such important variable costs as raw materials (Dominguez, undated).

The VCS alone as a cost accounting system does not have a measure to evaluate a company's productive capacity. It is true that this system is better than the ACS for many companies that have not been able to notice that their environments have changed and their systems should also change. While VCS defines product costs as including only variable costs, in practice, direct labour is considered part of product cost, whether it is a variable cost or not.

Although academic accountants, supported by economists, have argued strongly that variable costs are the relevant ones for product decisions, the VCS has been subjected to many criticisms by practitioners. For example,

> The definition of variable cost that academic accountants use assumes that product decisions have a short time horizon, typically a month or a quarter. In practice, managers reject this short-term perspective. In their eyes, the decision to manufacture a product creates a long-term commitment to manufacture, market, and support that product (Bruns and Kaplan, 1987, P. 205).

Also, surveys conducted by Mills, 1988; and Govindarajan and Anthony, 1983 revealed that product costs play an important role in pricing decisions. These studies suggested that cost-plus pricing is widely used, particularly in thin markets where customised products are produced that do not have readily available market prices. The surveys indicated that full costs are widely used to set selling prices. The preference of using full costs may be due to practitioners adopting a long-term strategic view with decisions being made on the basis of longer-term, rather than the short-term, variability in costs. Product costs are also of considerable importance in competitive markets where an established market price exists (Kaplan and Atkinson, 1998).

In a survey on the product costing practices used by 260 UK manufacturing companies findings indicate that product costs computed to meet inventory valuation requirements are widely used for decision-making and internal profit measurement. The majority of firms, however, used both full costs and variable costs for decision-making (Drury and Tayles, 1994).

> The marginal costing invented when product diversity was sufficiently small that there was no wide variation in the demands made by different products on the firm's production and marketing resources. Thus, even if direct or marginal costing was once a useful recommendation to management, *even if correctly implemented*, it is not a solution-and is perhaps a major problem-for product costing in the contemporary manufacturing environment. (Op.cit., 1987, PP. 214, 215).

The controversy surrounding direct costing had largely to do with the potential for making poor pricing decisions if selling prices are based on variable costs without allocated overhead, and the difficulty of classifying costs as fixed or variable (Greer, 1965). In addition, VCS was not allow for inventory valuation by financial accounting standards.

While absorption cost is meant to be a surrogate for long-run manufacturing costs, in nearly all of the companies Burns and Kaplan visited, management was not convinced that their Absorption-cost systems were adequate for product-related decisions. In particular, management did not believe that their systems accurately reflected the costs of resources consumed to manufacture products. But managers were also unwilling to adopt a variable-cost approach. Burns and Kaplan identified two major reasons for managers' reliance upon absorption-cost information for product decisions: (1) The relative ease of introducing products versus discontinuing them meant that the decision to introduce a product had long-term implications. Using absorption cost reduced this temptation and apparently provided a degree of protection against underpricing. (2) Managers felt that variable costs did not adequately reflect the demands different products placed on their fixed or capacity resources (Bruns and Kaplan, 1987). In contrast, some authors indicated:

> Full costing is widely criticised because, in practice, it tends to use past costs and to restrict its consideration of future costs to outlay costs (Mclaney and Atrill, 1999, P. 312).

However, there are other factors affecting the use of the ACS in manufacturing companies which made cost accounting as a subservient, that is financial accounting. The next section, therefore, explains the impact of this major factor.

### 3.1.5 Subservience of the Traditional Cost Accounting System to Financial Accounting

It has been shown that, under the old production environment based upon push systems discussed in chapter two, inventory was viewed as one of the most important assets in a company. In that environment, holding inventory was a target of companies to ensure that all production lines were busy and satisfy rush-orders by customers quickly. On the other hand, companies did not consider an inventory an enemy that should be removed. Rather, they planned to hold the necessary level of inventory and used inventory control techniques that optimise costs. In these circumstances, financial accounting was interested in evaluating an inventory for external reporting. Cost accounting was subservient to the financial accounting system.

> Our historical review of the development of management/cost accounting systems indicated that the major advances in the design of these systems occurred sixty or more years ago under the influence of ........., the increased demands for external reporting by tax and regulatory authorities. Accounting for inventory was important since the production costs of an accounting period had to be distributed between goods that were sold and goods that still remained inventory. Cost systems therefore recognised the value added at each stage of the production processes by incrementing the WIP cost account after each major processing step, a producer that generated many transactions for the accounting system to handle (Johnson and Kaplan, 1987, pp. 221, 222).

Methods of valuing inventory for financial accounts are laid down by the professional bodies in each country in the form of accounting standards. Invariably these standards require the full absorption of overheads into the balance sheet inventories regardless of the bad motivational consequences of building inventory. Absorption costing motivates factory managers to utilise fixed capacity fully through long production runs. Both conditions lead to high inventory levels (Maskell, 1991). Financial accounting has been held responsible for inaccurate cost information produced by the traditional ACS. This is because accuracy was not a basic target in the cost information required for financial accounting, which only requires consistency when valuating inventory.

### 3.1.51 Limitations of Traditional Cost Accounting Systems

In the last two decades, the ACS has faced critical criticisms e.g. Johnson and Kaplan, 1987; Bruns and Kaplan, 1987; and Kaplan, 1988. Changes in the competitive and manufacturing environment had made ACS less relevant. Traditional formal cost accounting systems have often been found wanting because they do not provide information with the desired properties. Cost accounting is often accused of: (1) being too limited to meet management's needs; (2) not reflecting the manufacturing process; (3) evaluating performance based on the wrong goals; (4) aggregation of data to such an extent that the information produced is too general; (5) not accurately measuring resource consumption (materials, labour, and capital) or realistically assigning resource costs; (6) producing information too late; (7) producing unreliable information; (8) presenting information in terms and/or numbers that are impossible to decipher or irrelevant to the manufacturing process; (9) motivating the production of excess inventories; (10) performing unrealistic cost allocations; (11) restraining the acquisition of more efficient production facilities; (12) not providing a basis for planning and scheduling future production (Edwards and Heard, 1984).

## 3.2 Contemporary Cost Accounting Systems

Changes in the manufacturing environment have removed the conditions which supported the use of traditional CASs and have rendered them obsolete. As companies' environment has changed, their strategies and structures have evolved. Therefore, the CAS need to develop to provide information relevant to the current organisational environment. A paradigm shift in the field of cost accounting is occurring. Attempts to develop the conventional CASs will be discussed in the next section.

### 3.2.1 Attempts at Improving Cost Accounting for Decision Making

Horngren (1989) reflecting on his thirty-plus years of teaching cost accounting, referred to the dominance given to stock valuation. His research identified a change in emphasis in cost accounting textbooks away from stock valuation to cost control and decision-making: "The focus on cost control and management decision-making increased from 27 percent of the total chapters in 1945-50 to 54 percent in 1961-70".

#### 3.2.1.1 Activity-Based Costing (ABC)

> All of the changes in the business environment are having a significant influence on cost accounting systems. Most organisations have faced changing cost structures with a growth in those costs which do not change directly with changes in output, and which are difficult to trace accurately to products or services. This change in cost structure has created a need for organisations to review their existing cost accounting systems and consider implementing new systems that have emerged during the late 1980s and early 1990s (Drury, 2000, P.14).

Activity-based costing is the first attempt to develop cost accounting. It was invented by Cooper & Kaplan, and revived in the 1980s in order to overcome some limitations from which the traditional CAS suffered by focusing on activities.

> ABC can be considered an evolutionary extension of the two-stage allocation procedure that underlies most modern cost accounting systems (Cooper, 1994).

ABC is based on using a number of different bases for allocating overhead costs to products rather than a single base, usually direct labour hours or cost, which led to very arbitrary allocations in the traditional CAS.

The fundamental concept behind ABC is that activities consume resources (costs) and products consume activities. The ABC approach says that cost elements can be traced by the various activities that consume them. These costs, which are traced through such activities are absorbed by various product models. At the second stage, the criteria for such cost absorption is the cost drivers that cause cost elements to be consumed by activities. Costs are pooled based on activities and are then assigned to products based on the number of each activity is used

> ABC differs from traditional cost accounting system in that its cost centres are subdivided in more detail; consequently they can be used for a wider range of cost absorption criteria, going beyond the conventional application of cost drivers as mainly operating rate-related criteria (direct labour, machine operation time etc.). Another difference is that the ABC approach subdivides what are conventionally called auxiliary department costs into activities, after which the absorption of costs goes directly to products. Therefore, we do not examine how auxiliary department costs are absorbed by the manufacturing division but instead jump directly to a product-specific accounting of costs. Therefore, the ABC approach tends to recognise as many types of costs as possible as direct manufacturing costs (Monden, 1995, P.332).

A key characteristic of ABC is the categorisation of cost driver rates into a hierarchy based on cost behaviour patterns. Unit, batch, product sustaining and production facility sustaining costs are differentiated (Cooper, 1990). Activities at the unit amount level are carried out for each product unit manufactured. Thus, activities at this level are very repetitive. Two examples are direct operating time and machine operating time. The costs for these activities vary according to the production volume. Batch level activities are carried out each time a batch of goods is produced. Such things as machine retooling, order processing, and materials handling are more closely related to batch units than to product units. The costs for these activities are regarded as either common costs or fixed costs for all of the products in the batch, and these costs change according to the number of batches.

Activities at the product type level are carried out to support production of various kinds of products. Examples of activities at this level include making parts lists (bills of materials), updating work schedules, and some kinds of materials handling. Activities at the factory level support production processes for the factory as a whole. Such costs are common to various products, and it is very difficult to trace any particular factory-level activity to any particular product (Monden, 1995).

This analysis can be compared with the traditional cost behaviour model based on the fixed / variable categorisation.

> While for the most part the first and last of these cost types fall, respectively, into the traditional variable and fixed categories, the rest types are product-oriented costs representing the consumption of resource dedicated to specific products and they may be attributed to these products through the use of appropriate cost driver rates. Both directly contribute to the creation of the value of particular stock (Mitchell, 1994).

Incidentally, distinguishing among individual activities at the batch level and product type level is helpful when selecting appropriate cost drivers for activities that create costs that are seen as fixed costs in relation to production volume. Various kinds of costs change. Many costs that are fixed costs in relation to production volume are also variable costs in relation to other cost drivers. This situation is especially true of activities at the batch level and product type level. Costs incurred by activities at the factory level generally fall into the category of fixed costs, and they can be allotted or traced to products by arbitrary methods (Ibid., 1995).

Benefits claimed by proponents of ABC are accurate product costs (e.g. Cooper and Kaplan, 1988b; Raffish, 1991) and usefulness of costs for decision making (Woods, 1992; Cooper and Kaplan, 1988). They indicated that the possibility of distorted costs due to internal allocations is therefore much less in the ABC method than in the traditional one.

> Critics of ABC argue that analysis of overheads in order to identify cost drivers is time consuming and costly and that the benefit of doing so, in terms of more accurate costing and the potential for cost control, does not justify the cost of carrying out the analysis. ABC is also criticised for the same reason that full costing generally is criticised: because it does not provide very relevant information for decision-making i.e. it tends to use past costs and to ignore opportunity costs (Atrill and Mclaney, 1999, P. 102).

#### 3.2.1.2 Throughput Accounting (TA)

Throughput Accounting is another development in cost accounting literature. This development has been echoed strongly more recently in the "theory of constraints" literature as explained in chapter two (Goldratt, 1990; Galloway and Waldron, 1989b; Noreen et al., 1995; Dugdale and Jones, 1996, 1997). The TOC was developed by Goldratt (1984, 1990a) in the late 1970s and early 1980s. TA is not a complete cost accounting system but includes three measures, throughput, inventory, and operating expenses which Goldratt believes allow management to see the effect of operating decisions on the firm's profit. In Goldratt's view, the concept of product cost is misleading and should be discarded, replaced by the concept of throughput, which is defined as the rate at which the system generates money through sales (i.e. selling price less raw material). Raw material is defined in turn as all directly variable costs of producing a unit of product.

The concepts underlying TA are not fundamentally new: the definition of throughput in TA is the same as the definition of contribution margin in traditional cost accounting, and using throughput to make operating decisions would theoretically result in the same decisions that would result from a VCS. The differences in TA lie in the fact that direct costing systems generally consider direct labour as a variable cost, while Goldratt realizes that direct labour is frequently a fixed cost; and that in TOC, decisions take a firm's constraint or constraints into account.

The most fundamental difference between TA and the other cost accounting systems, however, is the fact that Goldratt views firms as systems of highly dependent processes and events and has attempted to develop an integrated cost and production planning and control system which takes this view into account. In TA, the three measures of throughput, inventory, and operating expenses are used in conjunction with the identification and management of constraints (which exist due to dependencies within the firm) to make decisions that move the organisation toward its goal.

### 3.2.2 Attempts at Simplifying Cost Accounting Systems

#### 3.2.2.1 Cost Accounting System For JIT Environment 'Backflush Costing'

Yee (1987) and Cobb (1993) indicate the need to modify the cost system for a JIT environment. For example, labour and overhead can be treated as period expenses with no portion of the costs being inventoried. This modification can be part of a change to backflush accounting, with material being the only cost tracked and recognised in inventory accounts. This treatment is feasible in JIT systems because WIP and other inventory accounts should be substantially reduced (or possibly eliminated) and product throughput times significantly decreased (Foster and Horngren 1988).

> Backflush costing is a costing system that omits recording some or all of the journal entries relating to the cycle from purchase of direct materials to the sale of finished goods (Horngren et al., 2000, P.728).

Tatikonda (1988) points out that in the JIT environment, manufacturing overhead, including fixed and variable costs are applied on the basis of cycle time of the product in the process. The cycle time is determined by the critical path of the product's operations. The product absorbs overhead in direct relationship to how much time it spends in the process. Neumann and Jaouen (1986) describe the JIT concept, then describe an implementation at Hewlett-Packard. The cost accounting system at Hewlett-Packard has moved away from job costing to a modified form of process costing. In particular, direct labour is de-emphasised, and overheads are allocated on a basis of material cost and cycle times. The production cycle is short, and no materials are allocated until products are completed. Unfinished goods are grouped as Raw and In Process (RIP). The conversion costs, including overhead, are allocated to finished goods.

Costanza and Wagner (1986) state that the simplicity of this accounting system is readily apparent. The quality of information received from such an accounting system is often considered more reliable than that derived from job order costing. The vehicle for collecting costs is the time in system, not a work order. Direct labour does not have to be discretely tracked, and is often simply applied in total to overheads. This is referred to as `charging labour` to the process. Again, this can be done because the labour portion of the product in a JIT manufacturing operation is small relative to the total manufacturing cost. The authors note that standard setting and variance analysis methods can also be used in JIT accounting.

Material cost tracking within a JIT setting will ideally involve the use of RIP account (Foster and Horngren 1988).

> Criticisms of backflush costing focus mainly on the absence of audit trails--the ability of the accounting system to pinpoint the uses of resources at each step of the production process. The absence of large amounts of materials and WIP inventory means that managers can keep track of operations by personal observations, computer monitoring, and non-financial measures (Horngren et al, 2000, 734).

However, JIT philosophies have helped organisations (IBM and Caterpiller) recognise that the issue is the elimination and prevention of cost, not simply the reporting of cost elements. (McIlhattan, 1987, P.22). Factors that impact on the cost accounting system are identified as cost drivers. Cost drivers are defined as `the cause of costs`. Foster and Horngren (1987) describe JIT purchasing, then discuss the effects of JIT purchasing on cost accounting. The effects of JIT purchasing include decreases in the number of suppliers, long term purchasing agreements, supplying sensitive information to suppliers, use of shop-ready delivery containers, and minimal checking of incoming goods. Cost accounting is affected by increasing the direct traceability of costs, changes in cost pools, changes in bases for allocation, and reduction in detail and frequency of purchasing reporting.

Schonberger (1986) points out that obstacles to JIT accounting success can arise. Suppliers whose quality and delivery are inconsistent are incompatible with JIT systems. However, case-based evidence indicates that some companies often continue to rely on conventional cost accounting systems when sophisticated manufacturing systems are employed (e.g., McNair and Mosconi, 1988; Cobb, 1993). This is contrary to those who argue that conventional cost accounting methods are not optimal when used in conjunction with modern manufacturing systems (Kaplan, 1984; Cooper and Kaplan, 1988; Cooper, 1989; Holzer and Norreklit, 1991).

### 3.2.3 Evaluation of the Old and New Cost Accounting Systems

None of the cost systems explained above is perfect, as illustrated below:

(1) Traditional absorption cost accounting, as practised, results in the use of allocated costs for decision making.

(2) Activity-based costing, similar to traditional cost accounting, uses allocated costs for decision making. Johnson (1992), whose views on ABC changed following its inception, later said that ABC is quite simply reconstituted accounting information.

(3) Direct costing, as practised, treats direct labour as a variable cost, again resulting in poor decisions. In addition, direct costing is criticized for not providing sufficient guidance for pricing decisions.

(4) The throughput accounting incorporates only those measures needed for making operating decisions, and it is not clear that a complete and consistent set of financial statements could be prepared using TA measures and principles.

(5) To assess Backflush costing, however, the actual operation of the RIP account may be unclear because JIT companies may choose to retain the title WIP even though the account is likely to represent a combination of materials control and WIP. Furthermore,

the evidence available suggests that the use of such an account is not widespread. In a field study of ten companies which had adopted JIT methods, Cobb (1993) did not observe any which used a RIP account. All the JIT companies continued to operate some form of WIP control account system. This did not appear to inhibit the operation of otherwise modified accounting systems (including in some cases the treatment of conversion costs as period expenses).

### 3.2.4 Shifting the Emphasis Towards Cost Reduction

#### 3.2.4.1 Cost Reduction

> The second major development is a shift of management's attention from cost control to cost reduction, or what Deming (1986) calls continuous improvement. This is a radical change in focus. Most current systems of variance measurement and reporting are based on the premise that all existing information is captured in current standard costs and flexible budgets. Historic comparisons are redundant. Deming rejects this notion, pointing out that standard costs mirror the status quo: cost reduction requires disturbing the established order. Meeting standard can lead to a false sense of accomplishment and get in the way of system changes that must be made if cost reduction is to take place (Shillinglaw, 1989).

For example, Cooper (1995) stated that Japanese firms use their product costing systems to support their cost reduction programmes rather than to obtain accurate product costs. In their field-based research with 25 Japanese firms, Cooper and Slagnulder (1997) concluded that a firm that fails to reduce costs as rapidly as its competitors will find its profit margins squeezed and its existence threatened. It is no longer good enough to say, "Reduce costs by 10 percent across the board." Cost management, like quality, has to become a discipline practised by virtually every person in the firm. Therefore, integrated systems that create intense downward pressures on all elements of costs are required.

### 3.2.4.2 Strategic Cost Management (SCM)

The emergence of Strategic Cost Management (SCM) in the latter half of the 1980s has been viewed as a paradigm shift in the field of cost accounting (Shank and Govindarajan, 1992; Shank, 1989). The rise in prominence of the strategic management field, and its recent paradigm shift precipitated the development of this new SCM framework. From strategy formulation through communication, implementation, and development of controls to monitor the strategy's success, cost information plays a critical role. SCM has emerged from the need for specific types of cost information for various purposes in the strategic management cycle.

SCM is clearly addressed in the field of economic theory by another prominent scholar (Bromwich, 1990). Two important economic theories are examined with a view to supporting SCM. The first theory is based upon the research of Lancaster (1966). The second theory expands upon research by Baumol, (1982).

> ...the good, *per se*, does not give utility to the customer, it poses characteristics, and these characteristics give rise to utility. (Lancaster, 1966, P. 134).

The first theory examines the firm's underlying characteristics of enterprise products. In essence, the theory argues that accountants should look at the cost structure not only of their own firm but all the current and potential suppliers in the relevant market. An important caveat is that costs must be viewed in the context of demand factors.

> The attributes are not only creating value by offering service potential for the customer, but different product attributes may also cause differences in cost. This analysing differences in attributes may be a way of understanding differences in costs (Bjornenak, 2000, P. 195).

The second theory is concerned with whether a firm's cost structure permits its market strategy to be sustainable in the face of potential entry. Demand and cost factors need to be considered simultaneously.

Bromwich (1990) maintained that use of this theory should provide additional insight into cost behaviour, in particular in high technology manufacturing. He argued that expanding cost/management accounting to encompass elements of these two approaches provides a new focus for cost/management accounting and one that will allow it to contribute directly to generic strategies to enable sustainable competitive advantage. He maintained that some firms already collect and analyze this type of information, particularly some large companies in Japan. He cited Hiromoto (1988) to support his argument.

Considering the new paradigm of accounting, cost information is currently viewed from a strategic perspective. It is this perspective that distinguishes SCM from its former cost accounting roots. Providing useful and relevant information to support strategic management decisions is the primary purpose of an internal accounting system (Shank, 1989). Often, decisions must be made regarding the following types of issues: which products to manufacture and in what quantities, outsourcing, price setting, cost control, and production process changes.

Current cost accounting systems, described above, have been criticised for not providing useful and relevant information for strategic management decisions (e.g. Berliner and Brimson, 1988). These criticisms have resulted from the fact that most cost accounting systems adopted a narrow perspective. The demand for useful, relevant information in the current environment gave rise to the SCM paradigm. SCM is defined as:

> Managerial use of cost information explicitly directed at one or more of the four [formulation, communication, implementation, and strategic control] stages of the strategic management cycle (Shank, 1989, P.50).

> The nature of strategic cost management has not been established precisely. The various requirements assigned to it by different authors may be summarised in the following two definitions. First, strategic cost management can interpret ways of effecting cost reduction in order to improve profitability of individual products or product groups at early business-process stages such as product planning, research and development and designing, when the greater part

> of the product life-cycle are settled. Second, it entails a political or intentional use of cost information for the sake of organisational reform or change at another phase (Ito, 1995).

Successfully establishing effective SCM requires a change in corporate philosophy from 'managing by the numbers' to management by commitment to continuous improvement. The central assumption is that the success a firm will have in changing to this philosophy depends on the extent to which the firm develops an implementation strategy that focuses on behaviour rather than technical issues (Shields and Young, 1989)

Strategic cost reduction is defined as follows:

> In contrast to the traditional approach,....strategic cost reduction as an approach ... can provide companies with better opportunities for creating and sustaining long-term competitive advantage. Strategic cost reduction is a long-term approach that integrates competitive strategy, technological strategies, human resources management strategies, and organisation design considerations to provide a focused and coordinated basis for sustaining competitive advantage (Shields and Young 1992).

Empirical analysis of 187 European manufacturers demonstrated that cost reduction is the result of having first been successful with other manufacturing strategies i.e. having first achieved improvements in quality, then dependability, and finally speed (Ferdows and Demeyer, 1991). Two critical aspects of developing a strategic cost reduction programme involve deciding where to focus the programme and the mix of methods to use to reduce strategically important costs (Shields and Young, 1991, 1992).

The author holds that SCM emerged from three underlying themes borrowed from the field of strategic management: strategic positioning analysis; value chain analysis; and cost driver analysis (Shank and Govindarajan, 1992).

#### 3.2.4.2.1 Strategic Positioning

The first major theme underlying the development of SCM is strategic positioning (Shank and Govindarajan, 1992, Shank, 1989). The strategic goal of a company in the new manufacturing environment, as explained in chapter two, is achieving a competitive advantage. Strategic positioning follows Porter (1980) delineation of the two basic choices firms have regarding their competitive strategies. He notes that a business can develop a sustainable competitive advantage by following one of two strategies: a low-cost strategy; or a differentiation strategy. The primary focus of a low-cost strategy is to achieve low cost relative to competitors (i.e., cost leadership). Cost leadership can be achieved through such approaches as economies of scale in production; experience curve effects; tight cost control; and cost minimisation in such areas as research and development (R&D), service, sales force, or advertising. The primary focus of a differentiation strategy is to create something that customers perceive as being unique. Product uniqueness can be achieved through such approaches as brand loyalty, superior customer service, dealer network , product design and product features, or technology.

Whether or not a firm can develop and sustain cost leadership or differentiation depends fundamentally on how the firm manages its own value chain relative to those of its competitors. Both intuitively and theoretically, competitive advantage in the marketplace ultimately derives from providing better customer value for equivalent cost or equivalent customer value for a lower cost. Thus, value chain analysis is essential to determine exactly where in the firm's segment of the chain -from design to distribution- costs can be lowered or customer value enhanced.

To support the organisational strategic positioning under both of these strategies, the intracompany value chain is analyzed for the purpose of gaining the low cost position within the company's industry. Having the low cost position at one or more of the value chain stages can establish the company as the low cost competitor, thereby creating a defensible strategic position.

Cost information is important to both of the competitive strategies: cost leadership and differentiation. However, these strategies each require different cost perspective (Shank and Govindarajan, 1992; Shank, 1989; Porter, 1985). Cost leadership requires that the primary focus of activities along the value chain is upon developing economies of scale and low cost production. Differentiation requires the organisation to focus primarily upon the activities which preserve the product's superior image, e.g. service, technology, etc. Under either strategy, the costs which enhance the organisation's strategy cannot be eliminated. The costs which do not add to the strategic focus are viewed as candidates for minimisation. Therefore, opportunities to minimise costs of activities along the value chain differ dependent upon the organisation's competitive strategy.

**3.2.4.2.2 The Value Chain Analysis**

The second fundamental theme underlying the development of strategic cost management is a value chain analysis. The value chain concept focuses on cost management efforts (Shank, 1989). To manage costs strategically requires a broad focus that includes linkages with both the suppliers' and customers' value chains.

Porter (1985) defined the value chain as the linked set of value-creating activities from suppliers of raw materials, through the company's own production processes, to the delivery of the finished product to the end users. Analysis of the required set of activities along the value chain should reveal opportunities to exploit linkages with suppliers and customers, as well as within the company. Therefore, capturing the costs of all individual organisational activities along the value chain is of critical strategic importance. Since traditional accounting system costing procedures usually focus on only manufacturing activities, and the impact of other activities on relative cost position is not emphasised.

The value chain concept is a method for breaking down the chain -from basic raw materials to end-use customers- into strategically relevant activities in order to understand the behaviour of costs and the sources of differentiation. As noted earlier, a firm is typically only one part of the larger set of activities in the value delivery system. Suppliers not only produce and deliver inputs used in a firm's value activities, but they importantly influence the firm's cost or differentiation position as well. Similarly, distribution channels have a significant impact on a firm's value activities. As is discussed more fully below, gaining and sustaining a competitive advantage require that a firm understands the *entire* value delivery system, not just the portion of the value chain in which it participates. Suppliers and distribution channels have profit margins that are important to identify in understanding a firm's cost or differentiation positioning, because end-use customers ultimately pay for all the profit margins throughout the value chain (Shank and Govindarajan, 1992).

Porter (1985) contends that once an organisation's value chain is defined and costed, it can be used to support both overall cost control actions as well as strategic positioning activities. Further, Stonich (1982) holds that a superior and defensible relative cost position at a key stage of value added will be the basis for a long term strategic advantage. Value added is defined as the amount of additional economic benefit provided to the customer at each stage from raw material acquisition through final usage, i.e. what unique product / service aspects the customer is willing to pay for (Rappaport, 1986; Stonich, 1982). The proportion of value added at each stage of production, through completion and sale, is critical in evaluating strategic alternatives and controlling costs.

From a strategic perspective, unlike the value-added concept, the value chain concept highlights four profit improvement areas: (Shank and Govindarajan, 1993).

(1) Linkages with suppliers

(2) Linkages with customers

(3) Process Linkages within the value chain of a business unit

(4) Linkages across business unit value chains within the firm

**3.2.4.2.3 Cost Drivers Analysis**

The third strategic management theme underlying the SCM paradigm is recognition of the fact that costs are driven by many complex and interrelated factors (Shank and Govindarajan, 1992). In contrast, the traditional cost accounting system assumes that costs are driven solely by output volume. This assumption underlies most of the currently used cost accounting techniques such as standard costing and variance analysis, cost categorisations, break-even analysis, and overhead application. SCM, however, assumes that structural choices such as scale, scope, automation, experience, technology, and complexity, drive costs. In turn, these structural choices, which are usually included in the ever-increasing overhead cost component; drive product costs. It is, therefore, structural cost drivers, not output volume, upon which product costing techniques should be based.

Rather, multiple cost drivers are usually at work. Further, cost drivers differ across value chain activities. For example, number of orders received is the cost driver for the receiving activity, number of set-ups is the cost driver for the production control activity, and number of orders shipped is the cost driver for the shipping activity.

Attempts have been made to create a comprehensive list of cost drivers (e.g. Porter, 1980). In the strategic management literature, in particular, the list of cost drivers is divided into two categories: structural cost drivers and executional cost drivers.

## 3.3 Summary

This chapter has presented a comprehensive review of traditional and contemporary cost systems. The researcher assessed the different cost systems in relation to the production planning and control systems illustrated in chapter two. The literature review revealed a transferring of focus in cost accounting from cost allocation to reduction and decision making. Searching for cost drivers is very necessary if a company wishes to gain a competitive advantage. Understanding the real reasons for costs occurrence leads to identifying ways getting them down. This requires that a company adopt a strategic perspective of cost and investigate its value chain.

The literature in the area supports the view that traditional cost accounting systems are not suited to the current environment, where they are supposed to help control and decision making. The inter nature of the CAS is a function of the lack of awareness of production developments by accounting personnel and the rigid structure of the traditional CAS. As the evolution of production accelerates, the relevance of the cost accounting reports for management is degraded or lost. The literature asserts that there is a tendency for managers to rely on such alternative sources as engineering sources for cost information for operational control and decision making, and to use cost accounting information for public financial statements and inventory valuation

(Howell et al., 1987). To overcome the existing deficiencies and cope with the production changes, an extensive cost control model is required.

Table (3-1) compares the elements of the traditional and new cost accounting systems.

Table (3-1)

Traditional cost accounting systems versus the new cost accounting systems

| Old CASs | New CASs |
|---|---|
| **COST INFORMATION** | |
| 1. Periodic | 1. Constant |
| 2. Emphasise labour efficiency | 2. Emphasise overall plant productivity |
| 3. Emphasise capacity absorption | 3. Emphasise capacity utilisation |
| 4. Variances from standard | 4. Actual (traceable) costs |
| 5. The vehicle for collecting costs is a work order | 5. The vehicle for collecting costs is the time in system |
| **PERSPECTIVE & FOCUS** | |
| 1. Perspective is Added value | 1. Perspective is Value chain (entire set of linked activities from suppliers to end-use customers) |
| 2. Focus is internal | 2. Focus is external |
| **COST DRIVERS** | |
| 1. Cost driver is single (volume) | 1. Multiple cost drivers [structural drivers (e.g., scale, scope, experience, technology, and complexity) and executional drivers (e.g., participative management, total quality management, and plant layout). |
| 2. Application at the overall firm level (cost-volume-profit analysis) | 2. A set of unique cost drivers for each value activity |
| **COST CONTAINMENT PHILOSOPHY** | |
| 1. 'Across the board' cost reductions | 1. View cost containment as a function of the cost driver (s) regulating each value activity. |
| | 2. Exploit linkages with suppliers |
| | 3. Exploit linkages with customers 'Spend to save' |
| **INSIGHTS FOR STRATEGIC DECISIONS** | |
| 1. None readily apparent (this is a large reason why the strategic consulting firms always discard the conventional reports as they begin their cost analyses). | 1. Identify cost drivers at the individual activity level, and develop cost/ differentiation advantage either by controlling those drivers better than competitors or by reconfiguring the value chain |
| | 2. For each value activity, ask strategic questions pertaining to: - Make versus buy - Forward/backward integration Quantify and assess 'supplier power' and 'buyer power' and exploit linkages with suppliers and buyers. |
| **TIME FRAME** | |
| 1. Short-Term | 1. Long-Term (Strategic Dimension) |

### 3.4 Developing the Conceptual Model

Cost accounting system answers the question of which products to produce while the production planning and control system answers the questions of how and when to produce them. Traditionally, because the questions of what to produce (answered by the CAS) and how and when to produce it (answered by the PPC system) appear to be independent, there would appear to be no inherent conflict in using any of the cost accounting systems with any of the production planning and control systems. This, however, is not the situation, as suggested in table (3-1). This inconsistency lies in the fact that the questions of what to produce (answered by the CAS) and how and when to produce it (answered by the PPC system) are not, in fact, independent questions. The questions are connected. Discussion, however, the relationships between cost accounting systems and production planning and control systems should be conducted under both old and new manufacturing environments.

In the old manufacturing environment, the question of when to produce the product, once the decision is made to produce it, is addressed by the scheduling aspects of the production planning and control (PPC) systems. For example, a reorder point system (ROP) would release an order for a part when the inventory level reaches a certain point; an MRP systems would release an order for a part based on the shipping date for the finished product, offset for lead time and adjusted for inventory of the part on hand. In such environment, inventory played a significant role. The PPC systems were used for planning and maintaining inventory in order to secure the continuous of operation and to match customers' orders.

Traditional cost accounting systems (ACS, VCS) were affected by this environment in which mass production and direct labour were prevalent. In such old environment, companies were concerned with valuing inventory rather than seeking methods to eliminate or reduce it. The traditional CASs also met the target of building-up inventory which was planned to be maintained in order to satisfy both manufacturing's requirements and customers' needs. For example, such traditional CASs as absorption costing had a adverse motivational consequences towards building inventory. It induced managers to spread fixed costs such as set-up costs over large batches in order to keep them down. Consequently, excessive inventory was created. Moreover, traditional CASs did not aid management to achieve an effective operational control, especially as a 'normal' allowance for scrap, waste, and rework was estimated and built into the standard costs for the process. They also considered long lead time as given when setting standards of operating time. Because they are based on an assumption of long production runs of a standard product with unchanging characteristics and specifications. Consequently, we can conclude that traditional cost accounting systems were consistent with the conventional production planning and control systems, i.e. ROP and MRPI. The relevance of the traditional CAS in the new manufacturing environment has been lost.

Although MRPII system provides an integrated information system for the entire manufacturing organisation, it builds in all the inefficiency factors. It is based on unrealistic assumptions such as infinite capacity, fixed lead times and fixed batch sizes and thereby it, like ROP and MRPI, optimises manufacturing activities. Therefore, the deficiency of MRPII is that it accept the current value of these manufacturing variables and does not seek to change them. This means that MRPII is also consistent with VCS and ACS which encourage inefficiency factors as explained above.

In the new environment, such new systems as TOC and JIT have revolutionised the manufacturing shop floor. A JIT system, through MPS, would schedule production to match the customer's rate of use; and a TOC system would schedule production based on the constraint schedule and the customer due date. While a facility managed using ROP or MRP would generally follow a philosophy of maximising utilisation of labour and equipment, a JIT facility would generally only produce what is needed by the customer regardless of utilisation of labour and equipment. A TOC facility would attempt to maximise utilisation of the constraint resources but not non-constraints. In TOC, through the existence of constraints, which determine not only what should be produced but also when and how it should be produced.

To evaluate the consistency of the traditional cost accounting systems in the new manufacturing environment, we can say, because such cost accounting systems as ACS or ABC assume that these above questions are independent of each other, all combinations of these systems are conceivable and can probably be found in practice. In addition, use of ACS or ABC systems with such systems as a TOC would lead to inconsistencies due to different decisions processes and different underlying assumptions. If we make a comparison between absorption costing system and TOC, we will find that the first rule of the TOC is to identify the constraint, or the thing which prevents a firm from moving toward its goal. There are a number of ways in which absorption costing measures could differ from TOC. A basic one is the fact that, generally, absorption costing ignores the existence of constraints. A second is that even if the existence of a constraint is acknowledged, absorption costing might differ in how the second step of the TOC, deciding how to exploit the constraint, is performed. TOC states that, in the product mix problem, for example, the product with the greatest throughput per constraint unit should be produced. Absorption costing might say that the product with the greatest contribution per direct labour hour or the product with the greatest profit per unit should be produced. A third way that a company using absorption costing measures could differ form TOC is in the third step of TOC, subordinating the rest of the system to the decision made in step two, the exploitation step. Absorption costing measures, as indicated above, would generally lead to maximisation of efficiency or utilisation of work centres, departments or labour. This would go directly against the TOC policy of allowing non-constraints to work only as much as needed to supply the constraint.

Also, we can say that in comparison between TOC and ABC, the later is a variation of absorption costing which uses different methods of allocating overhead costs. This means that ABC suffers from the same inconsistencies noted between TOC and either absorption costing or direct costing.

A comparison between TOC and VCS explores inconsistencies in some aspects. For example, VCS considers direct labour to be direct cost. VCS suggests that decisions should be made based on the contribution margin (selling price less material and direct labour) for each product. The inconsistencies between TOC and VCS is that the later ignores constraints and it would suggests a different answer in the exploit step, and it would suggest maximising utilisation of resources.

A key innovation of the JIT philosophy is that it simplifies production activities. Likewise, JIT can allow accounting records to be simplified through backflush costing whereby the level of detail with which product information is recorded is greatly reduced. In contrast, VCS, ACS and ABC systems track costs through work in progress beginning with introduction of raw material into production. Therefore, the three systems are in consistent with JIT specially, ABC better reflect a particular conception of the extent of manufacturing complexity.

The consistency of the contemporary cost accounting systems with the new production systems is evident. For example, TA is driven from TOC, and backflush costing is driven from the JIT. In some aspect, there is clear inconsistency between the

JIT and TA which are largely compatible because JIT focuses on throughput, which is also the most important measure in TA, and because one of the major methods of continuous improvement and increasing throughput in JIT is reduction of inventory, which JIT views as a clear enemy. While TOC is not a zero-inventory system like JIT, it is a low-inventory system, recognising the significant negative impact of high inventories on throughput.

The combination JIT and SCM might be considered the most consistent one. JIT is not only a production planning and control system but also it a philosophy which aims to reducing costs and improving productivity as an ultimate goal by eliminating all forms of waste. In JIT environment, knowing the cost of your operations, however, is not enough. To succeed in the increasingly competitive global market, a company has to know the costs of its entire economic chain and has to work with other members of the chain to manage costs and maximize yield. Companies are therefore beginning to shift from costing only what goes on inside their own organisations to costing the entire economic process, in which even the biggest company is just one link.

SCM adopts a strategic perspective by taking a long-term view and looking behind the four walls of a company. SCM manages the cost of each component along a value chain from product design till shipment it. It also assists to know the real cost drivers through cost drivers analysis. SCM is an integrated system which achieves the objectives production planning and control "JIT" i.e. cost reduction. Strategic cost management, therefore, is consistent with the purpose of the just-in-time and a company's strategy as well.

Table (3-2) compares the extent of consistency between cost accounting systems and production planning and control systems.

Table (3-2)

The Conceptual Model

"The extent of consistency between cost accounting systems and production planning and control systems"

**Lead**

| COST ACCOUNTING SYSTEMS | MANUFACTURING ENVIRONMENT<br>Production planning and control systems | | | | |
|---|---|---|---|---|---|
| | ROP<br>1930s | MRPI<br>1950s | MRPII<br>1970s | TOC<br>1980s | JIT<br>1980s |
| | | | 1 | | 2 |
| ACS (1900) | High | High | High | Low | Low |
| VCS (1930s) | High | High | High | Low | Low |
| ABC (1980s) | High | High | High | Low | Low |
| | | | 3 | | 4 |
| TA (1980s) | Low | Low | Low | High | High |
| Backflushing (1980s) | Low | Low | Low | High | High |
| SCM (1980s) | Low | Low | Low | High | very High |

**Lag**

The matrix shown in table (3-2) consists of four panels: panel 1 represents High consistency between the traditional CASs and the old manufacturing environment. Panel 2 indicates Low consistency between the traditional CASs and the new manufacturing environment. Panel 3 reveals Low consistency between the contemporary CASs and the old manufacturing environment. Panel 4 expresses High consistency between the contemporary CASs and the new manufacturing environment.

The matrix characterised by dynamic. The lag of the CASs increases in two directions when a company goes up and moves to the right of the matrix. In contrast, the lag of the

CASs decreases as a company goes down and moves to the left of the matrix. Also, we can note that the consistency is high in panels 1 and 4, while it is low in panels 2 and 3. The matrix provides a scale upon which a company can know the extent of consistency of applying cost accounting systems in the current manufacturing environment. The matrix shows that the changes in manufacturing environment lead the changes in cost accounting systems. A company should select or design its CAS in consistent with its manufacturing environment.

The global competition has drived companies to pursue JIT philosophy. This dramatic shift reveals the obsolescence of the traditional CASs. It also exposes the need to a new CAS which should be consistent with the corporate commitment to JIT, and promote its efforts on the basis of cost, quality and lead time. The failure to adopt a value chain perspective may doom any major effort by a company. The lack of awareness of supply chain cost analysis concepts on the part of a company's cost accountants proved to be a very costly oversight.

The remainder of this thesis uses a case study method to examine the research hypothesis empirically. This study attempts to seek to answers for the following research questions in a real life situation: what are the developments in a manufacturing environment and its implications to cost accounting systems?; how can the company allocate and control its costs in an increasingly complex technological environment?; what is the extent of consistency between the CASs and the other operating systems, such as production planning and control, in the company?; and how it might be developed to support organisational strategic decision making and cost control in the new manufacturing environment?.

# Part II

# The CASE STUDY

## “El-Nasr Automotive Manufacturing Company”

# INTRODUCTION

El-Nasr automotive company is a leading manufacturer and assembler of vehicle products in Egypt. The company's original manufacturing strategy, based on feasibility studies, started its activity with complete assembly of its products which were limited to buses and some trucks. At that time, it had a plan to reach full local manufacturing content of its products. Production operations depended largely on direct labour. The old-established production control systems were sufficient to satisfy the simple manufacturing requirements. There was no problem in controlling the manufacturing resources, particularly in the areas of the availability of materials and parts on production lines or of controlling the human and productive capacity. The company had a monopoly of the Egyptian automotive industry, so there was no need for strict control of its manufacturing resources, or to trace idle capacity; the selling price then was Cost-plus mark-up which covered full exploited and un-exploited costs. Under these circumstances, Absorption costing was relevant. Direct labour cost was a reasonable basis for cost allocation purposes.

Today, the competition environment of the company has changed dramatically, particularly as the Egyptian Government has moved towards the removal of trade barriers, the deregulation of industry and change of ownership structures by privatisation. New competitors has been entering the market and increasing the competition based on a free market concept. Accordingly, El-Nasr Co. has faced an increasingly difficult and dynamic business environment. The pressures of strong competition and the desire to expand markets requires the company to operate efficiently and effectively. Therefore, it is committed to improve productivity and product quality and has recently implemented a major change in its manufacturing operations and information systems. The production process is both fabrication and assembly operations and increasingly is using such automated equipment as NC and CNC. Thus, the production process has become more automated than dependent on direct labour.

The new manufacturing environment of El-Nasr Co. is more complicated than formerly, because it has to deal with numerous domestic and foreign vendors who are supplying materials and parts; is diversifying products and models, each of which consists of thousands of parts; and establishing several decentralised stores. The new manufacturing environment has two serious consequences: Firstly, the cost structure has changed, while both materials and parts' costs and overhead costs have increased, direct labour cost has diminished, because of the gradual trend towards increasing local manufacturing content and using advanced automation in the production process. Secondly, controlling the cost of materials, parts and overhead costs has become more difficult and significant.

The old-established systems designed years ago inadequate support the needs of the company facing these new demands. Lacking flexibility, unable to integrate data properly or provide timely information, these outdated systems failed to support today's different, more complex needs. The old systems were no longer adequate to satisfy the accelerating requirements of manufacturing and decision making. Consequently, the emerging need gave justification for the use of an expensive computerised integrated system for control and costing manufacturing resources directly on to the production lines to ensure the consistent flow of resources and to avoid idle capacity or bottlenecks. As a result, the company has installed a computerised integrated system to control and regulate the flow of materials and components on production lines, and to control its manufacturing resources. However, the company has suffered from serious problems with suppliers and delivery to customers and threats from competitors. The current system does not provide means of solving these problems.

The next chapter, therefore, is dedicated to investigate the effect of the transition in the Egyptian economy in re-shaping the manufacturing and competitive environment of the ex-public sector companies.

# Background of the Industry

## Effect of the Changing Competitive and Manufacturing Environment On The Ex-Public Sector Companies

During the late 1970s and early 1980s, the profitability of many State-owned Egyptian industries deteriorated rapidly. Many ex-public manufacturing companies were no longer competitive in quality or price, whether in domestic or world markets. They produced lower-quality products at a higher cost than their local competitors in the private sector and also their counterparts in foreign countries. The Egyptian automotive industry was no exception. By the mid-1980s, it (in particular passenger car assembly operations) was in a state of flux. Given the very low volumes of production and the continuous demands made by the industry on foreign currency to import parts and components needed for local assembly, Egypt's automotive industry has been cited as an instance of inefficiency (International Arabic Conference, 1997).

In the late 1980s and early 1990s, a major programme of privatizing such industries was undertaken to meet the challenges of local and international competition. These changes have led to restructuring of many industries including their managerial philosophies, production techniques, competitive policies and internal information systems. The Egyptian economy has undergone three fundamental stages of the changes which determined the environment of the Egyptian industrial companies:

(1) The Stage of Nationalisation and Adopting Planned-Oriented-Economy.

(2) The Stage of El-Infitah Policy and Transferring to a Mixed Economy.

(3) The Stage of Privatisation and the Transition to a Free Economy.

This chapter is divided into two main parts: Firstly, it will explore the effect of the above stages of transition in the Egyptian economy in re-shaping the manufacturing and competitive environment of the ex-public sector companies. Finally, the automotive industry will be examined later.

## 4.1 The Stage of Nationalisation and Adopting Planned-Oriented-Economy

The economic and social conditions which prevailed in Egypt in the 1950s led to the extensive intervention of the government in economic activity, via owning and managing enterprises through the public sector. The establishment and dominance of the public sector was achieved through many procedures, including nationalisation of private enterprises and setting up new projects to carry out economic activities.

> Studies indicate that the public sector controlled most economic activity fields in Egypt. It captured about 70 % of investments, 80 % of foreign trade and more than 90 % of the banking system as well as the insurance sector and about 60 % of the value added industrial sector (Egyptian National Bank, 1992).

A major portion of the industrial sector was transformed into State-Owned-Enterprises (SOE). Examining and investigating the changes in the manufacturing patterns in country like Egypt requires a study of the industrialisation policies imposed by the government on public sector companies, especially after the state adopted a Central Economic Planning policy and nationalized the major industries.

### 4.1.1. Industrial Development In Egypt Under a Centrally-Planned-Economy

Industrial policy during this period, as formulated in The First Industrialisation Programme 1957, aimed at: (World Economic Survey, 1967)

(1) self-sufficiency through import substitution;

(2) expansion of industries with export market orientation;

(3) obtaining a balance between the development of basic and consumers industries;

(4) achieving an equitable regional distribution of industry in the country.

The list of criteria that gave a project a certain degree of priority on the plan was rather lengthy, but not always very clear. The list of the first industrialisation programme enumerated, without income, local and foreign finance needs, profitability, increase in productive capacity of capital goods, contribution to the supply of consumption goods, savings of foreign exchange, the length of the gestation period, absorption of locally available factors of production such as raw materials and non-skilled labor, and national strategy. It is of particular significance that import substitution and export promotion did not appear explicitly on the list, although they did not fail to leave their finger prints wide and clear (Awad, 1973).

These policy considerations were observed through later stages of industrial development. They were re-shaped and emphasised in The Second Industrialisation Programme of 1965 with a few additions:

(1) Heavy industries were to have priority, without however jeopardizing expansion of consumer industries.

(2) Consumer industries, with their great capacity for workforce absorption, were both to satisfy local consumption needs and provide in the immediate future a more attainable opportunity of reaching neighbouring export markets.

(3) Industrialisation of the rural countryside was to reach new dimensions for employment and accelerate the transfer to an industrial society.

The Second Industrialisation Programme was more decisive in favour of export promotion industries as a target, and in giving top priority to the non-defined strategic factor and to 'important' basic industries. Two totally new conditions were also laid down: inter-industrial complementary, and fundamental industrial location considerations (Ibid.).

#### 4.1.1.1 Protecting Industry from Foreign Competition

In the stage of first transition towards a State-Controlled Economy, developing countries (and Egypt is no exception) have found it necessary to provide some degree of protection from foreign competition so as to permit the emergence of industrial activities that can be built up into a manufacturing sector. A study of the particular features of the measures and machinery of protection which played a part in shaping the present structure of Egyptian industry seems appropriate. Industrial policy in the field of tariff protection passed through a number of stages. According to the predominant aim at each stage, specific instruments have been emphasised and others neglected or played down. With the evolution of Egyptian industry over the past decades, the various instruments of protection and control have necessarily alternated or combined through most of these stages.

The real influence of the protectionist policy, however, was to create a climate of excessive protection for domestic industry. Furthermore, imports, with the attraction it offers by way of minimum technical and capital needs, were adopted as an industrialization strategy, at least in the first and second industrialisation programmes (1957-1965), with the resultant sacrifice of productive efficiency and jeopardizing the establishment of a rational industrial base. Industry was necessarily directed, therefore, towards production lines related to the demand for finished consumer goods, even though only the final processing stages were sometimes covered, at least in the initial period. It was not until the introduction of the Third Industrialisation Programme that an intensive type of growth in industry based on a more critical selection of alternative forms of industrial development was favoured to encourage increasing specialisation and provide the foundation for a more self-supporting type of industrialisation that would satisfy one of the most demanding requirements of development, namely, an ever-increasing volume of export manufactures.

### 4.1.2 Difficulties Facing Egyptian Industry in the Ex-Public Sector

Egyptian ex-public sector companies faced, during the nationalisation period, a number of problems which were either neglected or overlooked. For example, absence of secure and permanent sources of finance; dependence on extensive protectionist policies kept costs above standard levels; neglect of modern techniques of production; and imposition of legal constraints on management of public enterprises.

This section deals with the obstacles from which ex-public sector's manufacturing companies suffered during the transition stage of the Egyptian economy, as well as the essential reasons for these obstacles. All enterprise operations were affected by various governmental policies:

(1) Government Supervision and Control

(2) Social Pricing Policy For Industrial Products

(3) An Employment Policy

(4) Customs and Import Policy

(5) Government Subsidization Policy

(6) Investment Policy for Renewing and Replacement

A brief review of these policies is given below.

#### 4.1.2.1 Government Supervision and Control

The many Government supervisory and controlling agencies, their rigidity and conflicting interests and instructions, resulted in difficulty in setting in objectives and planning policies for these companies, placing increasing burdens and pressures on these companies' management. Interference of government directly or via authorities as controlling agencies in the work of the companies and the interests of their broad directors, led to much confusion and conflicts as well as fear of action which may result in the displeasure of the controlling agencies. Other problems included, deficit in accounting, managerial and controlling systems of these companies with the result of a gap between planned policies and actual execution of them, as companies could not keep pace with developments in administrative, economic and accounting literature in the world.

Another control problem was the concentration of decision-making in many cases at the level of the concerned minister. Moreover, the minister's role was not only to plan public policy but also to follow-up results and evaluate them. This resulted in direct responsibility as for the operating results of these companies being borne by the Government instead of the companies themselves (Egyptian National Specialised Councils, 1989).

#### 4.1.2.2 Social Pricing Policy For Industrial Products

In the first stage of the Egyptian economy, the ex-public sector companies were subject to Government policies aiming at serving society. Prices for goods and services offered by these companies were kept much lower than their economic costs, in line with the Government policy of relieving the burdens on the broad masses of the Egyptian society. The public sector was an instrument of government to realise the aims of its social and economic development plans and fight the economic demerits of inflation. There was a distortion in prices, with a great gap between economic prices and the social ones which the public sector used. The distortions were of three kinds: (Al Ahram al-Iqtisadi in Egypt, 1989)

(1) The gap between price levels inside the country and international prices;

(2) A rising gap as a result of lack of correspondence between different prices and the relative costs of the same item;

(3) A distortion resulting from multi-prices for a single item.

Hence, ex-public sector manufacturing companies suffered from pricing problem, where the government intervened to limit product prices. It placed fetters on sale prices and fixed them for long periods for the benefit of those of limited or fixed incomes. This compulsory pricing policy existed at a time when the prices of most raw materials and production requirements were increasing at the international level, capacity costs rising and the prices of foreign currency exchange increasing. This led to heavy burdens borne by companies in the cost of financing imported production requirements as well as the burden of extra employment, reflected in a rising wage bill and reduced the productivity. Besides compulsory pricing policy, public sector companies operated under constraints in planning their production programmes, as they were required to produce some quantities of items in certain qualities. This policy hid the real production costs and made it difficult to evaluate productive efficiency in different companies.

According to the World Bank study (1987), the pricing policy in Egypt has had the most damaging influence on the efficiency of public sector enterprises. Essentially the policy differentiates in its applications of pricing measures between categories of goods. Public enterprise products are classified into two groups: essential goods and non-essential goods. The first group are those goods that are deemed essential either for direct consumption or for intermediate consumption. The prices for goods on the essential goods list are determined by an inter-ministerial committee. Prices of non-essential goods category (constituting 65 per cent of total industrial products) are set by the board of directors of the enterprise although changes in these prices are subject to the approval of the appropriate ministry with consultation with other concerned ministries. Typically, essential goods prices were kept low.

For non-essential products, multiple pricing of the goods was allowed, with low prices accorded to users in the public sector, higher prices for such a pricing policy has had a distortive effect on enterprise operations. For instance, it imposed constraint on the financing of the enterprise by requiring the enterprise to sell goods below its average cost of production. Secondly, by pricing goods below their market value, whether for use by public enterprises or for final consumption, the policy induced an inefficient allocation of resources. Moreover, when prices are subject to control, there are no incentives for efficient operation of the enterprise or for reshaping output in response to changing market conditions (Ott and Hartley, 1991).

#### 4.1.2.3 Employment Policy

Labour cost was considered an important element of production cost in the public industrial sector companies in Egypt. Consequently, changes in it might affect the item's production cost and its selling price, particularly for those items in which the ratio of labour cost was high compared with total production costs. These companies suffered from the rising cost of labour. The cost of labour treated as a part of fixed costs. Employment effects on the ex-public sector were: [(Egyptian Central Agency of O & M, 1987) (Al Ahram al-Iqtisadi in Egypt, 1990)].

(1) Increasing employment as a result of government obligation to appoint graduates on the basis of full employment to satisfy social considerations concerning the necessity of providing job opportunities.

> In some cases, like the case of Egypt.....,legal limitations preclude layoffs and strong organised labour groups oppose any weakening of job security protections (Assaad, 1999, P. 117).

This had the adverse consequence as that companies had to appoint un-required extra labour in their plants.

(2) Low the technical level of employment and lack of practical experience which led to many technical and managerial problems.

(3) Increased rate of growth in the annual wage per worker, at the time of declining his productivity. On the other hand, the discrepancy in wages between the public and private sectors for the same job created feelings of anger and disloyalty as a result of wages that did not keep pace with prices.

(4) Neglecting the condition of full-time service for any public job. It became commonplace for a public employee to occupy a job and have several sidelines.

(5) Migration of specialised and technical employment and managerial leaderships in top management.

(6) Inflexibility of the rules and laws.

(7) Shortage of trained skilled and technical labour owing to the deficit of training centres to supply them in the necessary numbers and at the necessary levels. This led to a lack of production efficiency as well as increasing shortfalls in requirements, reduced life-span of machinery and increased proportion of faulty products. This led to reduction in production growth and lack of profits, as well as increased inventory and deterioration of conditions in these companies.

(8) Granting incentives and rewards to all workers as a basic part of their salaries, automatically, irrespective of productivity. Hence, incentives and extra wages lost their meaning and purpose.

(9) Increased absence from work without good cause, as well as leaving work early, before the official times.

(10) Insufficient attention of training to raise the efficiency and skills, and failure to raise the educational and cultural level of employees.

#### 4.1.2.4 Customs and Import Policy

Customs laws in Egypt were set up to protect national industry. These laws limited the competitive of the public industry sector. The negative aspects of this policy were: (Egyptian National Specialised Councils, 1987).

(1) Restrictions were imposed on production requirements of machinery, raw materials and medium articles.

(2) Many time-consumming procedures had to be completed connection with necessary imports to companies, which increased the cost of importing.

(3) Insufficient financial resources and foreign currency were available for obtaining regular supplies of production requirements from abroad.

(4) Higher customs duties were imposed on some imported articles needed for production, than would have been imposed on the same articles if they were imported ready-made.

(5) Some imports were exempted duties, causing unfair competition with local products, upon which duties were imposed.

(6) Some economic sectors were exempted from customs for imported articles, whereas similar ones produced locally were subjected to customs duity upon their imported production as well as duties being imposed upon imports by these sectors. This extended to treasury duties which were imposed on local production only.

(7) The rates of customs duties were high continuously.

(8) Products were imported with different qualities compared with Egyptian ones, in some economic sectors.

According to the above, the ex-public industrial sector had to carry out its importing operations according to laws and expensive long managerial procedures that delayed its work and increased its costs. Encouraging and activating the private sector in the field of importing and commercial agents created unequal competition between the ex-public industrial sector and private sector. Thus, the severity of competition increased as a result of the concentration on importing activity, particularly consumes goods, without exportation.

#### 4.1.2.5 Government Subsidisation Policy

Government support or passive taxation was one of the fundamental features of the nationalisation phase of the Egyptian economy. It was embodied in an unannounced contract between the government and the people. Accordingly, the government supported goods, particularly essential ones, and fixed prices, employed graduates and prevented high rents of land and houses. In return, the people gave up participation in politics.

The most important kind of support is the implicit one represented in losses which firms bear as a result in the difference between production costs and limited sale prices. Considering that companies do not have freedom to price their products and the prices are under uncontrollable factors such as severe competition and decreased demand influenced the company's profits (Misr Bank in Egypt, 1986).

#### 4.1.2.6 Investment Policy for Renewing and Replacement

Investment policies in ex-public industrial companies were associated with agreements that imposed certain kinds of machinery and certain production types. Opportunities in these companies for investment were subject to governmental procedures, outside management control, without differentiation between the nature of the ex-public industrial sector and governmental administration sector. This led to these companies being provided with required resources late, as well as negative results. (Egyptian National Bank, 1987). The weakness of investment expansion and replacement projects was due to the following reasons: [(Ministry of Industry in Egypt, 1987) (Egyptian National Bank, 1987)].

(1) Weakness of self financing opportunities and decreasing surplus in these companies;

(2) No freedom in making investing decisions;

(3) Insufficient monetary provisions as well as depreciation amortisations to replace capital assets;

(4) Inability of the Government to execute the plans of renewing and replacement due to wars;

(5) Continuous change in investment plans and reconsideration in priorities in nearby periods.

(6) Decrease in the relative importance of public investment in industry because of an economic policy biased towards non-industrial and unproductive activities, and facilitations for the private sector without equal consideration for the public business sector.

(7) The many procedures involved in confirmation of the annual investment budget for a company. The year usually ended before these procedures were completed and the company had to re-claim again in the next fiscal year.

Undoubtedly, the above reasons prevented maintenance, renewed and development in factories of the ex-public industrial sector, resulting an increase in costs and shortage in production, as well as spoilage and faulty products and lack of innovation products. The Egyptian industry was unable to compete locally or globally.

## 4.2 The Stage of El-Infitah Policy and Transferring to Mixed -Economy.

This stage started in April 1974. In this stage the Government began to move away from a planned-oriented economy. It sought to change the course of the economy through liberalisation. The economic reform involved some aspects which encouraged the private sector to share in the corporate economic development plan. However, the El-Infitah policy was an initial attempt to improve the efficiency of the public sector companies. For example, some aspects of liberalisation were:

### 4.2.1 Exchange Rate Policy

Traditionally, the exchanges rate in Egypt has been overvalued and subject to tight control. Some liberalization measures were introduced: the parallel exchange market was set up in 1973 which allowed exporters to receive a premium over the official rate. Private sector enterprises were allowed to operate foreign currency accounts and to retain export earnings. In January 1979 the market and the official rates were unified, and was set at L E 0.7 = $ US 1. In August 1981, two foreign exchange pools were created: the Central Bank pool and the commercial pool. The exchange rate remained at the rate of L E 0.7 = $ US 1 in the Central Bank pool whereas it varied in the commercial pool. Others measures were also introduced, but still the rate remained overvalued. The overvaluation of the rate has had a debilitating effect on Egyptian exports.' Thus, unfair competition between State-owned-enterprises and private enterprises was existed.

### 4.2.2 Trade Policies

Trade policies in Egypt have always favoured protection of domestic industries rather than providing stimulus to the export sector. Until 1973, tariff and quotas were used to foster import substitution. After 1973, tariff and subsidies offered effective protection to certain groups of products with high tariff on consumer goods, and low rates for capital and intermediate goods not produced at home.

El-Infitah policy or The October paper called for a "partial liberalisation" of the economy while preserving government control over ex-public sector enterprises. El-Infitah policy called for, first, liberalisation of foreign exchange markets and some imports and second, the provision of incentives and inducements to private domestic and foreign investment. These provisions were spelled out in Law 43 of 1974. The object of the new policy was to stimulate a large inflow of foreign capital to help the economy to recover; to convert the country's short-term debt to longer terms and finance the trade gap. Other aspects of the policy included modest reforms of pricing and subsidy policies, and legislation affecting the supervision and control of ex-public companies (Ott and Hartely, 1991).

The attack on ex-public sector enterprises and their management led to the passage of Law 111 on 28 July 1975, abolishing the General Organisation. Under the Law, public sector companies were given greater discretion in the hiring of labour, and for liquidating or selling off weak or loss making enterprises. Law 111, in combination with the terms of Law 43 whereby all joint ventures between foreign investors and ex-public sector companies would be legally within the private sector, led many observers to conclude that the ex-public sector would soon be dissolved (Mursi, 1976).

El-Infitah policy did not extend to the domestic economy. The government asserted that El-Infitah policy was not a 'retreat from a dominant public sector - only an attempt to improve its efficiency (Nyrop, 1983). By retaining total government control over public enterprises, where 70 percent of industrial output originated, and on agricultural products, together with a total governmental monopoly on supporting infrastructure, El-Infitah policy did little except frustrate private domestic initiatives.

A second investment law, the private companies Law 158 of 1981, gave impetus to private sector investment. The average growth rate of private investment, foreign and local, was however modest: 4 percent for the former and 2.6 percent for the latter. The private sector role in the domestic economy has improved somewhat since El-Inftah. The private enterprise share in industrial value added increased by 8 percent between 1973 and 1984-85. Still the ex-public sector continued its domination of the commodity sector, with two-thirds of the stock of fixed capital in government hands (World Bank, 1987). An attempt was also made to give managers limited autonomy by allowing them to exercise control on pricing their output, freedom to participate in own-exchange import arrangements and in negotiating labor contracts.

Law 97 of 1983 established Public Sector Authorities (PSAs) to act as coordinating bodies between public enterprises and the ministers. Unfortunately, this decentralization effort did not come off too well. The new Authorities added yet another level of bureaucracy and major decisions still remain in the hands of various ministries and agencies (Ott and Hartley, 1991).

Working with the International Monetary Fund (IMF),, the World Bank and the US Agency of International Development (AID), the Egyptian government is trying to put an economic reform program in place. A significant feature of the programme is liberalization, with a view towards enhancing competition and greater participation of private sector enterprises. In preparing the five-year plan in 1986, the government declared its intention 'to rely on the private sector as the future "engine" for industrial growth.

## 4.3 The Stage of Privatisation and the Transition to Free-Economy.

Undoubtedly, the former public sector was a government tool and means to collect resources and direct them towards carrying out development plans. The problems of public sector companies, whether due to financial, marketing or technical reasons, or lack of managerial efficiency, became evident. These problems led to apparent trend towards privatisation as a means to increase the role of private sector so that private investments incentives might play their role in achieving economic rates higher than known opens in public sector (Egyptian National Bank, 1992).

> By all accounts, the Egyptian economy is in dire need of reform. This judgment is based on three factors: a negative capital growth rate of output; a deficient performance of public sector enterprises and an enormous external imbalance. Privatisation of public sector enterprises is a vehicle not only for the restructuring of the Egyptian economy towards more private sector involvement and greater competition but also as an infrastructure necessary for development (Ott and Hartley, 1991).

This trend has come under the economic reform programme and re-construction and applying market mechanisms. In the late 1980s and early 1990s, the state started the transition to a Market Oriented Economy by privatising the state-owned monopolies based on an ongoing programme.

> The new economic policy was characterised by the following features: Firstly, the private sector is to play a major role in conduct of economic activities. The role of the state has been changed from that of producing goods and services to that of just planning and controlling production and designation of activities. Secondly, the public sector manufacturing companies were gradually privatised while maintaining their current available production capacities and developing them whenever possible (Ministry of Public Business Sector, 1993).

### 4.3.1 Objectives of Egyptian Privatisation Programme:

The objectives of privatisation were, according to the Egyptian National Planning Institute ( 1989):

(1) To increase the rates of utilisation of capacity of public sector companies;

(2) To limit the resources consumed and achieving a better level for their use;

(3) To give the chance to connect with the developed countries and obtain modern technologies;

(4) To expand the ownership base among citizens and increase the private sector share of domestic investment;

(5) To support the shift of automobile production from public to private hands;

(5) To activate exchange.

Privatisation of companies was based on the following important principles: *Profitability,* priority was given to profitable companies or those with potential to be profitable, as well as small and medium ones. *Competition,* concentration on companies which has competitive advantage; *Marketing advantages,* whereas companies with market potential are preferred; *Managerial support,* meaning that top and middle management and labour, in a privatised company, are persuaded of the feasibility and importance of privatisation.

This trend was a response to changes and international economic trends besides pressures of International Financial Institutions such as the World Bank, IMF and AID.

> In order to activate the Egyptian Stock Market, it was necessary to make the Egyptian Trade free in accordance with the international agreement GATT and to execute privatisation programmes (Egyptian Central Agency of P M & S, 1994).

> It is noteworthy that since the launching of the privatisation programme up till the end of 1998, about 119 companies were privatised, representing 38 % of 314 public business sector companies (National Bank of Egypt, 1998).

### 4.3.2 Price Reform

To improve the market environment, the government instituted in 1987 and 1988 some elements of reform in its industrial pricing policies. As a part of a budgetary exercise undertaken in 1986, the Egyptian government began removing certain industrial products from the 'essential' goods category. The list was reduced from 29 to

19 items, and price increases were permitted. The list is given of essential products and products for which price changes were allowed in 1987- 88. According to the World Bank assessment of the price reform, the Egyptian government is moving towards a more realistic pricing system for both the essential and non-essential commodities. A more rational pricing policy is believed to be necessary to offset financial losses experienced by the government following the devaluation of the pound in 1987, and hence the rise in the costs of import, and for addressing the more fundamental problems of inefficient resource allocation (Ott and Hartely, 1991).

### 4.3.3 Enterprise Competition

The majority of Egyptian public sector enterprises faced little competition, domestic or foreign. A competition environment cannot exist unless domestic firms are allowed to compete and protection from foreign suppliers, if not eliminated, somewhat reduced. As shown earlier, the majority of public industrial firms face little or no domestic competition either from private or public sector firms, and/or enjoy protection from foreign competitors. As a step towards 'enhancing' competition, the Ministry of Industry (1987) has outlined several industrial activities where private sector participation is said to be welcomed. An expanding private sector role in engineering, building materials and electrical and electronic industries is provided. Domestic competition started to be have a positive impact on the efficiency of public firms and could lead to more realistic pricing practices (Ministry of Industry in Egypt, 1987).

### 4.3.4 The "ISO" Quality Certificate.

From the beginning of this transition towards a market economy, quality became the cornerstone of the industrial development strategy in Egypt through the application of quality control systems in industrial production establishments. The aim was to guarantee product quality according to Egyptian and international specifications. Therefore, the Ministry made the following decisions:

(1) The Ministry made decision No. 17 of 1991 which states that the Industrial Control Organisation is responsible for controlling the factories' production, and also to ensure that quality standards laid down by the Central Agency of Standard Specification (CASS), are well enforced.

(2) The Ministry made decision No. 179 of 1996 to have the producers produce initially 412 main products with pre-determined specifications.

(3) The Ministry decision 180 of 1996 stated that, in the event that a product fails to meet the Egyptian standard specifications, it is allowed to apply for some other international standards from Europe, America or Japan.

(4) The Ministry decision 179 of 1996 stated that manufacturers of consumer goods should advertise the detailed specifications products.

(5) The Industry Ministry also established "The Egyptian Quality System". It aims to the following goals:

- Linking Egyptian specifications to international specifications so that all exports and imports meet the same quality standards.
- Developing detailed technical instructions for the Egyptian industry to ensure that manufactured goods meet the standard specifications and generalising the concept of Quality as a national motto.
- Developing the existing labs of the industry ministry to be internationally reliable, thus being capable of issuing search certificates before loading.

(6) In order to ensure the competence of the offices for presenting search and testing certificates and ISO certificates, a National Council for Authorising Confirmation was established. One of its tasks is to issue certificates to production, quality, environment, labs and members. It is a system to maintain the good reputation of Egyptian products both at home and abroad. So, the republican decision No 312 on 13-10-1996 was issued to establishing the national council to supervise the Industry Ministry.

Thus, most Egyptian companies have increasingly emphasised the quality dimension. This development came about when many Egyptian companies found out that they were about to be ousted by World-class quality products. The Egyptian companies have realised that in order to compete in the world markets, they will have to meet world quality requirements. The recognised international organisations in Britain, Germany, France, US and Japan have determined international standards of quality specifications. In order to produce internationally-accepted products or services, a company must obtain the "ISO" certificate issued by these organisations. Quality system standards such as the ISO 9000 series are now accepted world-wide as models for the implementation of basic quality management techniques.

The ISO quality standard with the four known levels are an important element of total quality management. Many Egyptian companies regard the standards as essential tools for providing a basic structure which will give a foundation for international competition. Companies have realised that registration to a quality systems standard (ISO 9000) can be regarded as part of a progression towards quality improvement.

In summary, Privatisation is considered one of the important instruments of economic reform policy. It is not a mere selling of the public business sector's companies but an integrated group of procedures which lead to shrinking the role of government in direct practice of economic activity and providing suitable conditions to encourage free competition. It is mentioned that privatisation policy is looked upon as means to raise and improve efficiency.

> The results of studies showed that comparison between organisations affiliated to the public sector and the similar ones affiliated to the private sector operating in the same field showed that the latter achieved high profits in return for low costs and high efficiency (Kay, 1987).

Reform of the economy has enabled the following advantages to be achieved: (e.g. National Bank of Egypt, 1999).

(1) The productive system of these companies was reorganised and cumbersome managerial mechanisms abolished.

(2) It gave the companies necessary flexibility to combine technology, managerial experience, capital, production methods and marketing abilities in different ways for different enterprises, which could not be done under the control of ex-public sector.

(3) It led to a more flexible system of incentives and wages, and connected with productivity and profitability, motivating management to improve performance and decrease costs.

(4) It encouraged and increased competition and this makes public sector companies more responsive to market and consumers' desires.

(5) Improved efficiency resulted from competition pressures and other means.

(6) Some ex-public sector companies have a strategic importance and economic power and a great share of the market. When they registered in the stock exchange these companies contributed in developing and supporting the stock market.

(7) Managers become directly accountable to shareholders and not to bureaucratic employers. The main objective of the company will be to maximise profitability. Performance evaluation of managers in these companies will be on the basis of success in realising this objective.

(8) Privatisation led to improving managerial decisions in ex-public sector enterprises by reducing political intervention in the operations and decisions of these companies. Thus, concentration is focused on maximising profitability and improving organizational performance.

The next section deals with the impact of changing the competitive environment on the automotive industry in Egypt.

## 4.4 Changing the Competitive Environment of Egyptian Automotive Industry

### 4.4.1 Egyptian Automotive Industry

The Automotive Industry in Egypt, like those in other developing countries, is influenced by several Governmental policies. This industry is important for the balance of payments through replacing imports, increasing the ability to export and providing employment opportunities. The outcome of this industry are also relevant to the efficiency and profitability of other industrial sectors. Therefore, it can be stated that the import replacement policy was in keeping with the national economic strategy. This industry can be an important participant in economic development, as its effect extends not only to providing opportunities of employment but also to capitalistic investing development, industrialisation systems, research and development and saving wealth.

The automotive industry in Egypt began at the end of the fifties at the time of the first transition stage of the Egyptian economy, its production and contribution to national economy being vital. In spite of the revival in the ex-public sector, the private sector did not give this vital industry the required importance. If we take into consideration the most important international economic events concerning the rise of economic alliances, liberating international trade, globalisation and its probable reflections, we can clearly understand the great importance of developing this industrial sector. The automotive industry started with the establishment of two monopoly companies which were managed and controlled by the public sector. One is a large company called El-Nasr Automotive Manufacturing Company and the other, a small company called Ramsees Company, which manufactured microbuses, cycles and motorcycles. The latter changed its name to El-Tramceco.

Development of the automotive industry under Governmental protection policy and trials of self-sufficiency had adverse results according to the International Arabic Conference of Automotive Industry and its supplier industries (1997, PP. 1-57).

(1) The relative cost of production was high compared with international standards.

(2) As it was permitted to expand production and consumption of the automotive industry's products, the import substitution policy was often not sufficient and a difficulty arose in exporting due to insufficient production. Although the prices were competitive, the problems with quality created difficulties even before exporting was possible.

(3) The existing industries under the protection policy created technological gaps. Innovative products were not introduced and the production of old designs was continued. This gave rise to a lack of opportunities to export to foreign markets. The

result was such that this industry was uneconomical in production even for local markets and obsolescent technology meant its products could not compete internationally.

(4) When the protection policy was set up, it became difficult to remove due to the vested-interests involved. The short term benefits created by this protection policy and compensating exports encouraged the development of several uneconomic and unproductive factories till the market reached its needs. The higher the customs tariff rose for banned imports, the greater were the existing industries' deficiencies.

### 4.4.2 Government Incentives

In order to encourage those investments necessary to the automotive industry, the government created suitable conditions for this industry. This took into account the need to liberate trade and also some private incentives. Custom tariffs were modified to help local manufacturers in respect of imports. Measures included abolishing tariffs on imported components in return for local manufacturers to export. Also, local official support to help training; Research & Development; and spreading technological knowledge, improved the manufacturing environment.

In 1993, the Government issued a new law on importing cars as well as a duties scheme for developing and promoting the Egyptian automotive industry by attracting more foreign investments and reducing the shortage in foreign trade in this industrial sector. These new Governmental policies aimed at encouraging the local automotive and supplier industries. Rapid growth took place in this industrial sector due to the coming into force of these new policies. For example, the original custom tariff on imports of passenger cars ranged between 70% and 200% according to the engine size. The Government reduced this tariff gradually to range from 50% to 160%. Tariffs for commercial vehicles's (CVs) products ranged from 10% to 70%. The government realised that the policies for not importing and maintaining a high local content could be seen only as a short term success and they were going to fail in the long run as a result of the absence of competition. (Ministry of Industry in Egypt, 1998, PP. 12, 13).

The history of the automotive industry shows that this industry flourishes in private enterprises and in the atmosphere of the free market, so it is necessary for Egypt to liberalise the conditions under which these industries function. Low tariff and local content policies, control on local production and investment policies are the common trends at present. Nowadays, Egypt has reduced the constraints of producing and purchasing vehicles and increased the sources from which components are imported and also the range of vehicles. The survival of the industry depends on its ability to produce efficiently. In the modern automotive industry there is no place for inefficiency and the liberalised atmosphere is a pre-condition to keep this industry alive.

Thus, the Government has realised that automotive firms may grow and develop on the following bases: (1) Increasing competition; (2) Liberalising imports; (3) Guiding industries; (4) Facilitating entrance to foreign market; and (5) Facilitating property laws.

Consequently, the automotive industry grew in Egypt rapidly during this period. Table (4-1) shows that many private firms have been established recently, leading to an increase in marketing and production capacities in the industry. For example, actual production of passenger cars was 32,000 units in 1996, and it is expected that this volume will be multiplied by three by the year 2000. Production of light CVs was 17,500 units and that production of lorries and buses was 11,000 units in 1996. It is expected that production will continue to multiply until the year 2000. The demand in 1996 was estimated to be about 50,000 passenger cars and 25,000 CVs of different sizes. It is expected that local production of passenger cars will exceed the local demand in the coming years by some 30%. Also expected is a reduction in imports, due to the ability to produce modern cars locally.

Table (4-1)

Egypt's vehicle industry and its products for 1997

| Company | Local participant | Passenger cars | Cvs | Beginning date of production |
|---|---|---|---|---|
| Strewn | Jak | FIAT AX , | | 1993 |
| Fiat Efico | El-Nasr | FIAT 131 | Busses, Lorries | 1970 |
| General Motors | G M Misr | Fectra | Lorries G M & Eusuzu | 1980 |
| Hyundai | Gaboor Group | Ekssent | | 1995 |
| Kraizlr Kamyon (Torky) | Egypt Medico | | PD 950 (18 tons) | 1996 |
| Marcheieds Penz | Gaboor Group | | Service vehicles, Heavy lorries, and Buses | 1996 |
| Marcheieds | Penz Natco | E-Class | | 1996 |
| Nissan | Sudia Group | | Service Vehicle & Minibus | 1995 |
| Peugeot | American Motors | 405 | | 1994 |
| Skania | Gaboor Group | | Busses and heavy Lorries | 1990 |
| Suzuky | Modern motors | Soyft | | 1992 |
| Piagu | Military Plans plant | | APE (3-Wheeled) | 1997 |
| Scoda | Artok | Felyshia | | 1997 |
| Daywo | | Nyksia | | 1997/98 |
| BMW | Abo El Fottoh | Group 5 | | 1997 |

[Egyptian Industrial Union (EIU), 1997]

The available productive capacities of nine Egyptian automotive companies for passenger cars are shown in Table (4-2).

Table (4-2).

Available productive capacity for passenger cars

| No. | Company | Available Capacity |
|---|---|---|
| 1 | El-Nasr Automotive Manufacturing Co. | 13,500 |
| 2 | General Motors/ Egypt | 17,500 |
| 3 | Briema of Engineering Industries 'Huindai' | 20,000 |
| 4 | Peggua / Egypt | 03,000 |
| 5 | American Arabic of Cars 'Scoda' | 10,000 |
| 6 | Egypt Suzuky | 08,000 |
| 7 | El Massrya of Cars Manufacturing -Jak 'Strewn' | 25,000 |
| 8 | German Egyptian of Cars 'Marchieds' | 01,000 |
| 9 | Abo El Footoh to Assemble 'BMW' Cars | 01,000 |
| | | 99,000 |

[Egyptian Industrial Union (EIU), 1996]

Table (4-3) shows the Egyptian passenger cars' market share for 1996.

Table (4-3)

Egyptian passenger car market share for 1996

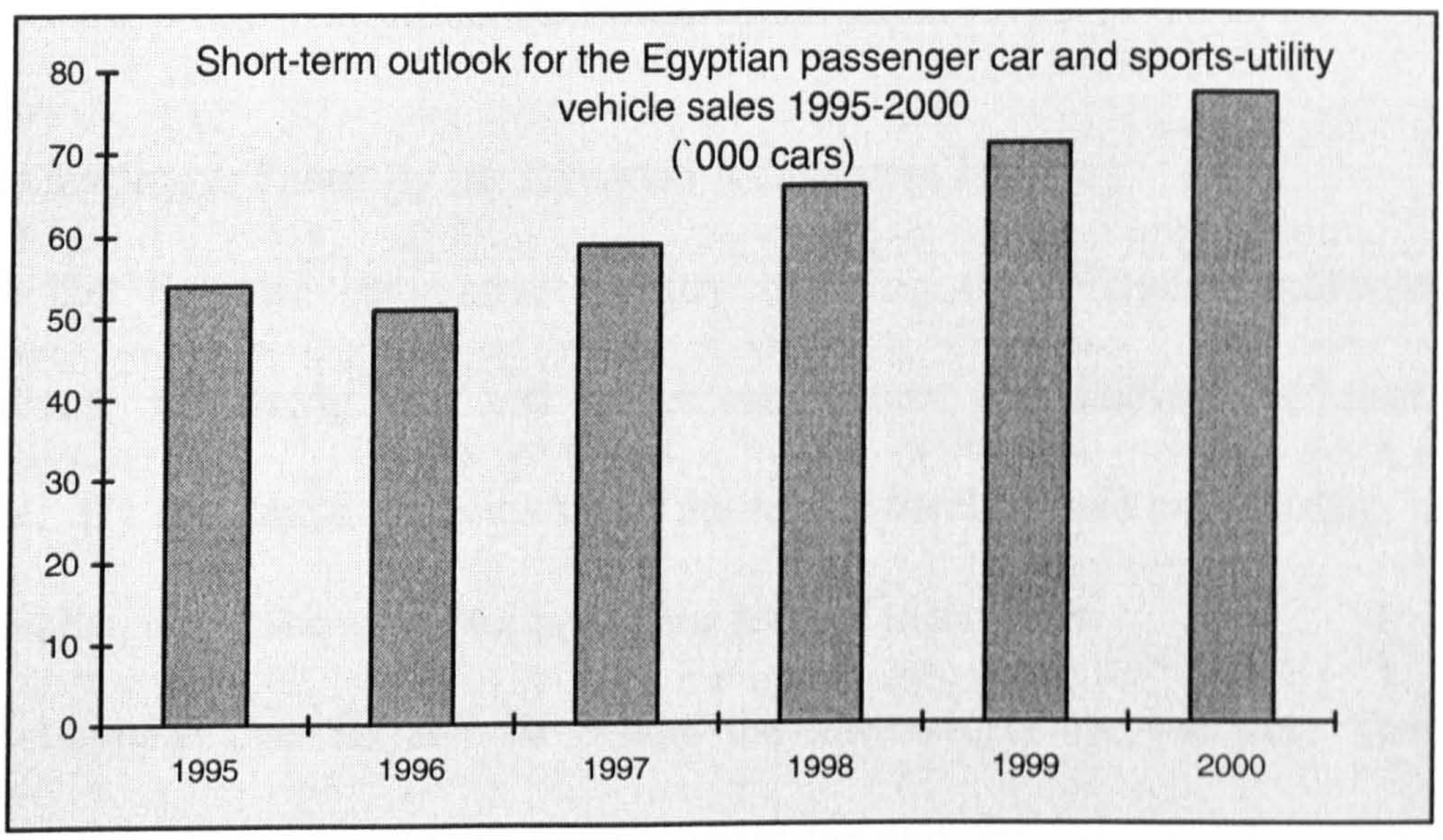
| Company | Market Share % |
|---|---|
| Hyundai | 15 |
| Scoda | 15 |
| Suzuky | 14 |
| Fiat | 12 |
| Lada | 11 |
| General Motors | 09 |
| Peugeot | 05 |
| Strewn | 04 |
| Others | 15 |
| Total | 100 |

[Egyptian Industrial Union (EIU), 1997]

### 4.4.3 Growth Expectations of Egyptian Automotive Market (1995-2000)

The demand for passenger cars in the Egyptian market reduced from about 54,000 cars in 1995 to 51,000 in 1996, despite improving economic conditions. This situation arose for two reasons: firstly, a levelling off in the market after a sales improvement in the previous years and secondly, the expectation of a reduction in import tariff. It is expected that the market will grow particularly in the passenger cars sector, as these products will benefit from the reduction of tariffs. Figure (4-1) shows the market's expectations of the passenger car and sport-utility vehicle market, 1995-2000.

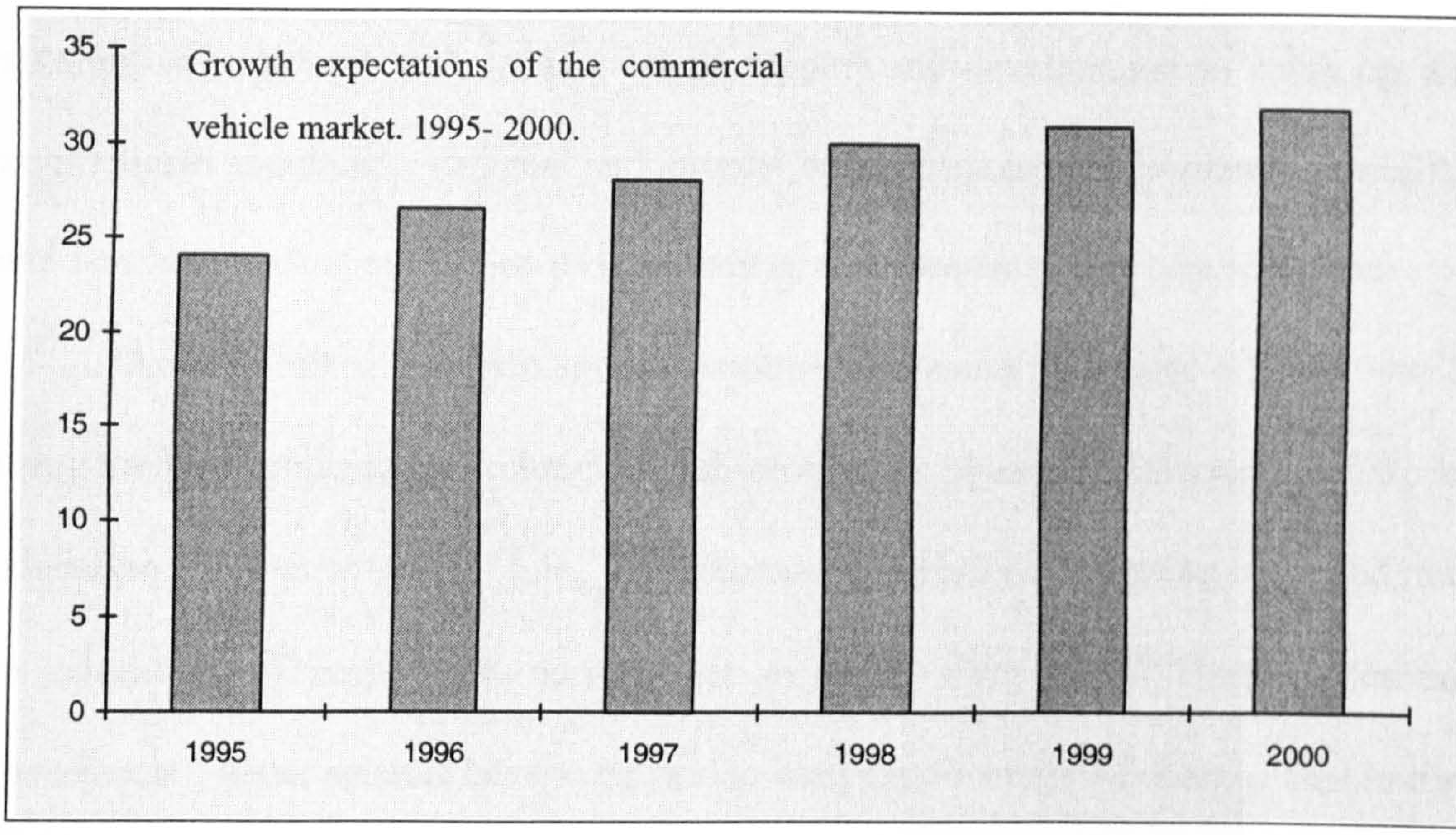
Figure (4-1)




[Egyptian Industrial Union (EIU), 1997]

Egyptian CVs's market benefited from the increase in utilities activities in 1996. The growth rate was 10% in 1995 and was expected to continue in 1997. Figure (4-2) shows the growth expectations of the commercial vehicle market, 1995- 2000.

Figure (4-2)




[Egyptian Industrial Union (EIU), 1997]

### 4.4.4 Challenges Faced By the Egyptian Automotive Industry

The Egyptian automotive industry is facing the following challenges and limitations: (1) Strong local and foreign competition, particularly from Japan, West Europe; (2) The increasing activities of the second-hand or used cars market; and (3) demand for cars which relates to the income level of individuals.

Egyptian cars are still far behind the international competition. Too small production numbers are an impediment toward the only solution, which experts see as increasing the "local content" rate as well as to improve the quality of products and of producers. Therefore, a supplier industry has to be developed on long term basis, which will finally lead to a cost reduction. Nevertheless, the challenge is huge, since packed and shipped CKD-Kits (Complete Knocked Down) may be more expensive than imported CBUs (Complete Build Up) i.e. the imported vehicles, particularly when the GAAT agreement is in force. Also, the local industry is obstructed by low volume that does not justify investments in High Technology equipment to produce world class quality components. It may not obscure the fact that the majority of Egyptian automotive industries still needs a lot of support and development to catch up with international standards. External and internal order management, planning capabilities and constant product quality are as important as cost awareness and cost reduction.

Another factor is to structure automotive companies in a more efficient way by using modern management techniques and information systems. Also staff and worker education plays an important role. The automotive industry is investing more and more in education of employees, and to get a return from such "Human Resource Investment", better salaries have to be paid to bind people to the company. This in turn, will be reflected in better purchase power of the employees, who will start thinking about buying a car also. To improve quality levels of products as well as to ensure constant company quality levels, different certification programmes have been started and already successfully implemented by some companies.

In sum, Egypt is an interesting market for car producers since a new generation of automotive supplier companies is going to grow up. Market pressure is realised by new local car competitors which provide better products for lower prices. Through GATT, Egyptian car producers are forced to deepen and strengthen their production- and supply chains and to improve products and processes.

## 4.5 Summary

This chapter has investigated the effect of the transition of the Egyptian economy on the manufacturing and competitive environment of ex-public sector companies. Three basic phases of economic transition were identified: nationalisation and adopting the central-planning economy, El-Infitah policy and reforming towards mixed economy and privatisation and the transition into Free- market economy. These three phases reshaped and influenced the manufacturing and competitive environment of Egyptian ex-public sector companies. Under a Centrally planned economy, the Government economic policies created a context in which it was difficult for manufacturing companies to perform well. The Egyptian ex-public sector companies faced a number of governmental difficulties or constraints which were either neglected or overlooked. For example, modern techniques of production were often neglected. Legal constraints imposed on management in these companies restricted the managers' ability to lay off redundant workers, eliminate social pricing or perform discriminatory practices. In effect, managers had little authority over key decisions and they lacked flexibility in managing day-to-day operations. These companies lacked the capability to compete in world markets and even in the domestic market, where they were unable to ward off the invasion of foreign producers. Lack of competitiveness was seen to embrace not only price, but, perhaps more significantly, other dimensions such as quality and delivery performance.

The first reform of the Egyptian economy was adopting El-Infitah policy as the manufacturing sector attempted to find solutions to its problems. It was a preparatory phase to transition partially into the free economy and incomplete competition. The Government issued several laws of economic reform in order to improve the efficiency of the ex-public sector's companies. The recent reform of the Egyptian economy is to transform completely, though gradually, into a free economy based on privatisation and liberation. Privatisation of the Egyptian ex-public sector companies is considered one of the important instruments of the new economic reform policy which has led to shrinking the role of government in direct practice of economic activity and provided suitable conditions to encourage free competition which was lacking in the old-established public sector due to the governmental protection. As a result, the ex-public sector companies have started to modernising their production techniques, become interested in product quality, and are using sophisticated managerial policies. The search for competitive advantage and attempts to achieve world class manufacturing standards have become the goals of companies.

The current research is meets the need to examine the effect of the changing manufacturing and competitive environment on development of cost accounting systems in a factual situation. The next chapter, therefore, is dedicated to investigate manufacturing environment of the case company and the potential production problems.

Chapter Five

# Background About the Company and the Manufacturing Environment

## 5.1. Background About the Company

### 5.1.1 Business Area

El-Nasr Co. is one of the biggest automotive companies in the Engineering industry sector not just in Egypt but also in the Middle East and Africa. It occupies 1,660,000 square metres, out of which 378,816 square metres is covered. It has selected the current location because of nearby major local supplier industries and availability of transportation. The company has performed a vital role by supplying transport vehicles to the different classes of the Egyptian society. The company manufactures, assembles, and sells various types of vehicles including passenger cars, trucks, buses, tractors and trailers. It also makes engines, necessary components for production, and spare parts for its products and manufactures for others (El-Nasr Bulletin, 1997).

It has been in business for 40 years and has experienced a very high growth rate, with revenues of over LE 778.50 million and total assets of over LE 1.50 billion. Vehicles sell in the markets in a built-up (complete) or in parts state. All are processed in seven fabrication and assembly plants before release to the market place. The company's sales during its years of production, total, according to the Company magazine (1998): Passenger cars 340,000; Lorries & Tractors 118,000; and Buses & Min-Buses 22,000.

### 5.1.2 The Organisation Structure

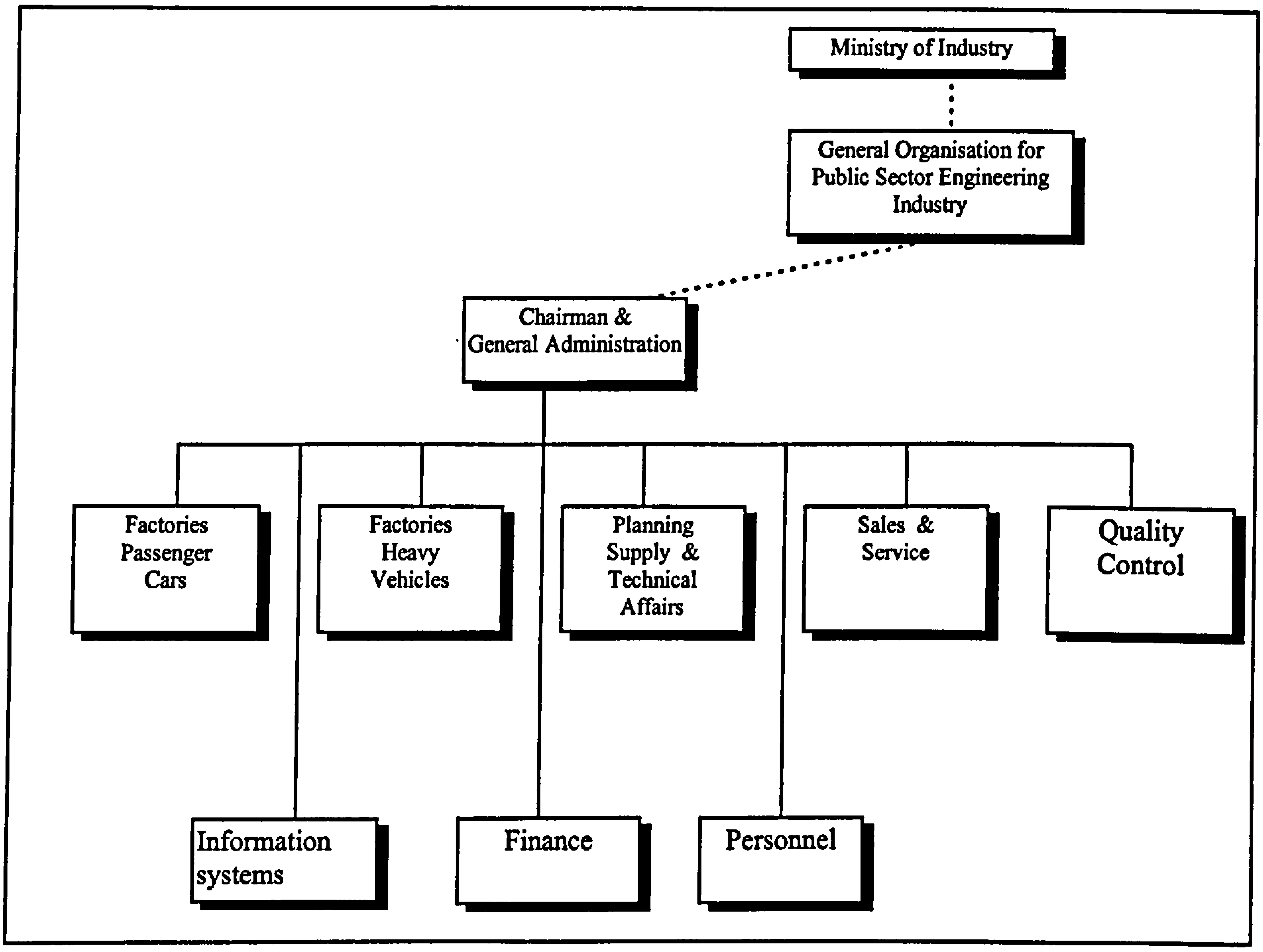
> The public enterprises were considered the 'private' property of the state, and they were managed by individuals who more often than not had no experience in the field, while the organisation of the public sector failed to provide enough checks and control against illicit practices by the management of the public enterprises (Interview with vice-president, July 1998).

Public organisations were therefore abolished by a law that concentrated power in the hands of the Board of Directors of the individual public companies. This power gives the Board responsibility for following up the implementation of projects and meeting deadlines, achieving financial targets, developing resources, recruiting and training manpower and implementing quality and quantity control.

The Government's need to plan and control the manufacturing industry in the ex-public sector has, however, recently resulted in a new umbrella organisation, intended to overcome the old policy of concentration of the power and management in the central government. The General Organisation of Public Sector with subdivisions for individual branches (engineering industry, chemical industry etc.) is thus the newly formed intermediate body between the Ministry and the individual company (see figure 5-1).

Figure (5-1)

Organisation structure of the company




The company is organised in six sectors, each sector having a number of divisions. The dotted line indicates the indirect supervision of the Ministry of Industry as a representative of the Egyptian Government. This means that although the Government has abandoned its direct control of the ex-public sector companies, political objectives cannot be ignored as an influence on organisations. Further changes in the present organisational structure of the company can be anticipated if agreement is reached in present negotiations between the company and 'Daewoo' (Korean Co.) about a joint venture, DMCC (Daewoo Misr Car Company) for the production of Buses and Trucks.

With reference to the company's organisation structure in figure (5-1), the present study was carried out within four sectors : the two Factories sector; the

Planning, Supply and Technical Affairs sector; and the Finance sector. Thus, viewpoints have come primarily from these sectors rather than, for instance, from the Sales and Service sector.

### 5.1.3 Company Strategy

Government policies are important in determining the way in which the company's strategy is formulated, since the company's strategy is developed and promoted as a part of the industrial development strategy of the country. At the time of the company's establishment, the dominant strategy was for the local manufacturing content to achieve a hundred percent import substitution, as will be explained in more detail below. The tendency in this company was for large-scale manufacturing enterprise to be highly vertically integrated.

During the 1980s, the Government tried to change the industrial strategy from import substitution to export promotion. Increased competition has led the company to seek to develop a sustainable competitive advantage by adopting not only a low-cost strategy but also a product differentiation strategy. The company has achieved recognition of quality programmes. In 1996, it obtained an International Quality Certificate of ISO 9002 in the field of passenger car products. It is planning to integrate new technology with a substantial base of existing equipment. Joint venture is a part of the company's strategy at present and for the future.

## 5.2 Manufacturing Environment

The manufacturing environment of the company has changed over time. It is affected by the prevalent conditions of competition, the extent of government ownership and control, and changes in customers' tastes. The company has started to adopt new advances in production technology. In this section, a brief outline of the company's production systems, shop-floor organisation, engineering and assembly processes, and production organisation is given.

### 5.2.1 Production Systems

The company uses a batch production system to produce groups of similar units in a certain order to meet the continuous demand. When a set quantity of an item has been produced, the factory sets up machines for making the next group of items. Then, after the required quantity of the other items has been made, the factory returns to producing the earlier items, and so on. The batch production system, in this case, combines both continuous and intermittent production systems. Thus, the company's plants have the characteristics of both systems. The continuous production is characterised by standardisation and repetition because materials and components flow from one workstation to another, regularly and in sequence. Each process in the series is related to the proceeding and subsequent processes. It is desirable that production should pass through these processes smoothly, without bottlenecks.

Also, the production system is intermittent because the company produces according to customers' different tastes and requirements. The plants' facilities are characterised by a flexibility that allows the output of various types and volumes of products. The design is such as to allow changing the product from time to time.

This system is very complicated and needs a sophisticated information flow. For example, in the assembly plant of the passenger cars, where a single product is made continuously, an assembly line is designed to perform specific operations. All parts and components which flow through the line pass the same operations. Nevertheless, the cars that appear at the end of the line are not necessarily similar. For example, some cars have two doors, others have four doors. Some might be green, others black. Some are fitted with standard tyres and others with special tyres. As a result, layouts of the company's plants take these differences into account.

Under the batch production system that apply in the company, production may be one of such aspects as: a 'one off' batch; a batch as required; a batch to meet a continuous demand (Factories' tours, Observations, and Interviews with the production engineers and the operators at the company, June, 1998).

### 5.2.2 Shop-Floor Organisation

As discussed above, parts production at El-Nasr Co. is (batch-) flow-oriented, where material and components in process are transferred among operations in machine centres. A number of machine centres belong organisationally to an operations room within a plant, and each centre is equipped with a group of homogeneous machines and skills based on the functions to be performed. The operations room is the operational conjunction between the planning department and the shop floor.

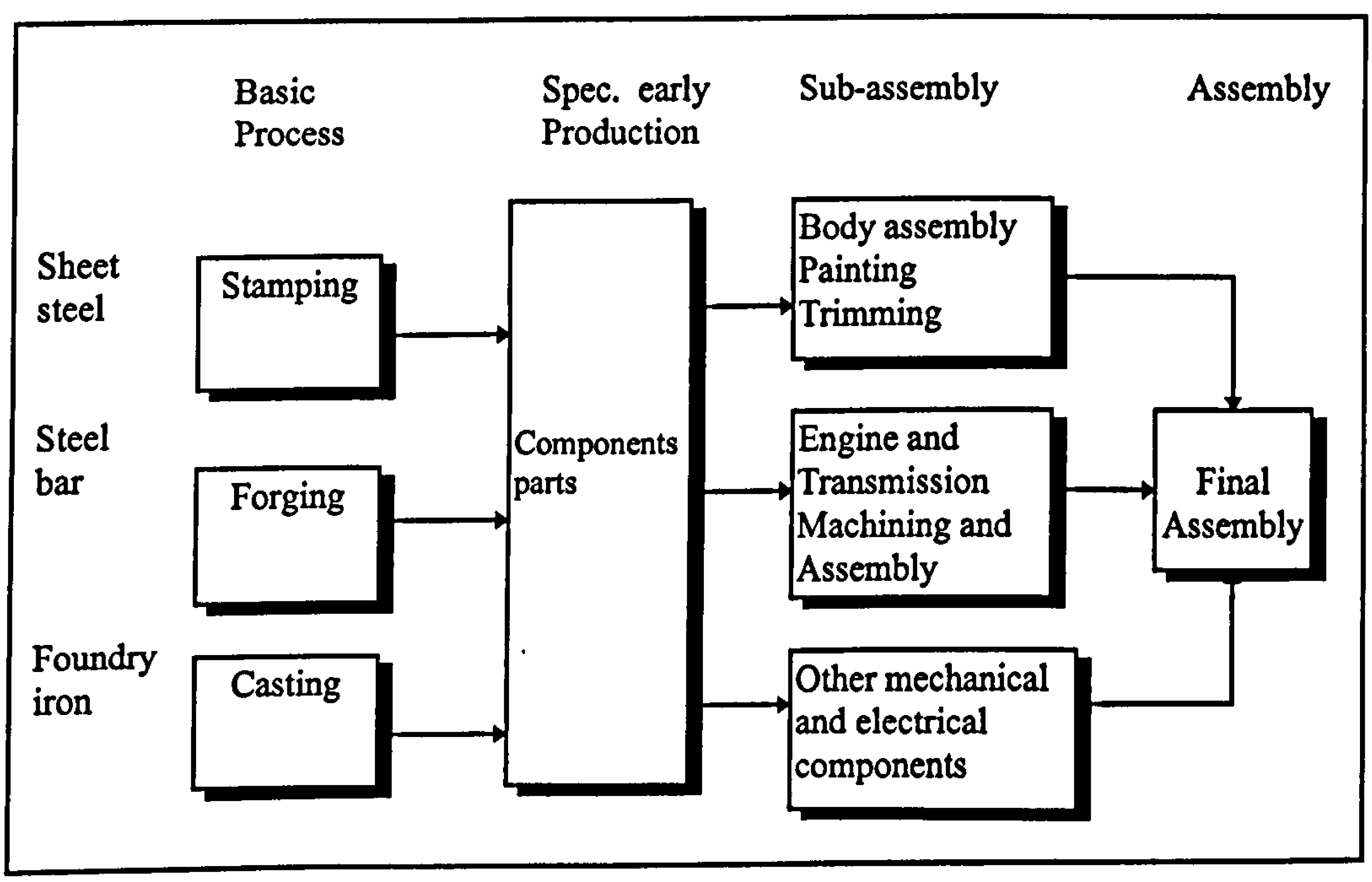
Works orders are either for single units or batches of identical units, e.g. a customer may order a car, or a Governmental institution such as "the Corporate Institution of Transportation" order a batch of buses. The sizes of orders are determined according to economic rules (economic order quantities). Each order specifies the required operations that are to be processed in certain machine centres. Associated with each operation is an operation time, i.e. the sum of transportation time, machine set-up time, process time, and machine tear-down time.

The sequence of operations is usually constrained by technological requirements and thus determines the routing of the order across machine centres. The planning of job shop activities is based on assumptions about availability of resources and standard times for machine work. The accuracy of these assumptions and the applicability of the standard times are important for the capacity planning. As we will see below, this results in a serious problem at the company.

However, the making of any type of motor vehicle involves in general three basic phases: design, fabricating of parts and the assembly of components, first into sub-assemblies and then into the finished vehicle. A characteristic of production under license, as with El-Nasr Co., is that design is subject to engineering changes imposed by local requirements.

Figure (5-2)

The motor vehicle production process



Stamping of sheet steel into body shells (see figure 5-2) is the only basic process done by the company. Forging and casting of, for example, engine blocks and gear box housings is done outside, partly at 'El-Nasr Company for Forging', another public industry in Egypt. For basic parts production, as well as for sub-assembly steps, there are thus different sources of supply: from foreign subcontractors, from other Egyptian local supplier companies and from in-house production.

### 5.2.3 Engineering and Assembly Processes

#### 5.2.3.1 Engineering Process

It is worth mentioning that metals are the basis of the engineering process, but there are other industries' products which are also necessary, for example, plastic, glass, rubber, etc. The engineering process supplies manufactured parts and components to the assembly process, to be assembled into the form of finished commodities. Consequently, the purpose of an engineering process is to convert and form the metal and non-metal products -through an assembly- into products with specific features which are ready to be used by consumers. Therefore, an engineering process depends, firstly, upon other industries which provide the production requirements. Assembly is the last process in the production system in the company. This engineering process needs highly skilled labour, continuous training and advanced manufacturing technology as well. Engineering products' consumers are either final consumers, as when a motor is used to assemble a car, or intermediate ones, such as when a motor is used to operate a machine, to produce other goods (Interview with the Director of the Fabricating parts' factories).

#### 5.2.3.2 Assembly Process

The assembly process at the company is in charge of assembling products which consist of several parts and components. These processes are accomplished in a chain of operations and performed by either a single group or many sub-groups, proceeding to the final assembly. The parts which a worker (or workstation) is responsible for assembling are also required to be determined in advance. The output of this assembly process is always a completed product which is different in form and characteristics from its contents, i.e. parts and components. The assembly process can be either as simple as assembling a chassis or as complicated as assembling a car. This company uses assembly lines to assemble parts and components in order to obtain a finished product.

To ensure the continuity of production, materials and parts have to be available regularly, and the production lines be balanced or reconfigured as well. It is necessary to maintain good planning, control and follow up of the production throughout the assembly process. Also, efficient and effective systems of purchasing, storing, material handling and transport are important to guarantee a continuously production flow.

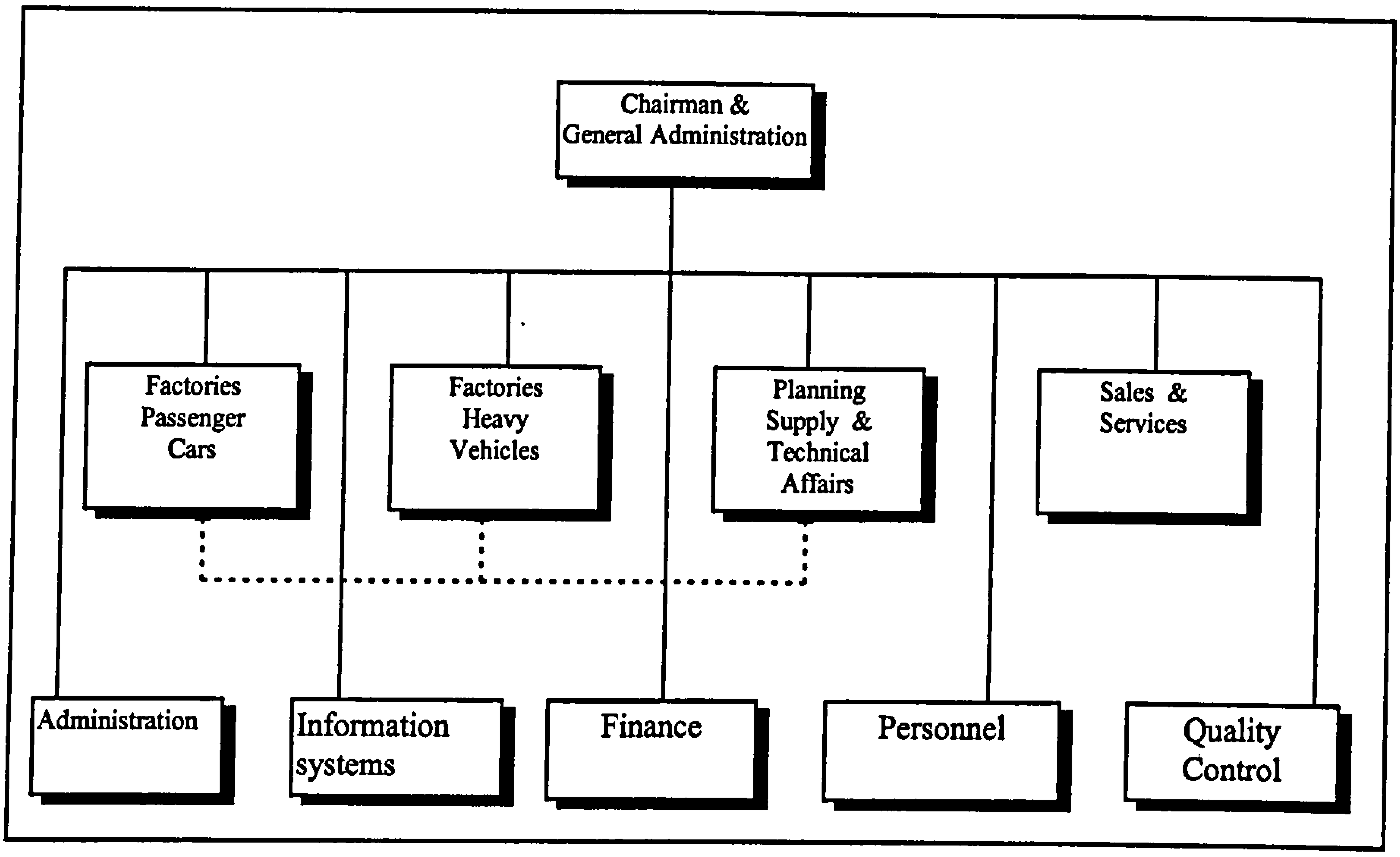
In the following we will restrict the study of El-Nasr Co. to the flow of material for final assembly. This view will, however, include not only material but also in-house manufacturing of parts and sub-assembly of components. Before the material flow is described in more detail, partly below but primarily in chapter seven, an overview of the production organisation is presented.

### 5.2.4 The Production Organisation

The company is organised in six sectors, each one with a number of divisions. Figure (5-3) shows the company's production organisation.

Figure (5-3)

The production organisation at the company




### 5.2.4.1 The Manufacturing Plants

Engineering factories at the company include diesel engines factory, petrol engines factory, miscellaneous machines, gears and heat treatment factory, press factory and tool shop room. Assembly factories at the company include a factory for trucks, tractors, trailers & buses and a factory for passenger cars.

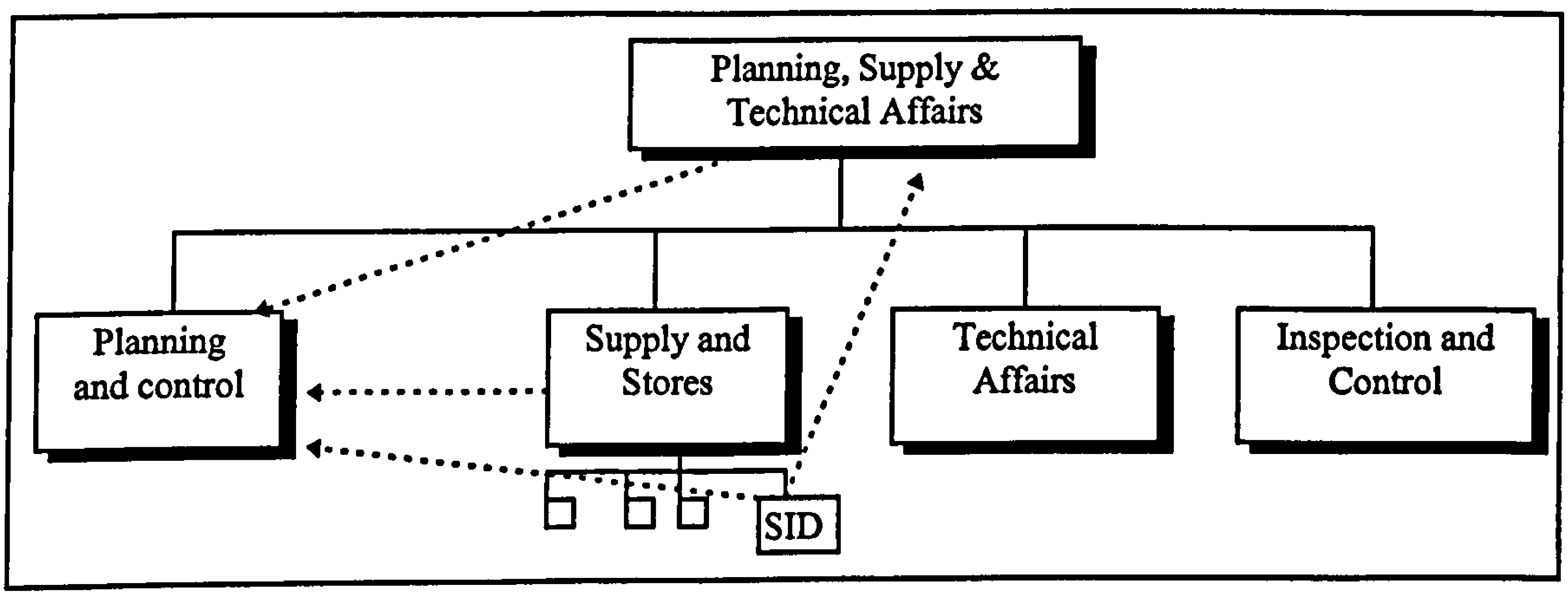
In house-manufacturing takes place in Hangars 2, 5, 6 and 7. Hangar 2 is the Diesel Engine Factory where items such as cylinder blocks, crankshafts, connecting rods, oil pans etc., are manufactured out of components that are supplied in incomplete condition. The factory has lines for assembly, testing and run-in of diesel engines. In Hangars 5 and 6, various mechanical components for heavy vehicles are manufactured in four different sections. In section one are production lines for components of differential rear and front axis. In section two are machine groups for various machining operations, e.g. lathes and boring drilling and broaching machines. Section three is dedicated to gear cutting and there are machine centres for cutting pinion gears, different gears, gears for gear boxes etc. Section four is for heat treatment.

Hangar 7 is the press shop, performing the only basic process done within the company. Here, parts for heavy vehicles are formed, welded and machined. Items manufactured in the press shop are, for instance, doors, bumpers, bus body parts, axle housings, brake shoes and tractor fenders.

#### 5.2.4.2 Planning

The Planning, Supply & Technical Affairs sector, having the operational responsibility for the planning of production and for materials supply, is of particular interest throughout this study. A more detailed organisational chart of this sector may therefore be useful:

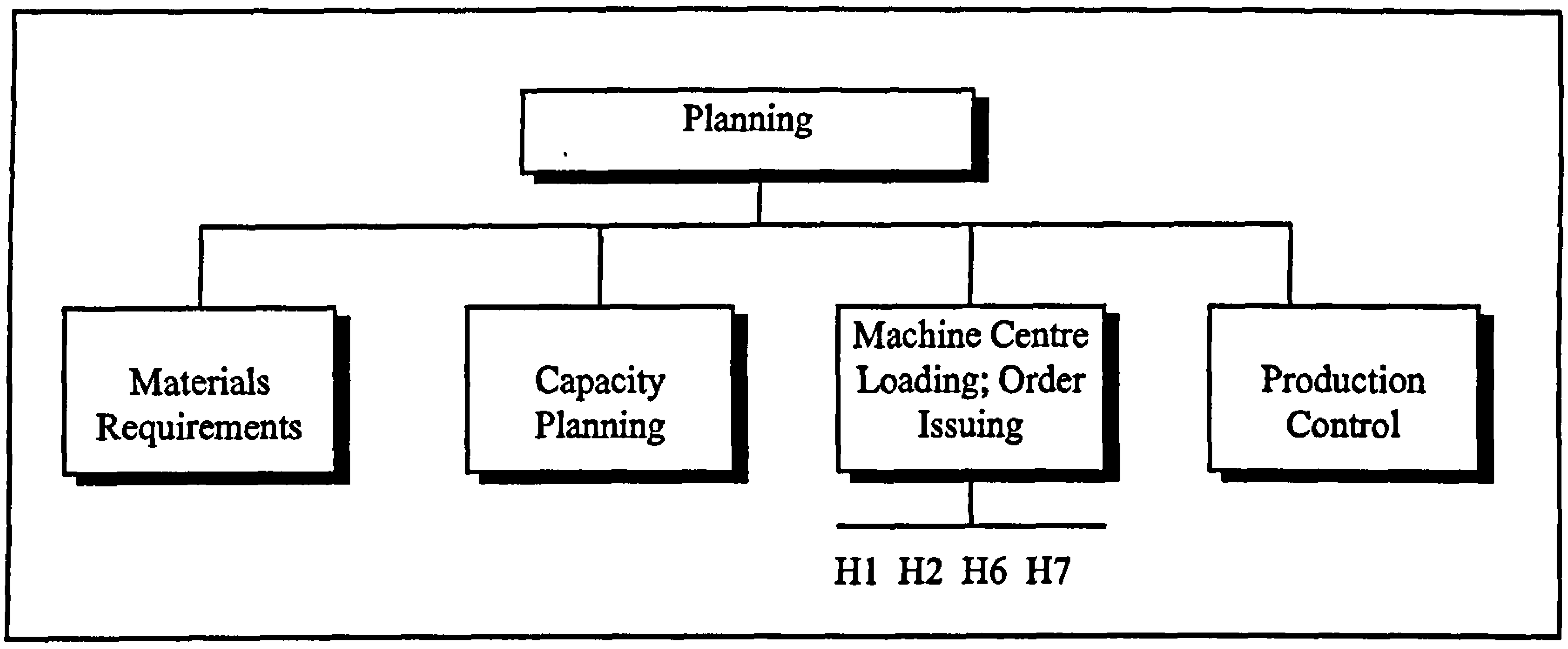
Figure (5-4)
The planning, supply and technical affairs sector




The planning and Supply and Stores divisions are organised as follows:

Figure (5-5)

The departmental organisation of the planning division



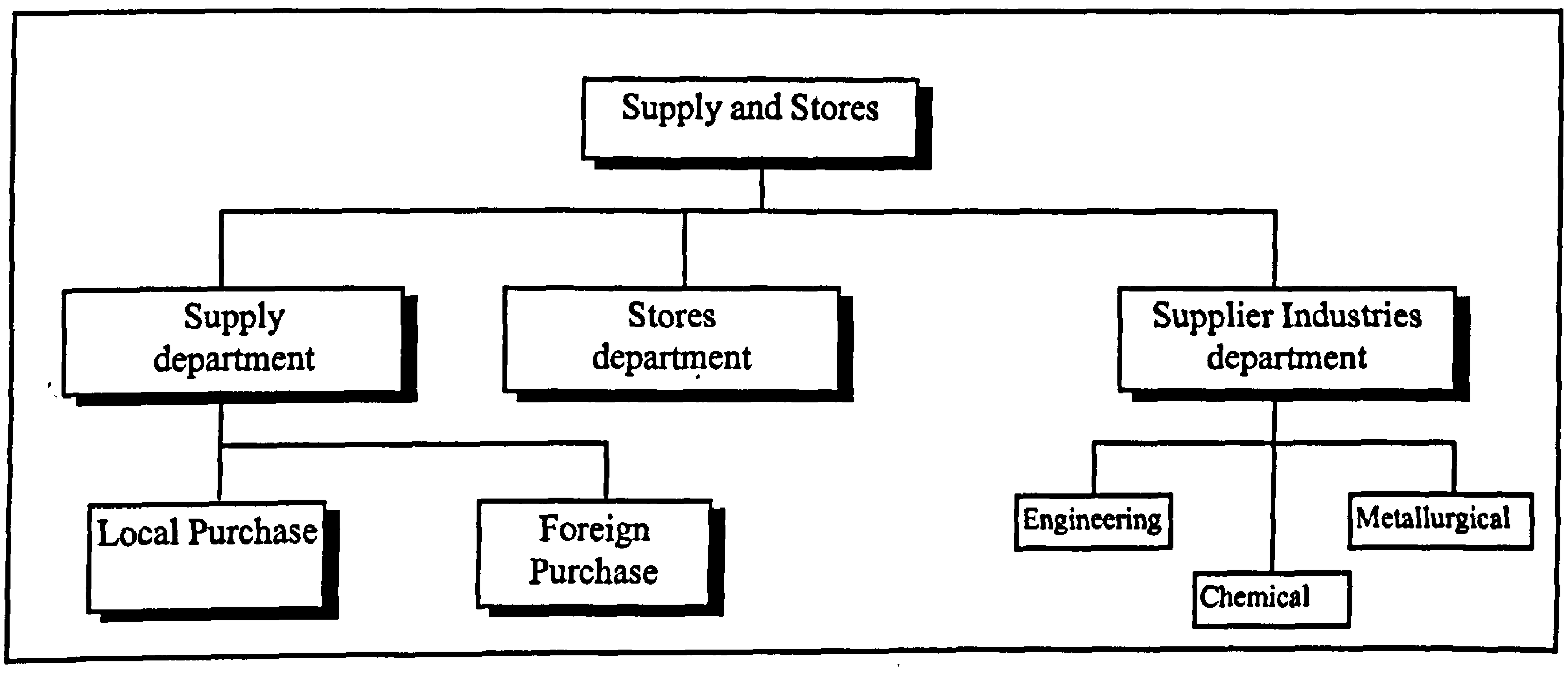

H: Hangar

### 5.2.4.3 Stores

There are three different kinds of stores: the Principal Store, common for the heavy vehicle production, and organised under the Supply and Stores division (Figure 5-6);

Figure (5-6)

The departmental organisation of the supply and stores division




Control Storage, belonging to the Planning division, which serves as a materials buffer, and third buffer, is found in each Hangar Store. It should be noted, however, that a not insignificant volume of material in various shapes and conditions is found outside the three official stores, i.e. in the surrounding alleys and open places within the factory area. This material represents work-in-process or products for storing.

### 5.2.5 Local Manufacturing Strategy at the Company

Since the establishment of the company, the strategic target has been to promote and enhance domestic production by encouraging local enterprises. There are two main reasons for this: to build an indigenous skill in industrial production and to reduce the outflow of capital for the import of material and parts. The company has a role in the establishment of local industries, both through its Supplier Industry Department and in a few joint projects, and there is a long-term plan to exploit any available potential to increase domestic content in the final products. Though the company has made efforts to buy-out most of its requirements from local suppliers, it still chooses to internalise production of some parts and components whenever there is available capacity, especially with the general bias against private industries which appears to have been carried over from the days when the private sector was not politically favoured.

As a matter of fact, this domestic production strategy is still determined in the light of the political objectives of the Government. An effect of this is that the government may establish rules that are intended to benefit the country but are not necessarily in the interest of the company. For example, the transfer of purchase of certain components from a foreign to a local supplier may be regarded as important from the government's point of view (import substitution) whereas for the company the result may be quality problems or delivery delays. This is further discussed below.

However, it is not easy to reach the target because of the fact that the automotive industry requires huge capital investments, advanced technology, availability of the raw material, labour skills, technical, engineers, and very large space for the hangars, stores and other administrative departments.

The establishment of the Fabricating factories at the company is clear evidence of the intention for the company to produce a complete locally manufactured and assembled product. During 1960 and 1961, three agreements for three new projects were signed. The domestic needs for the products of each project, as well as their importance to the national economy, were borne in mind in determining priorities. Hence, top priority was given to the manufacture of trucks and buses, followed by agricultural tractors, third was assigned to trailers. The passenger cars project occupied the fourth priority.

Despite the efforts made by the company in order to achieve the targeted percentage of local manufacturing content, the company, by 1991 had achieved various levels of local manufacturing content for different products, as follows:

Table (5-1)

The local manufacturing content of the company's products in 1991.

| Product | Local Content Percent |
|---|---|
| Engines | 90 % |
| Mini Bus | 74 % |
| Modification Bus | 84 % |
| Heavy Bus | 60 % |
| Lorry & Tractors | 35 % |
| Developed Lorry | 76 % |
| Saturn Lorry | 85 % |
| Military Lorry | 70 % |
| Passenger cars | 20 % |

General administration of factories at the company, Performance assessment reports, 1990/91 (Local content includes both in-house production parts and local purchases including customs duty. It also excludes the assembly operations and imports).

Table (5-2) shows the progressing of local manufacturing content of products at the factories level in 1997. It can be seen that the percentage of local content is higher in buses, tractors and engines than in passenger cars.

Table (5-2)

The local manufacturing content of the company's products in 1997.

| Product | Local Content Percent |
|---|---|
| **Lorries:** | |
| -Saturn Nasr Lorry 125/ 13 Engine 125 H. P. Chassis /Box 8.6 ton | 91. 49 % |
| -Modification Nasr Lorry 190 Engine 190 H. P. Chassis /Rear Tipper /Tractor head/ Fire Engine 10. 2 ton. | 83. 37 % |
| -Military Nasr Lorry 4*4 Engine 125 H.P. Chassis/ Box | 87. 33 % |
| -Heavy Nasr Lorry 2*4 /4*6 /6*6 Engine 256 H.P. Different Loads. | 50. 58 % |
| -Daily Nasr Lorry/ Light Truck Preparations/ Double Cabin | 52. 90 % |
| **Buses** | |
| -Modification Nasr Bus/ 924 | 93. 07 % |
| -Bien El Mudun Nasr/ 923 Standard/ | 86. 93 % |
| Air Condition | 79. 74 % |
| -Heavy Nasr Bus 871 Engine 256 H. P. Load 110 Passenger | 75. 72 % |
| -Tourist Coach Nasr "High Deck" | 75. 72 % |
| -Nasr Mini Bus 941 /Engine 88 H. P. Load 26 Passenger Standard/ Air Condition | 74. 33 % |
| **Tractors** | |
| Nasr Tractor 651/ Engine 65 H. P. Agriculture & Transport | 40. 72 % |
| **Passenger Cars** | |
| -Nasr Dogan 1600 Tempra | 44. 00 % |
| -Nasr Sahin 1300 | 46. 00 % |

General administration of factories at the company, Performance assessment reports, 1997. (Local content includes both in-house production parts and local purchases including customs duty. It also excludes the assembly operations and imports).

This strategy has a direct impact on the computerisation process of the company, since the goal of increasing local content also applies to the company's own production, where the share of manufacturing increases relative to assembly. This creates a demand for improved co-ordination of production and material supply and, hence, for efficient production planning and control methods.

## 5.3 Changing the Manufacturing Environment and Seeking to Competitive Advantage

The monopoly position of the company enabled it to enjoy most of the characteristics of scale economies of the automotive industry in Egypt. A higher volume of output was achieved, particularly, in the commercial vehicles rather than in the passenger cars, with a relatively unskilled labour force backed by heavy investment in machine tools and long model run.

In recent years, particularly, as the competition has become very strong, Egyptian markets are more accessible to foreign auto makers; and customers' tastes have changed as well. Achievement of a competitive advantage in the automotive industry in Egypt depends not only on production volume but also on the number of models produced and the length of life of these models. This factor is especially important in the production of passenger cars, due to the continuous change of models. The normal pattern has been for cars to get a major model change every two or three years. However, with rising costs of tooling, the cycle has slowed down to changes every four years, with face-lifting minor changes in exterior sheet metal, front grills, and chrome adornments in the interim years. This pattern is known as the style cycle. It is worth mentioning that the initial expenditure incurred by the company when changing a model used to be high, especially when most equipment used in car manufacturing was specific to a particular model. Obviously, the longer a model stays in the market the more it is possible to spread the costs of specialised machinery and tools.

In order to satisfy the diverse customers' needs, the company produces different versions of vehicle models. As a result, vehicle models change over time, particularly with technological progress and changes in product characteristics. The company has started to adopt a more flexible production technology, which has dramatically changed the production method. Flexible automation involves the use of numerical control machine tools (NC) and computerised numerical control machine tools (CNC) which can cope with different models in the different processes of motor vehicle production, e.g. stamping, welding, painting and machining operations, and testing.

Although the developments in production technology in the company have increased the flexibility of production facilities in responding to customers' rapidly changing demands, they have also led to even more capital intensive techniques, so that unit fixed costs have become even more responsive to volume and the financial burdens of under-utilisation of capital and production capacity have become more severe, as explained in Chapter Eight. For example, under-utilisation of capacity in the 1990s resulted in very heavy operating losses because of the increasing competition.

## 5.4 Production Problems Facing the Company

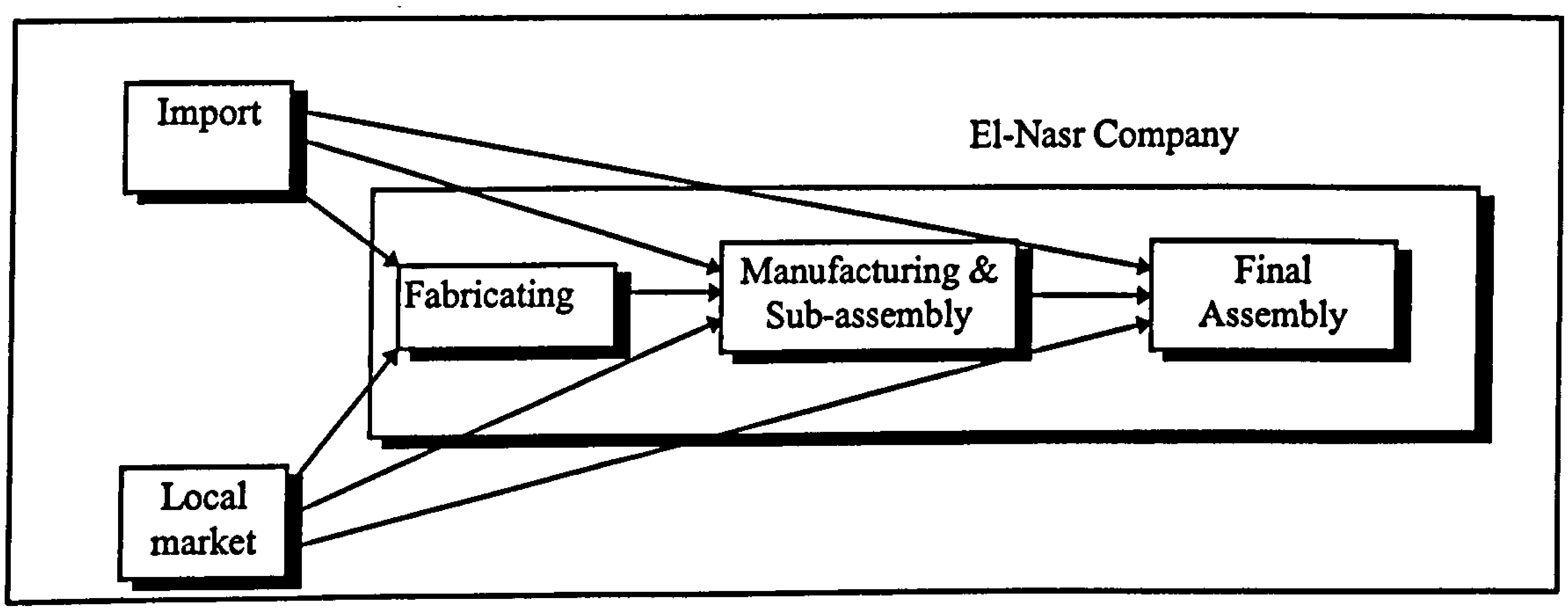
This section deals with manufacturing production problems from which the company suffers and explores the essential factors causing them. Some factors are connected with the internal affairs of the company and the others are non-controllable factors caused by external influences. Some of these problems have already been solved by the company, by installation of new developed systems, while others still need improvement. These problems are interacting and complicated and some of them are reflections of others. The problems and challenges that face the company vary and cover technological, suppliers, production planning and costing dimensions.

### 5.4.1 Production Control

At El-Nasr Co., the term production control is applied to both manufacturing and assembly as well as for materials supply, in accordance with general practice. Manufacturing and sub-assembly together with external procurement constitute the three sources of material supply for final assembly. It is also the task of materials management to ensure the supply of materials for in-house manufacturing. The focus of materials management is on the material flow, within as well as outside the company; through the study of the material flow it is expected to gain insight into the company's materials management.

Figure (5-7)

Multi-sourced supply of material for final assembly




We can state that materials management at the company involves the following areas: the forecast of material needs; the acquisition of material; and the supply of material.

The problems addressed by materials management at the company can be illustrated as follows.

### 5.4.2 Supplying Shortage of Materials and Parts on the Production Lines

Poor planning of raw materials and components, limited capabilities of the small package production planning system and its narrow applications at the company, led to emergence of a serious problem of missing parts or materials on some production lines. This phenomenon caused many stops in the production lines and failure to achieve the production plan. The shortage of imported components was only in the passenger cars factory because some products are assembled and licensed by the licence companies, so operating the factory depends on some imported parts. Shortage of imported parts occurred because hard currency was not available. From Table (5-3), we can find out that this problem is gradually disappearing; it decreased from 408 h. in 1984/85 to 199 h. in 1987/88. Table (5-3) shows that the greatest proportion of production stops caused by shortage of the local material and parts on the production lines, was in the Special parts' factory. It decreased from 61812 h. in 1984/85 to 57718 h. in 19987/88. These shortages were due to the production processes being planned and controlled badly and to lack of communication to handle data rapidly and precisely, moreover the computer facilities were still in the infancy stage. The shortage of local materials and parts in the other factories was not big and decreased gradually during the period from 1984/85/ until 1987/88, except for the tractors factory. Table (5-3) shows the trend of shortage at the seven factories during the periods from 1984/85 until 1987/88 before the introduction of a new sophisticated system.

Table (5-3)

Shortages of materials and parts at the company's plants

"Hours of stoppage"

| | * Shortage of Local Components & Materials | | | | ** Shortage of Imported Component | | | |
|---|---|---|---|---|---|---|---|---|
| | 85 | 86 | 87 | 88 | 85 | 86 | 87 | 88 |
| Lorries | 173 | 192 | - | - | - | - | - | - |
| Buses | 305 | 205 | 199 | 190 | - | - | - | - |
| Tractors | 42 | 110 | 131 | 286 | - | - | - | - |
| Passenger | 164 | 158 | 302 | 87 | 408 | 494 | 499 | 199 |
| Diesel Eng. | - | - | 37 | - | - | - | - | - |
| Special. parts | 61812 | 57666 | 49157 | 57718 | - | - | - | - |
| Petrol Eng. | - | 112 | 50 | - | - | - | - | - |

Production control department, Performance Assessment Reports and financial statements for the finished years in 1984, 1985, 1986, and 1988.

In order to avoid the risks of shortage of materials and components and to ensure fulfilment of the production plans, the company needs to hold a certain level of inventory of raw materials and parts at all times. The true reasons for this problem are explained below.

### 5.4.3 Problems With Local Suppliers

Generally, as claimed by interviewees, reliability levels of Egyptian domestic suppliers are extremely variable. However, this may be result from import substitution policies in general, rather than relying on local suppliers to produce the required parts and components. Some may allege that reliance on external vendors by El-Nasr company may lead to more hazard with increased probabilities of stoppage and may cause it some degree of discomfort, but this does not necessarily mean that in-house production of such parts and components would be less risky or more efficient.

Although the Egyptian Government's policies still have a significant influence on the company's decisions, the company has some autonomy in selecting of local suppliers, with the exception of a few public sector suppliers which monopolise some industries and from which El-Nasr Co. has to purchase its requirements for certain parts and components.

The best approach , from El-Nasr Co. viewpoint, is to have a limited tender with suppliers, to avoid the risk of supply. However, some public sector suppliers which are allowed by the state to have a monopolistic position in contrast to El-Nasr Co. can set certain conditions which El-Nasr Co. cannot negotiate. In fact, the interviewees claimed that for private sector suppliers, there are around 52 per cent of orders are finite tenders and the rest direct orders. In contrast, around 89 per cent of purchases from public sector suppliers are through direct orders, and only 11 percent are limited tenders.

It is preferred from the company's standpoint to rely on several suppliers and to induce and encourage efficiency in the local producers. Generally, the selection of suppliers by El-Nasr Co. depends on their efficiency, in conjunction with such determinants as prices, quality of products, time of delivery, according to the Department of Supplying Industry at the company. It was stressed that quality is the most important thing to be considered in relation to subcontracting.

#### 5.4.3.1 High Prices

The most important problems mentioned by the interviewees concerned in high prices. Prices of some local parts and components might be higher than those imported items, leading to higher costs of production. As stated by the interviewees it is better to have a finite tenders to get the best prices. However, some ex-public suppliers that are permitted to have a monopolistic place can impose high prices, that are not negotiable. It was also argued by the interviewees that private sector suppliers do not require down-payments to start producing parts and components for them, while the public sector suppliers claim at least a third of the price of an item.

### 5.4.3.2 Poor Quality of Local Suppliers

The other major problem facing the El-Nasr Co. is poor quality of parts and components made by some domestic suppliers and the incapability of some to adhere to specifications, leading to a high rate of rejection. Table (5-4) shows the proportions of the production accepted by El-Nasr Co.

Table (5-4)

Percentage of the quality approved commodities by the El-Nasr Co. from some of its suppliers

| Suppliers | Percentage of the quality approved commodities |
|---|---|
| Ex-public sector suppliers | |
| Nassr Co. of rubber | 65.7 |
| El Nasr Co. of forging industries | 67.9 |
| El Yayat Co. | 72.5 |
| Iron and steel Co. | 79.7 |
| Private sector suppliers | |
| Giza Co. of rubber | 91.1 |
| Iamco Co. | 85.4 |
| Dessouki Co. | 85.0 |
| Abu Yussef Co. | 79.4 |

(Interview with the director of Material Supply Division at the company, August, 1998).

From Table (5-4 ) we can see that the rate of rejection varies remarkably among ex-public and private suppliers. It is higher in the ex-public suppliers than the private ones. This may be attributable to the traditional close relationship between the case company and other ex-public sector companies. For example, El-Nasr Co. may tolerate a level of quality from other large ex-public sector suppliers which it might not accept from private suppliers. Large ex-public suppliers are not, in most cases, worried about meeting El-Nasr Co.'s specifications exactly, since they are confident that El-Nasr Co. is satisfied to buy some of its requirements from them. Also, the ex-public suppliers are large size companies, and the purchases of El-Nasr Co. represent a relatively small proportion of their total output. In contrast, private suppliers are usually small-size ones, which cannot afford to lose El-Nasr's customer by failure to conform to its specifications. It seems, from the viewpoint of El-Nasr Co. that ex-public suppliers are more secure than the private ones and some of them still have a monopolistic position. This behaviour would not be permitted for the private suppliers. However, this situation is affected by the old policy of the state that induced and encouraged public ownership and tried to support the role of ex-public sector at that time. It would be preferable, as argued by the interviewees, for the company to depend on several suppliers as this would encourage efficiency, whereas a monopoly position may lead to complacency.

It is worth mentioning that production of some items requires special facilities which may only be available with the large size suppliers. Therefore, El-Nasr Co. relies on the private suppliers to make some items that do not need high capabilities. For example, most of the medium and light pressed metal works needed for assembly of buses and trucks are provided by those small suppliers.

However, poor quality of components from local suppliers is often due to poor quality of local and imported materials. It was mentioned by the interviewees that some materials are imported to the Egyptian market are based upon low prices, irrespective of quality. This leads to lower quality and bad specifications of products produced.

#### 5.4.3.3 Delays in Delivery Schedules

Recent figures from El-Nasr Co. indicate that parts and subassemblies from own fabrication account for 31 percent of all delays in material supply. Locally supplied materials account for 54 percent, whereas imported materials account for 15 percent of all delays. Delays refer to the time difference between planned and actual events. Figure (5-8) shows a sample of lead times of some imported parts. The causes of delay are an important issue in the further analysis of materials management at the company. Locally supplied material accounts for the majority of all delays in material supply to El-Nasr Co., and most of the shortages (delays and partial deliveries etc.) occur with semi finished parts. There is, however, a considerable variation among suppliers with regard to delivery on time. While no delays were stated in deliveries of a few suppliers during the period considered, other public suppliers, foe example the El-Nasr Co. for Forging industry, a major supplier to the company, accounted for a significant share of all delays.

Figure (5-8)

The lead times of some imported parts

| Part | Order date | Issuing of order | Opening of credit | Freight start | Arrival of ship | Arrival of goods to the company | Issuing of delivery documents |
|---|---|---|---|---|---|---|---|
| Rubber bushing 33-54-109 | 15-03-96 until 20-04-96 | 25-8-96<br>“ | 14-12-96<br>“ | 18-05-97<br>30-06-97<br>(3 stages) | 02-08-97<br>03-09-97<br>(3 stages) | 23-09-97<br>07-10-97<br>(3 stages) | 30-10-97 |
| Rubber bushing 5555-34-10-06 | 15-03-96 until 20-04-96 | 25-10-96<br>“ | 30-12-96<br>“ | 16-05-97 | 13-06-97 | 14-07-97 | 25-09-97 |
| Roller bearing 30215DIN 720 | 15-04-96 | 24-05-96 | 20-06-96 | 11-01-97 until 27-2-97<br>(3 stages) | 21-03-97<br>23-04-97<br>(3 stages) | 29-04-97<br>15-05-97<br>(3 stages) | 27-5-97<br>12-07-97<br>(3 stages) |
| Connecting rod 0141-06-07-OIR | 06-03-96 | 28-06-96 | 10-11-.96 | 30-04-97 until 01-06-97<br>(4 stages) | 08-06-97 until 01-09-97<br>(4 stages) | 15-09-97 until 30-10-97<br>(4 stages) | 07-11-97 until 10-12-97<br>(3 stages) |

As an explanation of varying lead times, a number of parts from the company's parts list, randomly selected, were followed during the different material flow phases. It must be emphasised that the selected parts represent only a fraction of the total parts list and that different time periods manifest different cases; for instance, new suppliers become involved, transportation capacity deviates, and use is made of new production facilities. These restrictions not withstanding, the lead time facts accurately characterise an average for the company. It should also be emphasised that these illustrations do not essentially concentrate on the long lead times, nor the significant time difference observed between planned and actual observations. What is however remarkable, and what will be stressed as serious in the study, is the great variation in lead times. This means that El-Nasr Co. is at times encountered with uncertainty that does not give the company an adequate basis for cost and production control.

For imported material we can explore a variety of factors causing delays, e.g. when bank accounts are opened for payment to suppliers; when items have arrived and technical inspection is made; when material is carried from supplier to the company; and when purchase orders are prepared.

For in-house production, it looks as if there is no direct connection between the planned request date for materials availability and the actual production situation, i.e. between the date of demand according to the optimistic plan and the actual implementation of the work order in the factory (release date). It was noted by the interviewees that in 90 observations out of 100, actual order start was later than that planned by the planning department, and these delays ranged from two to nine months. Figure (5-9) shows the lead times for some selected work orders.

Figure (5-9)

The lead times for some selected in-house work orders.

| Part name | Material used | Issuing work order | 1st operation | |
|---|---|---|---|---|
| | | | planned | actual |
| Exhaust manifold | Assembly parts | 04-05-96 | 20-09-96 | 19-01-97 |
| Bracket for alternator | " | 02-04-96 | 07-05-96 | 15-08-96 |
| Intake manifold | " | 08-05-96 | 19-10-96 | 30-12-96 |
| Differential pinion cpl | " | 11-10-96 | 01-11-96 | 25-11-96 |
| Space ring | Semi-finished | 27-02-96 | 11-03-96 | 15-04-96 |
| Pinion shaft | " | 07-04-96 | 27-04-96 | 25-07-96 |
| Bushing | original mat | 12-12-96 | 02-01-97 | 07-6-97 |
| Sphericalset | " | 11-12-96 | 05-01-97 | 10-8-97 |

(Material Supply Department at the company, Performance assessment reports, 1997).

As a consequence of delays in delivery schedules by most suppliers, El-Nasr Co. has to engage in ad hoc month-to-month scheduling, suffering persistent disruptions of assembly operations to parts manufacturing schedules. These delays may cause production at lower capacity, forcing the company to charge unnecessary costs, including higher inventory costs to avert stoppages. The importance of on-time delivery for automotive assemblers is reflected in a recent development in automotive manufacturing, the adoption of the Just-In-Time philosophy, mainly in order to be able to reduce inventory costs. This point will be elaborated in Chapter Nine.

In this regard there are also some differences between public and private sector suppliers. From the interviews, El-Nasr Co. staff believed it is better to dealing with private sector suppliers. They pointed out that they faced many difficulties with public sector suppliers, which they assured were due mainly to their carelessness. One of the most serious issues by the interviewees was the delays in delivery by the public sector suppliers, which were affirmed to be very costly to the company, because of delays in their production schedule. Private sector suppliers were said to be more reliable regarding adherence to promised delivery times. Table (5-5) shows the delivery rates of some suppliers dealing with El-Nasr Co.

Table (5-5)

Delivery rates of some local suppliers dealing with El-Nasr Co.

| Supplier | Delivery Rate as to total contracted quantities |
|---|---|
| Private sector suppliers | |
| Giza Co. of rubber | 95.3 |
| Iamco Co. | 83.8 |
| Dessouki Co. | 79.1 |
| Abu Yussef Co. | 90.0 |
| Technical Co. for plastics | 80.0 |
| Arabic Co. for aluminium | 78.3 |
| Gahbour Co. | 89.0 |
| Al helal Co. for engineering works | 87.6 |
| El -Nigma Co. | 68.4 |
| Ex-public sector suppliers | |
| Nassr Co. of rubber | 78.0 |
| El Nasr Co. of forging industries | 83.1 |
| El Yayat Co. | 45.3 |
| Iron and steel Co. | 61.0 |
| Helwan Co. for diesel engine | 73.0 |
| National plastics Co. | 40.0 |
| Egyptian Co. of plastic and electricity | - |

(Material Supply Department at the company, Performance assessment reports, 1997).

#### 5.4.3.4 Irregularity of the Source of Supply

Another obstacle faced by El-Nasr Co., particularly with small size private suppliers, is that they are based on individual ownership, which generates no trust. This means when something suddenly occurs such as closure or activity being stopped for any reason, legal or illegal, that can affect the regularity of supplies to El-Nasr Co. In addition, some private supplying firms are not striving to achieve a national goal, in contrast to the ex-public ones. All these events contribute to create an atmosphere of insecurity of some private suppliers, which threatens the regularity of supplies.

Moreover, despite the difficulties faced in relation to public sector suppliers (basically caused by obstacles encountering the public sector in Egypt in general, e.g. over employment, poor management, shortage of foreign currency required to import raw materials), it must not be overlooked that public sector suppliers have capabilities to produce some parts and components which the private sector cannot produce because of limited technological facilities and financial resources.

However, the new reform laws and regulations made by the Egyptian government under the privatisation programme in recent years may help to improve the situation. The new economic policy aims to encourage the activities of the private sector and support its significant role in the new industrial programme. Although these changes carried out by the government provide a basis to build the infrastructure, the assemblers must reform and reconsider their relationships with their suppliers.

However, to deal with all the above problems with local suppliers, the company needs to reformulate its priorities and to reorganise its assistance to local suppliers. It may be interesting to explore (given the government objective of increasing local content of automotive production in Egypt) how far El-Nasr Co. is ready or able to encourage and aid local suppliers, given the fact that in the short-term, at least, there is a conflict between the goal of raising the local content of vehicles manufactured in Egypt and that of efficiency. For instance, in several cases, the requirements of lower prices for parts and components and increasing local content conflict (given the fact that at present El-Nasr Co. allows local purchase of parts and components to be up to 10 per cent over the price of imports) and also, while quality is non-negotiable, there is always a price that El-Nasr Co. has to pay to guarantee quality from local suppliers.

In some cases, El-Nasr Co. policies have, according to interviewees, led to some difficulties for the local suppliers. For example, it often has ordered a very low volume each time, which could not justify the high costs of dies and moulds required to produce some parts and components, particularly in view of the continuous changes of models. However, it was interesting to find that El-Nasr Co., shared some of these costs with some (but not all) of the public sector suppliers. For example, El-Nasr Co. pays fully for the costs of pattern plates needed to produce some malleable cast iron parts at El-Nasr steel pipes and Fitting Co. This type of assistance is rarely given to private sector suppliers. However, suppliers, as stated by the interviewees, still suffer from other obstacles with El-Nasr Co. For instance, suppliers do not receive their payments until long after delivery, because first, inspection is carried out by El-Nasr Co., which may take a few months (ranging from 1-4 months and in rare cases, six months). This is due to the complicated routine procedures, which take a long time.

### 5.4.4 The Lack of Long- and Medium-Term Planning

The lack of long- and medium-term planning is a major difficulty caused by El-Nasr Co., not to mention short-term planning and the continuous changing of plans and orders, e.g. orders may be deleted or replaced while they are in progress, which results in confusion to suppliers and may cause disruptions. Some managers explain this situation as follows:

> In one case the company asked a supplier to supply certain items, and then deleted the order because it found an alternative cheaper source of supply, but when the company procured the items from this new supplier, they detected them to be of an lower quality and had to deal again with their first supplier (Interview with the cost manager, July, 1998).

This continuous changing of plans and orders is detrimental to the relationship between the company and its suppliers. There must be a continuity of connections with technical and managerial support by the assembler to maintain constant good business relationships with its suppliers. This point will be elaborated in Chapter Nine. This can cause severe problems to suppliers. There are no reserved items to be outsourced by El-Nasr Co. but if the company has idle capacity, it starts producing parts which were previously outsourced, without realising the consequences, and dismisses their local suppliers. This problem is particularly serious for private sector suppliers. This is because the public sector suppliers are large companies where El-Nasr Co.'s orders represent a very small percentage of their total production. Any disruptions to their plans by El-Nasr Co. do not affect them to any great extent. In contrast, small scale private sector suppliers may depend heavily on orders from El-Nasr. The interviewees argued that there is no long term central planning for the company, which affects automotive supplier industries' efficiency and their capability to plan their own production, leading sometimes to high storage costs of both raw materials and final product. This specific problem, as argued by the interviewees, prevented suppliers from trying to rely much on El-Nasr Co.'s orders, with their very short-term plans, sudden decisions and persistent changes of orders (both quantities and/or time schedules). As one manager stated:

> The company has not long-term plans for its production, because of the continuos changes in the designs and customers preferences so how can it convey to suppliers any future schemes (Interview with the Planning Manager, July, 1998).

The company does not give its suppliers any warning about any expected disruption of its production plans. There is also no co-ordination between the company and its suppliers about future market programmes. Thus the lack of trust between the company and its suppliers is due mainly to inadequacy of information exchange between them.

Undoubtedly, suppliers require to have long-term programmes in order to reduce risks and uncertainty. They need to plan their requirements of raw materials to avoid bottlenecks (particularly when most of them are imported and take a long time). Also, they need to arrange a more accurate production schedule, and even to be able to plan future investments. If a supplier has already imported the required materials for producing the order issued by El-Nasr Co., then the company cancels it for any reason it will leave bad consequences for this supplier. The following is an example:

> This problem happened with a supplier called Helwan Co. for casting that was established to supply El-Nasr Co. with its needs of parts. According to the original programmes this supplier should have been supplying El-Nasr Co. with at least 86 per cent of its total output. Today El-Nasr Co.'s orders do not represent more than 12 per cent of its total output. This is because there is no long term central planning for the transport equipment industry in general, which is reflected in the manner of automotive assemblers in Egypt. This manner affects automotive suppliers and their capability to plan their own production, leading sometimes to high storage costs (Interview with the director of Planning & Supply Division, August 1998).

Thus, solving this planning problem will assist suppliers to reduce their costs of production considerably and at the end it will be reflected in reduced prices for items supplied to El-Nasr Co. and its production costs will fall in consequence.

#### 5.4.4.1 Other Problems That are Connected to the Lack of Planning.

The first problem is unrealistic delivery orders. The interviewees stated that there are sometimes unrealistic delivery orders by El-Nasr Co. with the pressure to accelerate delivery (e.g. 45 days), even though a supplier may need at least 90 days in order to produce the required item to the appropriate standard. They then go out of their way to claim compensation for late deliveries. However, this is very much related to the lack of planning at El-Nasr Co.

Another related problem is high storage costs. This problem is also related to the lack of planning by El-Nasr Co. and non-reliability of the suppliers In order to avoid the hazard of late deliveries and to ensure accomplishment of the production plans, the company needs to hold a certain level of inventory of components and raw materials constantly. For instance, inventory increased in 1991/92 by about 16% in compared to the previous year, because of materials arriving late at the end of the year. Appendices (B and E) show the various categories of inventories. This raises costs unnecessarily and may place the company in a critical financial condition. For example, in 1991/92 the company was charged interest on bank overdrafts of 123 Million LE. because of there was not enough liquidity to finance a full operating cycle. The company had to borrow around 873 Million LE from banks. This amount represents the most important cost element following materials cost. Obviously, this situation caused bad consequences for out-cash flow and liquidity at the company (see appendices B and C). Although the situation improved in 1996/97, the company still suffers from the same problem.

An excessive inventory is not invested funds, which negatively affects the liquidity of the company and causes disruption to its operations. Not only is the inventory as opportunity cost to the company, but it may jeopardise its familiar risks.

El-Nasr Co. does not any care to share its suppliers' inventory costs, leaving them to face all resulting costs and risks. This problem seems to be very clear in recent years, particularly when the El-Nasr Co. adopted a new policy of rationalising storage to reduce its inventory costs. This policy forces suppliers to store any item produced for

El-Nasr Co., thereby increasing their own inventory costs. This fact was confirmed by the manger of Suppliers Division at El-Nasr Co., he said:

> Giza Co. is a supplier making rubber parts for the company. The company's orders are continuous all year round and over several years. For example, the company may order 3,000 parts of which 500 units have to be supplied every four months. El-Nasr Co.'s aware that this supplier produces the entire order i.e. 3,000 parts required because the materials required to make these parts are not available all the time or take a long time to import. Then the supplier stores them, pending El-Nasr Co. requisition. This policy leads to raising the supplier's own storage costs accordingly (The manger of Suppliers Division, August, 1998).

The interviewees highlighted shortcomings in planning the production programmes, by considering only monthly programmes according to market requirements. This is due to continuous development in product designs; changes in customers' orders at short notice; inaccuracy in estimating requirements of raw materials; and fluctuation in raw materials ratios all the year round, particularly with high raw materials imported on account of the complexity of importing procedures; as well as increased rates of currency exchange.

Suppliers, as asserted by the interviewees, could not cope with or spend a lot of money to be able to adapt to these continuous changes. The persistent modifications in design of parts increased their costs, particularly as a result of the need to modify some parts, which are very costly and often imported. This problem is increased by the small batches required by El-Nasr Co. each time.

Poor planning of production has had bad consequences for the company. In one case, when the company faces a rise in demand, poor planning and changing production volumes of the plants leave it short of available capacity. The required capacity can be provided by having additional machines and equipment, additional people (perhaps temporary employees), the use of overtime and additional shifts, variable production rates on the machines, or a combination of all these. In contrast, the other case is when the company encounters slacking in demand, the poor planning capabilities of the company lead to An Idle Productive Capacity. The reduction of available productive capacity exploitation ratios is one of the chronic phenomena at the company, as explained in detail in Chapter Eight. Particularly since Egypt began its privatisation programme and transferred to a market economy, automotive competitors have increased. The company has faced difficulties in marketing its products locally and abroad. For example, finished goods inventory increased by 250% compared to the previous year. This is due to controllable factors such as decreased quality of some products which do not satisfy customers' requirements and are not consistent with world specifications for export. The non-controllable factors are, for example, wars, political interruption and cancelling of exporting contracts with some countries, as well as public economic conditions that led to spiralling inflation.

In fact, accompanying the poor planning, there is another type of obstacles, as the interviewees argued, which interrupt the efficient usage of the productive capacity at the company and lead to high selling prices because of increasing production costs. For example, the company size is not suitable with its marketing capabilities. It neglects marketing activities and has not established an effective market strategies. Some equipment is obsolescent; there are no planned maintenance programmes; electrical cuts are common; and productive capacity is not balanced along the production lines, so production does not go smoothly. Non-efficient lease transport is used to move raw materials and bought parts from suppliers to the company's sites. Some equipment is not installed because the required buildings are not ready on time.

#### 5.4.4.2 Shortage the Foreign Currency

Shortage of foreign currency is another obstacle which causes idle capacity at the company. It was argued by the interviewees that the changes in the Egyptian finance market were one of the most important factors behind the production problems faced by the company. The company used to obtain its requirements of the hard currency at a low exchange rate. The government allocated enough funds to finance the purchasing of necessary materials, parts, components, spare parts and equipment. Also, when the company was a monopolist, it enjoyed the protection from foreign competition imposed by the state. Nowadays, the recent changes to reform the Egyptian economy have led to liberation in the finance market. The company no longer enjoys subsidies from the state. It must get its requirements of hard currency by itself from the free finance market, at the real exchange rate. Thus, the company is caught in the vicious circle of being unable to get enough hard currency to import a sufficient volume of raw materials and components necessary to utilise available capacity, and/or equipment and machinery to upgrade capacity, either to achieve profit sustaining volume levels or to satisfy the local market demand for new vehicles.

The interviewees assert that idle productive capacity has had adverse consequences, for example, decreased productive capability and thus a drop in the yield in some plants and slow growth rates in others. Faulty production, spoilage, and waste of raw materials have increased. Consequently, the cost of some products has increased as a result of increased costs of fixed productive capacity, causing a rise in the selling prices and weakening the competitive position of the company in the market.

Undoubtedly, dealing with the problem of unemployed capacity at the company will improve the company's condition. By increasing production and decreasing costs, there is a possibility of reducing selling prices and getting better quality.

#### 5.4.4.3 Decreasing the Productive Efficiency

Finally, the company has faced the problem of decreasing productive efficiency (see the appendices) associated with labourers; wages; production planning and control; and obstacles connected with maintenance and quality control. In fact, decreased productive efficiency at the company is due to decreased available productive capacity exploitation ratios and rising unemployed capacities; decreased productivity of labourers; increased inventory; decreased efficiency of materials usage and decreased quality of some products. Figure (5-10) summarises cause and effect relationships of the main problems at the company.

Figure (5-10)

Analysis of the company's chain linkages causing problems in the production and cost systems

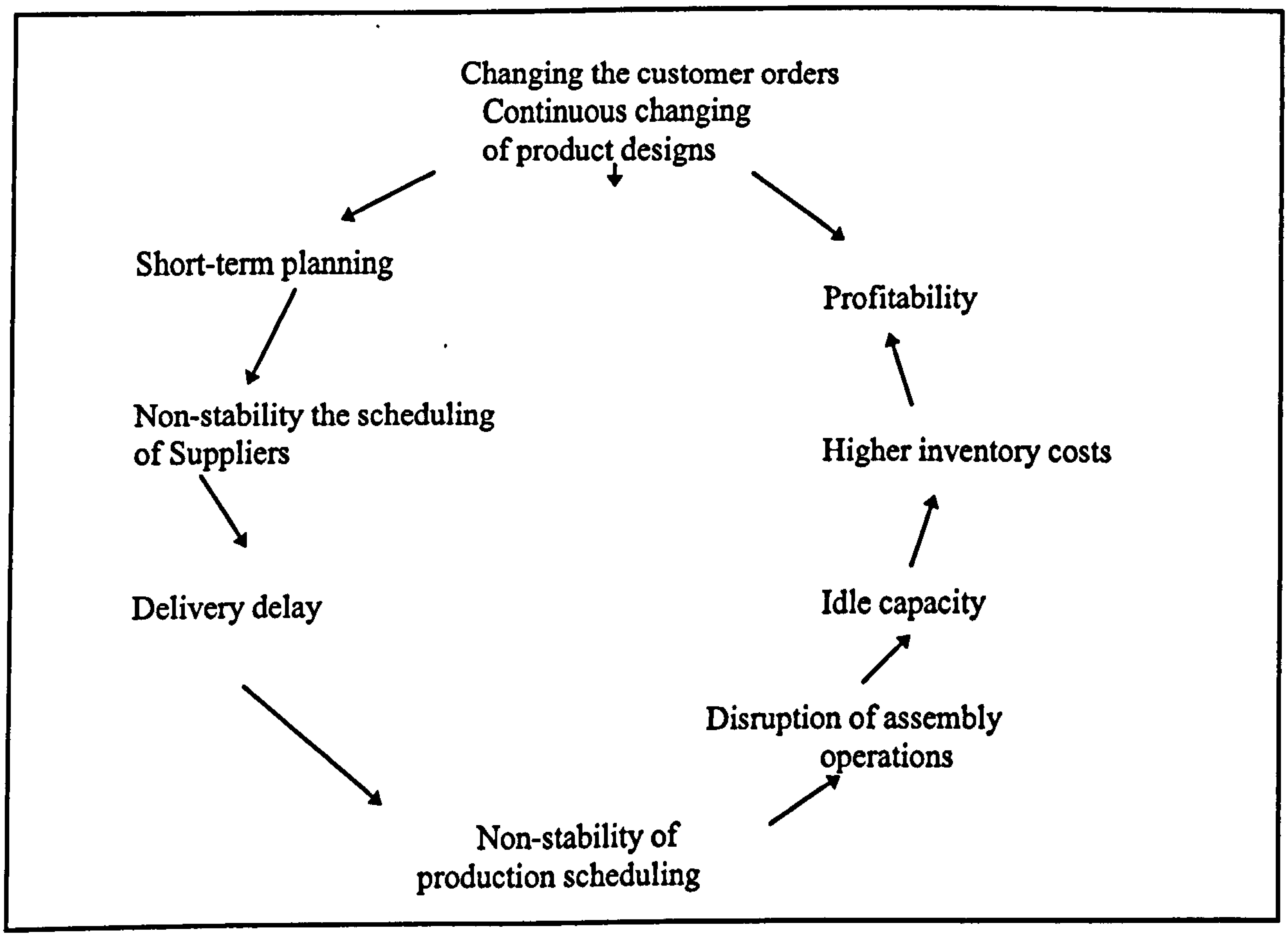


Table (5-6)

Summary of production problems facing El-Nasr Co.

| Source | Problem |
|---|---|
| 1. Un-reliability in local suppliers | A. high prices of materials and parts<br>B. poor quality of materials and parts<br>C. delays in delivery schedules<br>D. Irregularity in source of supply |
| 2. In-stability in production planning | A. unrealistic delivery orders<br>B. high storage costs<br>C. shortage in foreign exchange |
| 3. Un-reliability in the technical system | A. using traditional machines<br>B. using extra and non-skilled labour<br>C. irregularity in maintenance<br>D. long lead time<br>E. idle productive capacity<br>F. decreasing the productive efficiency |

Thus, if the company wants to prosper in a new competitive environment, an integrated computerised-aided manufacturing planning and control system is required in this environment. A key objective of the improvements made to the production planning and control processes is to ensure material availability and reduced inventories.

## 5.5 Summary

Since the late 1980s the company has encountered serious problems in production planning and control. These problems and challenges that face the company vary and include technological; suppliers; production planning and costing dimensions. Problems due to the need for timely supply of materials lead back to the material requirements planning. Poor planning of raw materials and components, limited capabilities of the small package production planning system and its narrow applications at the company, led to a serious problem of missing parts or materials on some production lines. This phenomenon caused many stops in the production lines and consequent failure to achieve the production plan.

Problems with suppliers include high prices. The higher prices (as compared to imports) of some parts and components, leads to higher costs of production. The other most significant problems are poor quality of parts and components made by some domestic suppliers, and the incapability of some to adhere to specifications, resulting in a high rate of rejection, and delays in delivery schedules. As a consequence, El-Nasr Co. may resort to ad hoc month-to-month scheduling, experiencing frequent stoppages of assembly operations to parts manufacturing schedules. These delays may cause production at lower capacity, leaving the company to charge unnecessary costs, including higher inventory costs to avoid disruptions. Insufficient responsiveness to customer needs has led to weakness the competitive position of the company, especially with the increased competition brought by the contemporary economic policy in Egypt, which has allowed local automotive competitors to enter the market.

Accordingly, the next chapter will examine the role of the original cost accounting system in solving the above problems which faced the company.

# Cost Accounting Systems at the Company

The company's cost accounting systems have been changed over time. They were established manually about 30 years ago. Later, they were partially changed, a computerised cost system was implemented on a microcomputer. Then they were integrated with production planning and control systems. This chapter investigates the framework of the original cost accounting system which is used currently for the purposes of cost allocation and inventory evaluation at the company.

Basically, the company used the absorption cost system to ensure that *all* manufacturing costs are directly traced or allocated to the various products produced. This was achieved through using hybrid cost systems, job-order costing system and process costing system. The former was used in the fabricating factories (Pressings, Treatments, Gears, Tool Room, and engine manufacture) that produce parts in distinct jobs. The cost of each job was tracked separately and job-order cost system accumulated costs by jobs. With this system, *all* manufacturing costs are assigned to the products produced. Process costing system was used in the assembly factories (Truck & Tractor, passenger cars, and engine assembly), that assemble vehicles in batches. Process costing is associated with flow production in the assembly processes. All costs of each process (i.e. direct material costs, direct labour costs and indirect costs) are accumulated and related to the units produced. This is at the plant level that produces multiple products as explained later in this chapter. For cost accumulation, a single record system was used to serve both financial accounting and cost accounting. The most important maintained cost records are the cost ledger, functional & natural classifications of cost elements, and records of batches or job order costs.

The company used the absorption cost system -except it used direct cost to evaluate machined parts and engines- for two purposes: Firstly, in financial reporting for determining inventory valuation and cost of goods manufactured. Secondly, in setting the selling prices for the products. The actual costs were used to account for both production costs and total costs as shown in Table (6-1). Actual total cost method was adopted for two reasons: First, recognising individual product costs was substantial when determining the selling price of each product and attaining maximum profit. Second, at that time, the computerisation was in its infancy and even sophisticated computations required much time and effort.

The standard rates were prepared manually and applied only for inventory valuation of the machined parts and engines. These standards were determined by the technical design department that established a Standard Parts List for each product produced. Then the planning department prepared a list of operations, an assembly plan, and a list of the required raw materials. Estimated product cost sheets were prepared for managerial purposes when they were required. The estimations were based on contracts with local or international vendors; average cost of the machined parts for the previous year and cost rates of all other cost elements for the previous year or years. Actual cost sheets were prepared for each main product twice a year. These sheets included the data needed to carry out further analysis. They did not include data on exploited and un-exploited capacity, waste, spoilage, re-repaired units, or any other aspects of loss.

Thus this chapter explains how the cost accounting system operates at the company, and evaluates the relevance of to what extent it adapted to the new manufacturing environment of the company. It is nearly impossible to consider the improvements of the new system without knowing the framework on which the system is built. A complete picture of the cost accounting system should be introduced to find out its shortcomings which are partially avoided by the current system.

## 6.1 The Framework of the Cost Accounting System at the Company.

### 6.1.1 Cost Classification

The company has used the natural classification of cost as Labour, Material and Overhead. For the purpose of product costing, the company has categorised the cost elements into direct and indirect costs. Direct costs included direct material cost, direct labour cost and other direct expenses e.g. expenses of design drawings associated with a certain product; while the indirect costs are divided into indirect manufacturing costs, marketing costs and administrative costs. Direct material and direct purchased parts costs are calculated based on the invoice price plus causal acquiring expenses (including purchase commission, freight, insurance fee and customs duties). In calculating the cost of material used, the company has used the weight average method. Direct labour costs are measured by the accumulated time spent in the production centre multiplied by the rate per hour. These costs are charged to the production centre in which they occurred. All direct costs are assigned directly to the products.

Indirect manufacturing costs are made up of indirect labour costs, indirect product requirements costs, indirect service requirements costs and other indirect costs. Indirect labour costs included salaries, fringe benefits, bonuses, overtime, insurance and allowances for employee retirement benefits. The total indirect labour costs are charged to the cost centres where the applicable employees work. Indirect product requirements costs included fuels, oils, electric power, tools, spares, stationery, electricity, gas and water; while Service requirements' costs included maintenance expenses, experiments & research expenses, public relations & reception, transport, leasing equipment. The other indirect costs are items such as depreciation, taxes, rent, interest,......etc.

Classifying and accumulating product costs into departments, [see sheets (6-7) and (6-8)] as will be shown in section 6.4.1, is the second step of the product cost accounting system which determines a unit cost from the total product cost for pricing and inventory valuation. The total cost of a product is computed by adding the selling and administrative costs to the product cost. Table (6-1) shows cost summary sheet.

Table (6-1)

Cost summary sheet

Date: El-Nasr Automotive Manufacturing Co.

| Element | L.E. | Description |
|---|---|---|
| Imported components : | | |
| FOB value | x | Currency rate: |
| Bank commission | x | Bank commission: (% of FOB value) |
| FOB Total | xx | |
| Seaborne Freight & Insurance | x | Seaborne Freight & Insurance: (% of FOB total) |
| CIF value | xx | |
| Custom duties | x | Custom duties: (% of CIF value without bank commission) |
| Evacuation, riddance & haul | x | Evacuation, riddance & haul (% of FOB total) |
| Total cost of imported components | xx | |
| Local requirements | xx | |
| Total cost of the components | xxx | |
| Expenses: | | |
| Direct labour cost | xx | |
| Manufacturing overhead costs | xx | |
| Total operating cost | xxx | |
| Marketing expenses | xx | |
| Administrative expenses | xx | |
| Total cost | xxx | |

Table (6-2)
Analysis of direct and indirect manufacturing costs
in the company during the period from 1984/85 until 1987/88
(.000 L. E.)

| Year | Total Costs | Total Production Costs | | Direct Manufacturing Costs | | | | | | | | | | | | Indirect manufacturing costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | | Total (4) = (5) + (6) + (7) | | | Materials (5) (including custom duties) | | | Wages (6) | | | Other expenses (7) | | | Total (8) =(9)+(10)+(11) | | Manufacturing (9) | | | Marketing (10) | | Administrative (11) | |
| | | cost | % of 2 | cost | % of 2 | % of 3 | cost | % of 2 | % of 3 | cost | % of 2 | % of 3 | cost | % of 2 | % of 3 | cost | % of 2 | cost | % of 2 | % of 3 | cost | % of 2 | cost | % of 2 |
| 84/85 | 301554 | 268470 | 89.- | 244118 | 81. | 90.9 | 22891 0 | 75..9 | 85.3 | 14429 | 4.8 | 5.4 | 779 | -.26 | -.3 | 57436 | 19.- | 24352 | 8.- | 9.1 | 3883 | 1.3 | 29201 | 9.7 |
| 85/86 | 336247 | 300134 | 89.3 | 274596 | 81.7 | 91.5 | 25835 2 | 76.8 | 86.1 | 14910 | 4.5 | 5.- | 1334 | -.4 | -.44 | 61651 | 18.3 | 25538 | 7.6 | 8.5 | 6812 | 2.- | 29309 | 8.7 |
| 86/87 | 380461 | 323409 | 85.- | 297758 | 78.3 | 92.1 | 28005 5 | 73.6 | 86.6 | 15504 | 4.1 | 4.8 | 2199 | -.6 | -.7 | 82073 | 21.7 | 25651 | 6.7 | 7.9 | 7557 | 2.- | 49495 | 13.- |
| 87/88 | 491863 | 418886 | 85.2 | 390397 | 79.4 | 93.2 | 37569 4 | 76.4 | 89.7 | 13902 | 2.8 | 3.3 | 801 | -.16 | -.2 | 10146 6 | 20.6 | 28489 | 5.8 | 6.8 | 7731 | 1.6 | 65246 | 13.3 |

(General Administration of Cost Accounting in the Company, Department of expenses analysis - Reports of performance evaluation and financial statements for the finished years in 1984, 1985, 1986, and 1988).

* It did not exclude the cost of the un-exploited productive capacity and also it did not include:
- Unabsorbed direct labour cost in engineering centres (i.e. the difference between actual direct wages and the absorbed or charged direct wages to production)
- The costs of purchasing and storing
- Local and foreign interests (otherwise the company used to included these costs in the costs of general production services' centres)

Table (6-3)
Analysis of direct and indirect manufacturing costs
in the company during the years 1991, 92, 96, and 97
(.000 L. E.)

| Year | Total Costs | Total Production Costs | | Direct Manufacturing Costs | | | | | | | | | Indirect manufacturing costs | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) | (2) (4) + (7) | (3) (4) + (8) | | Total (4) (6) + (7) | | | Materials (5) (including custom duties) | | | Wages (6) | | | Total (7) =(8)+(9)+(10) | | * Manufacturing (8) | | | Marketing (9) | | Administrative (10) | |
| | | cost | % of 2 | cost | % of 2 | % of 3 | cost | % of 2 | % of 3 | cost | % of 2 | % of 3 | cost | % of 2 | cost | % of 2 | % of 3 | cost | % of 2 | cost | % of 2 |
| 90/91 | 368169 | 330871 | 89.9 | 301418 | 81.9 | 91.1 | 289517 | 78.6 | 87.5 | 11901 | 3.2 | 3.6 | 66751 | 18.1 | 29453 | 8.- | 8.9 | 14174 | 3.8 | 23124 | 6.3 |
| 91/92 | 446331 | 407448 | 91.3 | 376104 | 84.3 | 92.3 | 364116 | 81.6 | 89.4 | 11988 | 2.7 | 2.9 | 70227 | 15.7 | 31344 | 7.- | 7.7 | 14090 | 3.2 | 24793 | 5.6 |
| 95/96 | 616176 | 575205 | 93.4 | 541341 | 87.9 | 94.1 | 518104 | 84.1 | 90.1 | 23237 | 3.8 | 4.- | 74835 | 12.1 | 33864 | 5.5 | 5.9 | 12560 | 2.- | 28411 | 4.6 |
| 96/97 | 625733 | 585847 | 93.6 | 548768 | 87.7 | 93.7 | 524528 | 83.8 | 89.5 | 24240 | 3.9 | 4.1 | 76965 | 12.3 | 37079 | 5.9 | 6.3 | 12112 | 1.9 | 27774 | 4.4 |

(General Administration of Cost Accounting in the Company, Department of expenses analysis - Reports of performance evaluation and financial statements for the finished years in 1991, 1992, 1996, and 1997).

* It did not exclude the cost of the un-exploited productive capacity and also it did not include:
- Unabsorbed direct labour cost in engineering centres (i.e. the difference between actual direct wages and the absorbed or charged direct wages to production)
- The costs of purchasing and storing
- Local and foreign interests (otherwise the company used to included these costs in the costs of general production services' centres)

### 6.1. 2 Cost Structure

Tables (6-2) and (6-3) show that the production costs are the highest per cent compared with the other costs (i.e. marketing and administrative costs). As a percentage of total costs, production costs increased gradually from 268470000 L.E in 1984/85 (i.e. 89 % of total costs) to 585847000 L.E in 1996/97 (i.e. 93.6 % of total costs). Figure (6-1) indicates the relative significance of manufacturing costs at the company. The percentage of direct material cost increased from 228910000 L.E (85 % of production cost) in 1984/85 to 524528000 L.E (89.5 % of production cost) in 1996/97 and is thus by far the dominant cost factor. Even minor variations in material price and exchange rates therefore have a significant impact on the total costs, not least because a large part of the material is imported and currency for materials import is sometimes obtainable only at a high price. Imported materials, as well as imported production equipment and spare parts, are subjected to governmental regulations on import duties and exchange rates, and prices are thus influenced by industrial policies. Local prices for parts and material can therefore be kept (artificially) higher than corresponding international prices. Thus, this reflects the increasing importance of controlling this element for cost reduction.

Tables (5-1 and 5-2) show the percentage of the local content of different types of vehicles produced by the company. From the tables we can find out the share of imports (as percentage of unit costs) ranging from as high as for Engine to as low as for Tractor.

Direct labour cost was the lowest per cent compared with the other manufacturing costs, while it was 14429000 L.E (5.4 %) in 1984/85, it decreased in 1996/97 to 24240000 L.E (4.1 % of production cost). This means increasing the attitude of using the manufacturing and assembly technology in the operations and shrinking the human work. Indirect manufacturing costs decreased from 24352000 L.E (8 % of production cost) in 1984/85 to 37079000 L.E ( 6.3 of production cost including indirect labour cost) in 1996/97. Even though these costs increased gradually every year, they decreased when compared with the production costs due to direct material cost increasing as shown in figure (6-2).

Figure (6-1)

Cost structure of the company in 1996/97

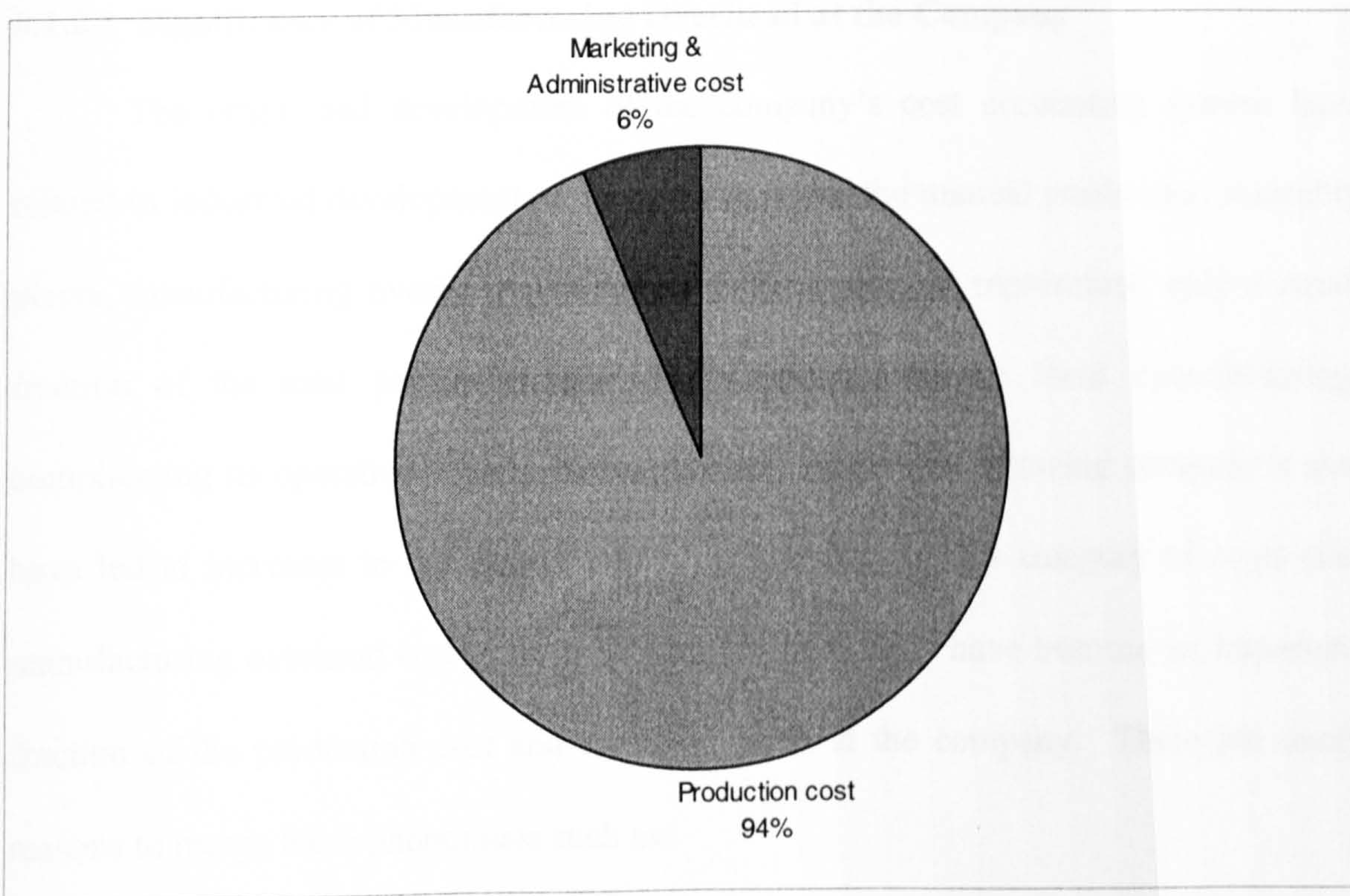
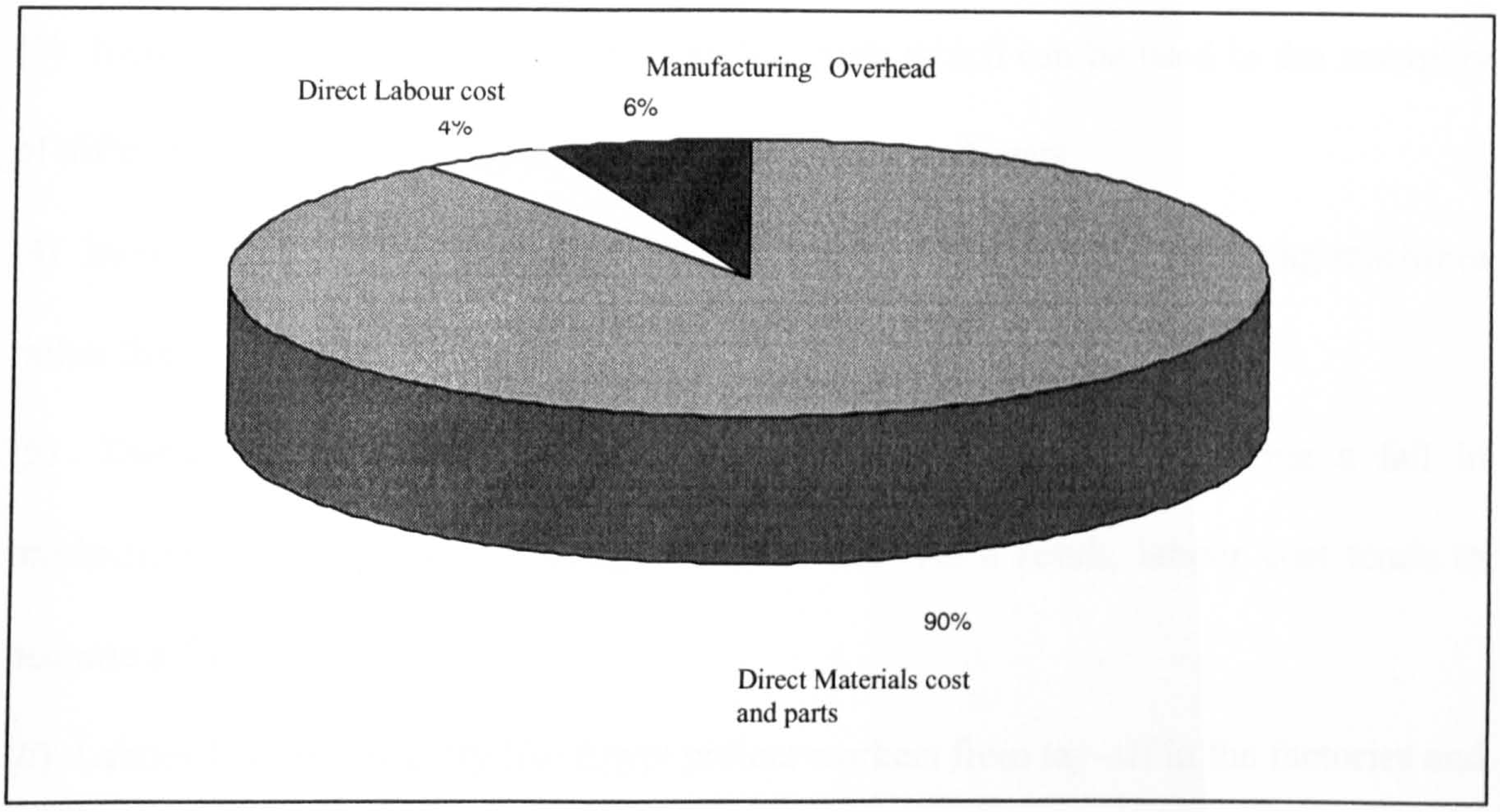


Figure (6-2).

Manufacturing cost composition in 1996/97




### 6.1.2.1 Significance of Manufacturing Overhead at the Company

The origin and development of the company's cost accounting system have related to industrial development. For example, under the manual production assembly plants, manufacturing overhead cost was not significant. It represented only a small fraction of the total production cost. The progress in the local manufacturing, complicating its operations, using advanced machines and the growing company's size have led to increases in the significance of accounting for this category of costs (i.e. manufacturing overhead cost). In some periods, these costs have become an important fraction of the production cost and effect on profit at the company. There are many reasons to merge these phenomena such as:

(1) Manufacturing companies in the developing countries like Egypt hope and plan to increase local manufacturing content to a hundred percent.

(2) Growing the investment capital and the continuous trend towards increased usage of automated machines (i.e. NC; CNC) in production, particularly in heavy industries such as automotive industry.

(3) Increasing attention to producing standard parts which can be used in the assembly of different vehicle models such as chassis, cylinders, and seats.

(4) Increasing the direct relationship between productive labour and operating machines rather than the produced units.

(5) Difficulty of restoring skilled labour in the case of disposal during a fall in production brought on by a shortage of materials. As a result, labour cost tends to become a fixed cost.

(6) Labour laws in a country like Egypt protect workers from lay-off in the factories and restrict the way in which companies could reduce their work force in adverse trading conditions. This, also, tends to made labour a fixed cost charged to the production regardless of the quantities produced.

Table (6-4) shows the relative significance of manufacturing overhead in both assembly and fabricating factories at the company.

Table (6-4)

Manufacturing overhead in both assembly and fabricating centres
of the study years
(.000 L.E.)

| Year | Fabricating Centres (1) | | Assembly Centres (2) | | | | | | Total (3) (1) + (2) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Sub-total | | Truck & Tractors | | Passenger Cars | | |
| | cost | % of (3) | cost | % of (3) | cost | % of (3) | cost | % of (3) | |
| 84/85 | 6650 | 27.3 | 17702 | 72.7 | 11285 | 46.3 | 6417 | 26.4 | 24352 |
| 85/86 | 8190 | 32.1 | 17348 | 67.9 | 12400 | 48.5 | 4948 | 19.4 | 25538 |
| 86/87 | 10923 | 42.6 | 14728 | 57.4 | 9454 | 36.9 | 5274 | 20.5 | 25651 |
| 87/88 | 7945 | 27.9 | 20544 | 72.1 | 11702 | 41.1 | 8842 | 31.00 | 28489 |
| 90/91 | 13207 | 44.8 | 16246 | 55.20 | 9136 | 31.00 | 7110 | 24.00 | 29453 |
| 91/92 | 10033 | 32.00 | 21311 | 68.00 | 12519 | 40.00 | 8792 | 28.10 | 31344 |
| 95/96 | 12193 | 36.00 | 21670 | 64.00 | 11400 | 33.70 | 10270 | 30.33 | 33863 |
| 96/97 | 11985 | 32.3 | 25094 | 67.7 | 12005 | 32.40 | 13089 | 35.30 | 37079 |

(General Administration of Cost Accounting at the Company - Reports of performance evaluation for the study years).

Figure (6-3)

Structure of cost accounting system

## 6.2 Process Cost System

Process costing is used in the assembly factories (Truck & Tractor, passenger cars, and engine assembly), that assemble vehicles in batches. Process costing is associated with flow production in the assembly processes. All costs of each process (i.e. direct material costs, direct labour costs and indirect costs) are accumulated and related to the units produced. This is at the plant level that produces multiple products as explained below.

## 6.3 Job Order Cost System

Job-order costing is used in the fabricating shops (Pressings, Treatments, Gears, Tool Room, and engine manufacture) that produce parts in distinct jobs. In the job-order cost system, cost of each job is tracked separately and accumulates costs by jobs. With this system, *all* manufacturing costs are assigned to the products produced. This is at the plant level that produces multiple products. Each product is produced in a batch requiring several different raw materials and different classes of direct labour. Moreover, the products utilise various combinations of common resources such as machines, supervisors, factory space, etc. Every job manufactured passes through a common machining process. The time spent in this machining centre is recorded for each job and is used to allocate manufacturing overhead costs to the job as will be explained later in this chapter. Each job in the factory has a job-order cost sheet that records the costs attached to the products produced in the batch and the number of machine hours spent processing the job.

A job-order cost sheet, as appears in Figure (6-4), is the underlying source document in the job-order cost system. The company used to maintain job-order cost sheets manually, but today these sheets are electronically recorded in computer systems.

The job sheet records all direct materials issued for the job, including the type, quantity, and cost of materials. A manual or computerised system tracks how each worker spends his or her time each day, including each job worked on or whether the worker was idle or in a training program, but it was difficult in the manual (or in the semi-computerised) system and was not precise. All payroll costs not directly traced to particular jobs are charged to overhead (see Table 6-8).

All direct labour worked on a job is posted to the job order sheet. The accounting system keeps track of the costs charged to each job by simultaneously posting them to ledger accounts via the usual mechanics of double-entry bookkeeping. As costs are charged to individual jobs, they are also entered in a work-in-process inventory account, which contains all jobs in process, including the direct materials, direct labour, and overhead allocations. As materials are issued out of raw materials and onto the factory floor for individual jobs, their values are transferred out of the raw material account and into the work-in-process account. When a job is finished and transferred to the finished goods inventory, the total job cost from the job order cost sheet is transferred out of the work-in-process account and into the finished goods account. Similarly, when the goods are sold, the values flow out of the finished goods account and into the cost-of-goods-sold account.

Figure (6-4)

Job order cost sheet

| Job Number | | | | | Date Started / / <br> Date Completed / / | | | |
|---|---|---|---|---|---|---|---|---|
| | Raw Materials | | | | Direct Labour | | | |
| Date | Type | Quantity | Amount (LE) | Machine Hours | Date | Type | Hours | Amount (LE) |
| x | x | x | x | x | x | x | x | x |
| x | x | x | x | x | x | x | x | x |
| x | x | x | x | x | x | x | x | x |
| x | x | x | x | x | x | x | x | x |
| Total | | | xx | xx | | | | xx |

| | |
|---|---|
| <u>Summary of Costs:</u> | |
| Total direct materials | x |
| Total direct labour | x |
| Overhead (number of labour hours x hour rate) | x |
| **Total job cost** | xx |
| Divided by: number of units in batch | xx |
| Average cost per unit produced | xx |

(General Administration of Cost Accounting at the Company).

The central problem addressed in the cost system is how to treat costs that cannot be traced directly to the products. The allocation of these overheads to products is often a key design issue in a cost system, and section 6.4 describes how overhead is allocated to products.

## 6.4 Apportionment and Allocation of Manufacturing Overhead Costs

### 6.4.1 Cost Centres

Classification of cost centres was effected by the functional division of the company's organisational structure (see figure 5.1). The company is divided into major segments which belong directly to the president of the directory board. They are: An Assembly Plant For Trucks, Buses, Trailers & Tractors; A Diesel Engine Plant; A Machining Plant For Alex, Gearbox & Chassis Parts (Miscellaneous & Gears Factory);

Press Factory; Tool Production Plant; Passenger Cars Factory; Petrol Engine Factory. Beside these factories there are other specialised Sectors and Departments supporting the production operation, such as: Sectors of Planning & Technical Affairs; Sectors of Sales & Service; Sectors of Financial Affairs; Sectors of Administrative Affairs; Supplies & Stores Sector; Inspection & Quality Control Sector; Training & Organisation Sector; Legal Affairs Sector; General Department of Projects; General Department of Design & Research; General Department of Plant Engineering; and General Department of Information & Computer.

The company used a functional classification to divide cost centres into production centres and production support centres. The last ones were categorised into three cost centres: production support centres, marketing centres, and administrative centres.

#### 6.4.1 .1 Production Cost Centres

A chart of production cost centres is used at the main centres level only (i.e. lorry, bus, tractor,..etc.). There was no analysis of cost centres at the level of sub-centres (i.e. chassis, body, painting, ...etc.). However, production cost centres are classified according to the nature of the production within fabricating and assembly departments as follows:

##### 6.4.1.1.1 Production Centres for Fabricating the Parts

These consist of hangar No.2 for Diesel Engine production centre, hangar No.5 for Tools Factory of fabricating & assembly centres, "Engine 1500 and 1600", hangar No.6 for Special parts production centre, and hangar No.7 for Presses production centre.

#### 6.4.1.1.2 Production Centres for Assembly of the Main Products

These consist of hangar No.1 for production centres of Lorries, Trucks and Tractors, hangar No. 3 for Buses production centre and hangar No.4 for Passenger Cars production centre.

### 6.4.1.2 Production Support Cost Centres

The production support cost centres are classified into: Own production support centres which serve the production centres only and General support centres which serve not only production centres but also the own production support centres. For example, oxygen station of factories engineering, carpentry shop, maintenance, planning, technical affairs, stores, services & sales, administrative & financial affairs, and the computer services centre.

### 6.4.2 Procedures of Apportionment and Allocation of the Manufacturing Overhead Costs

Manufacturing overhead costs contain: <u>Dedicated costs</u> designated to the production centres and production support centres such as indirect materials, indirect labour and machine depreciation; and <u>Common costs</u> that occur inside General production support centres such as medical affairs centres, social affairs centres, training centres, and so on which serve all departments at the company. (see sheet 6-6).

However, apportionment and allocation of the manufacturing overhead costs at the company was based on the actual basis according to the step-down method, through using three analysis sheets:

First sheet is to accumulate overhead costs of the General production support centres. Second sheet is to allocate the truck & tractors, and diesel engines hangars' costs; and the Third sheet is to allocate the machined parts, passenger cars, and 1500 Polieniz engines hangar costs. These procedures are explained below.

Sheet (6-5)

Costs of the general production support centres (GPSC);

| Production support centre | Code of cost centre | Total cost of production support centres before apportionment | | | | |
|---|---|---|---|---|---|---|
| | | Total | Wages | Product Requirements | Service Requirements | Other |
| | | | Acc. 31 | Acc. 32 | Acc. 33 | Acc. 35 |
| -Training | 60011 | xx | x | x | x | x |
| -Transport | 60012 | xx | x | x | x | x |
| -Medical services | 60013 | xx | x | x | x | x |
| -Social services | 60014 | xx | x | x | x | x |
| -Industrial security | 60015 | xx | x | x | x | |
| -Feeding industries | 60021. | xx | x | x | x | x |
| -Research & Design | 60022 | xx | x | x | x | x |
| -Planning | 60023 | xx | x | x | x | x |
| -Computer centre | 60024 | xx | x | x | x | x |
| -Inspection | 60025 | xx | x | x | x | x |
| -Factory engineering | 60031 | xx | x | x | x | x |
| -Oxygen station | 60032 | xx | x | x | x | x |
| -Carpentry shop | 60032 | xx | x | x | x | x |
| -Supply & storing | 60041 | xx | x | x | x | x |
| -Purchasing & contracts | 60042 | xx | x | x | x | x |
| -Services of hangar No. 1 | 61010 | xx | x | x | x | x |
| -Services of Lorry | 61011 | xx | x | x | x | x |
| -Services of Bus | 61012 | xx | x | x | x | x |
| -Services of Tractor | 61014 | xx | x | x | x | x |
| -Lorry inspection | 61030 | xx | x | x | x | x |
| -Bus inspection | 61031 | xx | x | x | x | x |
| -Maintenance of Hangar No.1 | 61040 | xx | x | x | x | x |
| -Maintenance of Lorry | 61041 | xx | x | x | x | x |
| -Maintenance of Bus | 61042 | xx | x | x | x | x |
| -....... .. of hangar No.1 | 61050 | xx | x | x | x | x |
| -Services of hangar No. 2 | 62010 | xx | x | x | x | x |
| -Engines inspection | 62030 | xx | x | x | x | x |
| -Engines Maintenance | 62040 | xx | x | x | x | x |
| -Engines ........... | 62050 | xx | x | x | x | x |
| -Services of parts factory | 63010 | xx | x | x | x | x |
| -Services of press factory | 63011 | xx | x | x | x | x |
| -Services of tools engineering factory | 63012 | xx | x | x | x | x |
| -Parts inspection | 63030 | xx | x | x | x | x |
| -Press inspection | 63031 | xx | x | x | x | x |
| -Parts Maintenance | 63040 | xx | x | x | x | x |
| -Press Maintenance | 63041 | xx | x | x | x | x |
| -Tools engineering Maintenance | 63042 | xx | x | x | x | x |
| -Services of hangar No. 4 | 64010 | xx | x | x | x | x |
| -Passenger inspection | 64030 | xx | x | x | x | x |
| -inspection of 1500 engines | 64031 | xx | x | x | x | x |
| -Passenger Maintenance | 64040 | xx | x | x | x | x |
| -Maintenance of 1500 engines | 64041 | xx | x | x | x | x |
| -Passenger ............ | 64050 | xx | x | x | x | x |
| Total | x xxxx | x x | xx | x x | xx | xx |

(General Administration of Cost Accounting at the Company).

**<u>First Sheet:</u> Accumulating Common Overhead Costs of General Production Support Centres (GPSC);**

This sheet contains the Common manufacturing overhead costs of the GPSC that serve all the company's sectors. Sheet (6-6) is used for this purpose. Costs of GPSCs are apportioned on both production cost centres and own production support cost centres in both fabricating and assembly hangars through the second and third sheets. The company uses an approximate basis to apportion the costs

Accumulating common overhead costs of GPSC are as follows: The costs of the industrial security, social, and medical services centres are allocated to the benefited centres by the percentage of employees in each centre. The training centre provides its training services to the different centres at the company. Also, it provides its training services to individuals from outside the company. In return, they pay training charges to the company. These revenues (i.e. the charges) are deducted from the training centre's total cost. The net costs are apportioned to the benefited centres based on the percentage of the trained employees in each centre. The transport centre provides its services both to deliver the production requirements to the company and to deliver the company's employees from and to their work locations, as well as from and to their summer resorts and trips. Again, the collected revenues are deducted from the centre's total costs. Then, the net costs are distributed to the benefited centres by the percentage of materials cost in each centre.

The computer centre provides its services to both the company and the others. Its net costs (after deducting its revenues from total cost) are distributed to the benefited centres by the percentage of the time spent for each centre. The industrial pupilage centre's costs are distributed by the percentage of the pupils' number in each centre. The inspection centres' costs are distributed by the percentage of the number of inspectors in both manufacturing and assembly centres. Both planning centre and supplier industries centre costs are distributed by the percentage of direct material cost used in the hangars of Truck & Tractors and in the manufacturing hangars.

The cost of the external and local interest is separated from the cost of the purchasing & contracts centre. The remaining costs of the centre and also the stores' costs are distributed to the benefited centres by the percentage of direct material cost. The cost of external and local interest is distributed to the benefited centres as follows: One third for the passenger cars, tractors, and water engines based on the production cycle of these products, which is six months only since components are delivered from foreign vendors to the company in the form of complete lots. Two thirds for lorries, buses, and air engines based on the production capacities of these products over a year from the date of opening credit until their delivery as a finished product to the customer, because the components are delivered to the company from different vendors.

Spreadsheet (6-6) shows the dedicated manufacturing overhead of production centres and the common manufacturing overhead costs apportioned from the General Support Production Centres. The next step is to apportion manufacturing overhead (including dedicated Manfg. Ov. costs and the apportioned common Manfg. Ov. costs) of the Own Support Production Centres, to production cost centres.

Sheet (6-6)

Manufacturing overhead costs in production cost centres

| Cost Centre | Code | dedicated manufacturing overhead of production centres | | | | | Total apportioned M.O. from the General support centres | Total | Absorbed direct labour cost | Total M.O. allocated |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Labour cost | Product Requirements | Service Requirements | Other | (1) | | (3) | | (5) |
| | | Acc/31 | Acc/32 | Acc/33 | Acc/35 | Total | (2) | (1) + (2) | (4) | (3) - (4) |
| TRUCKS & TRACTORS | 51100 - 51400 | X | X | X | X | XX | XX | XX X | XX | XXX |
| DIESEL ENGINES | 52200 | X | X | X | X | XX | XX | XX X | XX | XXX |
| TOOL SHOP | 53500 | X | X | X | X | XX | XX | XX X | XX | XXX |
| PARTS | 553200 - 53300 | X | X | X | X | XX | XX | XX X | XX | XXX |
| PRESSING | 53400 | X | X | X | X | XX | XX | XX X | XX | XXX |
| PASSENGER CARS | 54000 | X | X | X | X | XX | XX | XX X | XX | XXX |
| PETROL ENGINE | 55000 | X | X | X | X | XX | XX | XX X | XX | XXX |
| TOTAL COST CENTRES | | XX | XX | XX | XX | XXX | X XX | XXX X | XXX | XXXX |
| | | | | | | | | | | |

(General Administration of Cost Accounting at the Company).

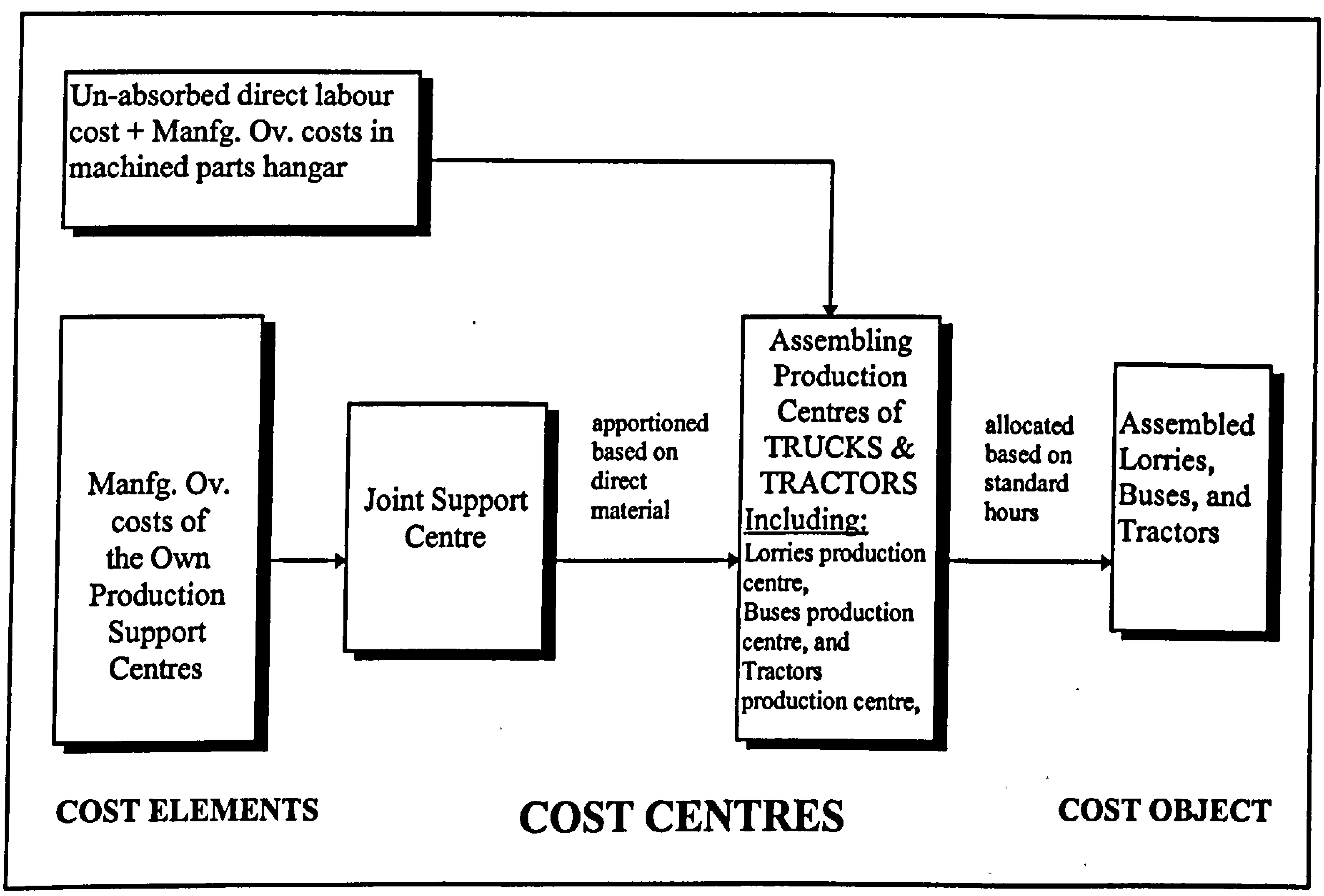
### 6.4.3 Apportioning manufacturing overhead of the Own Support Production Centres to Production Cost Centres.

<u>Second Sheet:</u> **Apportionment and Allocation of the Manufacturing Overhead Costs of Both Trucks & Tractors Hangar and Diesel Engines Hangar:**

Figure (6-5) shows the configuration of apportioning and allocating the manufacturing overhead costs in the truck and tractor hangar. This figure is a part from the overall figure (6-3)

Figure (6-5)

Apportionment and allocation of the manufacturing overhead costs of both trucks & tractors hangar and diesel engines hangar




Apportionment and allocation of manufacturing overhead costs in both the trucks & tractors' hangar and the diesel engines hangar are illustrated in the spreadsheets in tables (6-7) and (6-8). We can explain the allocation process as follows:

#### 6.4.3 1 Hangar of Trucks & Tractors

The costs of the own production support centres are accumulated in a joint support centre. The costs of this centre include the total cost of heat treatment centres (i.e. the hangar's shops) which prepare the production to serve both lorries and buses. The un-absorbed direct wages and indirect manufacturing costs in machining parts' hangars are charged to the trucks & tractors hangar because it uses most of the production of these parts' hangars for assembly. Consequently, the truck & tractors' hangar has more capability to bear these charges. The total cost of this joint services centre is apportioned to the main production centres (lorries, buses, and tractors) according to the percentage of total cost of direct materials used in each centre.

Total manufacturing overhead cost in each main production centre is allocated to its different products based on the percentage of the standard hours for the products produced. The manufacturing overhead cost is calculated for the produced unit in each type of the main product by dividing the costs of that type on the number of units produced.

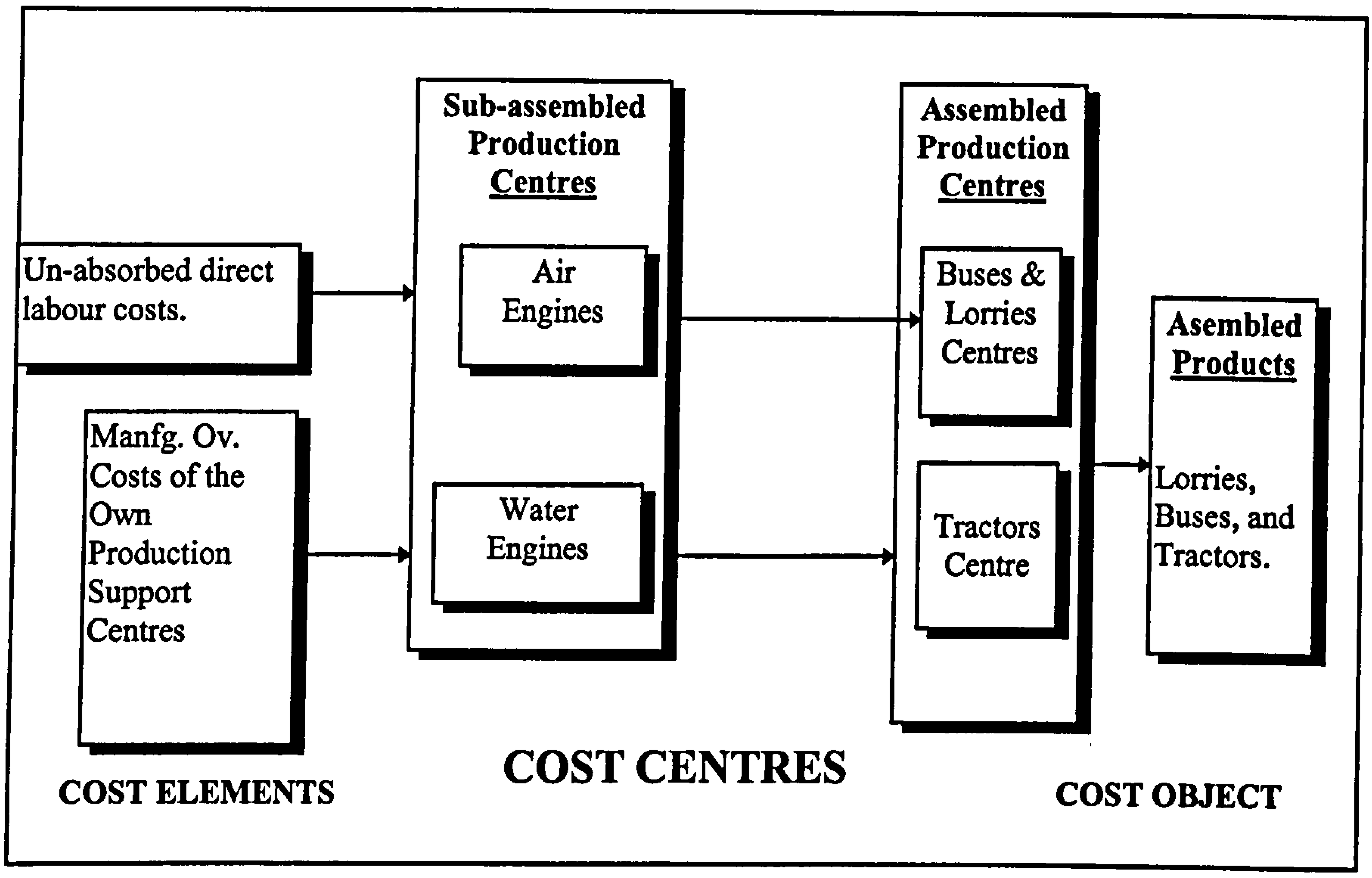
#### 6.4.3.2 Diesel Engines Hangar

Total cost of the five production support centres in the hangar is apportioned to the air engine production centres. Direct labour costs absorbed in manufacturing are deducted from total costs of the air engine production centre. The remaining costs , including unabsorbed direct labour cost, are forwarded to the air engines assembly centre. The total cost of the air engines' assembly centre is allocated to the bus and lorry centres while the total cost of the water engines' assembly centre is allocated to tractors' centre.

Figure (6-6) shows how manufacturing overhead of engines are allocated.

Figure (6-6)

Apportioning manufacturing overhead of engines hangar




The burden rate method used to charge overheads to the products of the diesel engine hangar is similar to the method used to charge overheads to the products of the machined parts' hangar as shown in the third sheet, which follows.

**<u>Third Sheet:</u> Apportionment and Allocation of Manufacturing Overhead Costs of the Special Parts' Hangar, Passenger Cars' Hangar, and Engines 1500 Polieniz's Hangar.**

### 6.4.3.3 Fabricated Parts Hangar (Tools, Special Parts, and Presses)

The total costs of the eleven production services centres are apportioned to the production centres based on direct labour cost. Absorbed direct labour cost is deducted from the total cost of the production centres. Absorbed direct labour cost is the standard direct labour cost charged to the job orders and is calculated as follows:*

| |
|---|
| Hourly wage rate of a production cycle = Actual direct wages of a production cycle / 160 standard hour (20 day per month x 8 hours per day) |

| |
|---|
| Absorbed direct wages of a job order = Hour wage rate x number of actual labour hours |

Absorbed direct wages charged to job orders are calculated by accumulating the wages charged to job orders in each hangar. The remaining costs in the production centres are manufacturing overhead costs and unabsorbed direct wages. The last one means the difference between total actual direct wages and the direct wages charged (i.e. absorbed) to the job orders. These differences add to manufacturing overhead costs and are treated accordingly. Application rate of manufacturing overhead costs is calculated for each hangar by dividing the manufacturing overhead costs and unabsorbed direct wages of a hangar on the direct wages charged to that hangar.

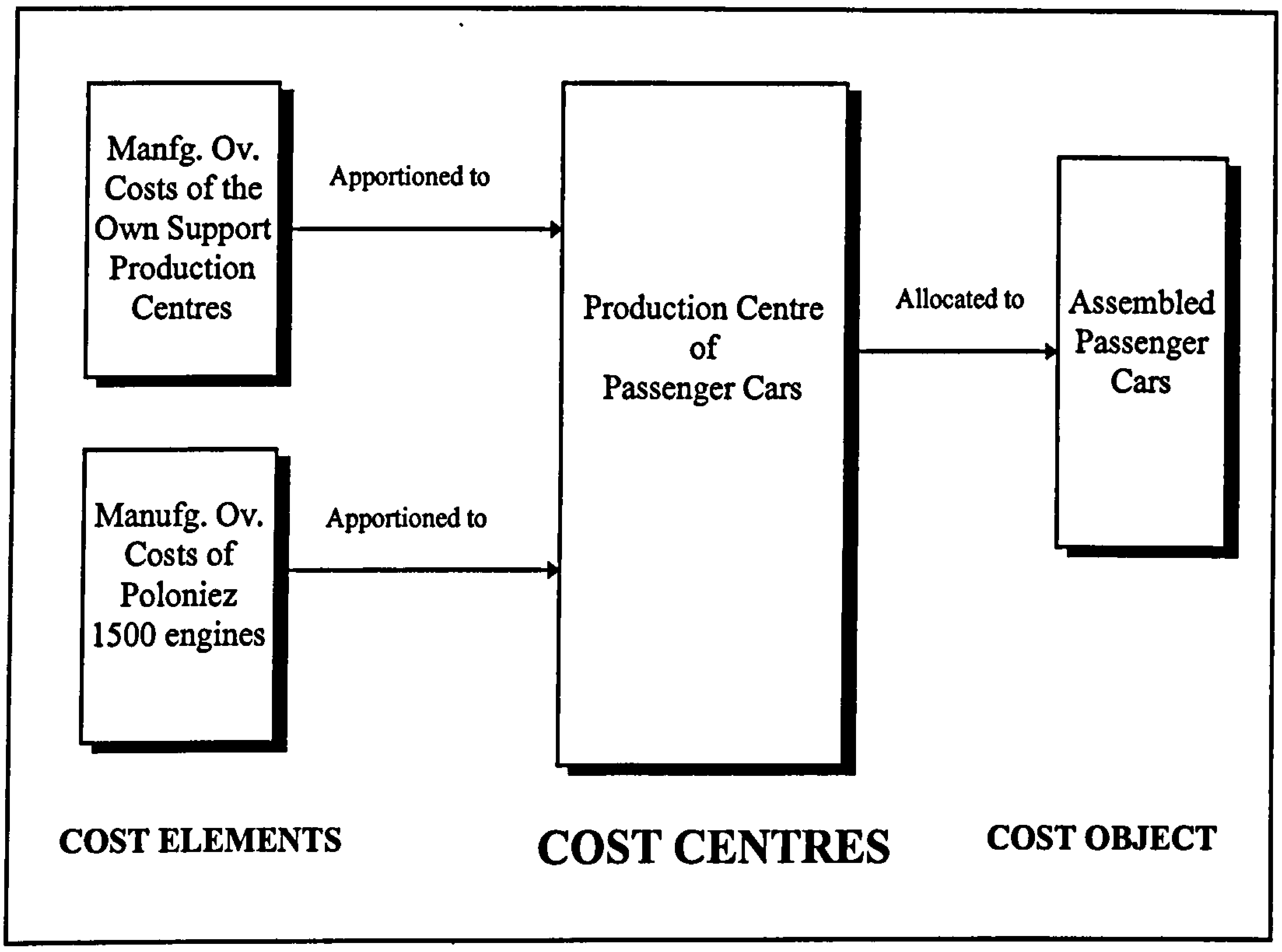
Finished parts transferred to the trucks & tractors hangar are valued by the total cost while finished parts which remain in the stores are valued by direct cost. Machined parts that are still on the production lines are valued based on the actual cost average of a part in the previous year multiplied by the number of the parts machined during the current year.

### 6.4.3.4 Passenger Car Hangar

Figure (6-7) shows the allocation process of manufacturing overhead costs in the passenger cars hangar.

Figure (6-7)

Apportioning and allocating Manfg. Ov. costs in passenger cars hangar




The total costs of the five production services centres, the costs of the Poloniez production centre in the hangar, and the costs of the assembly centre for 1500 engines are apportioned to the main passenger production centre, while the saddler production centre does not include manufacturing overhead costs. Manufacturing overhead costs in the main passenger production centre are allocated to the different models of the products. Allocation is by the ratio of number of standard hours of the assembled units in each model multiplied by the material cost of the unit.

In order to determine the unit's cost, manufacturing overhead costs are divided on the model's produced units. Finished produced units that remain in the stores are evaluated by total cost, while the units that are still in progress are evaluated by the standard direct material cost.

#### 6.4.3.5 Polieniz 1500 Engines Hangar

The total cost of the three production services centres is apportioned to the engine production centre. This means that the last centre includes the total cost of the production services centres plus its own overhead manufacturing costs plus direct manufacturing labour cost. Absorbed wages that are charged to the job orders are deducted from the cost of the engine production centre. The remaining cost is forwarded to the engine assembly centre. The total cost of the engine assembly centre is apportioned to the main passenger production centre. Finished engines that remain at stores are valued by direct cost, while engines still in progress are valued by the standard direct material cost.

The sheets (6-7) and (6-8) show how the overheads are apportioned and allocated at the company.

Spreadsheet (6-7)

DATE: COST ALLOCATION: THE STEP-DOWN ALLOCATION SHEET EL-NASR AUTOMOTIVE MANUFACTURING CO.

| COST CENTRE | MEDICAL | SOCIAL | TRAINING | TRANSPORT | INDUSTRIAL SECURITY | VOCATIONAL T. A. | VOCATIONAL T. B. | SUPPLYING INDUSTRIES | R & D | PLANNING | COMPUTER CENTRE | INSPECTION | INDUSTRIAL SERVICES | OXYGEN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-ALLOCATION COST: | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX |
| ALLOCATIONS | | | | | | | | | | | | | | |
| MEDICAL | | | | | | | | | | | | | | |
| SOCIAL | | | | | | | | | | | | | | |
| | - XX | - XX | X | X | X | X | X | X | X | X | X | X | X | X |
| TRAINING | | | - XX | X | X | | | | | | | X | | |
| TRANSPORTING | | | | - XX | | | | | | | | | | |
| IND. SECURITY | | | | | - XX | X | X | X | X | X | X | X | X | X |
| VOCATIONAL T. A. | | | | | | - XX | | | X | | | | X | |
| VOCATIONAL T. B. | | | | | | | - XX | | | | | | X | |
| SUPPLYING INDUSTRIES | | | | | | | | | | | | | | |
| R & D | | | | | | | | - XX | - XX | - XX | | | | |
| PLANNING | | | | | | | | | | | | | | |
| COMPUTER CENTRE | | | | | | | | | | | - XX | X | X | |
| INSPECTION | | | | | | | | | | | | - XX | | |
| IND. SERVICES | | | | | | | | | | | | | - XX | X |
| OXYGEN | | | | | | | | | | | | | | - XX |
| CARPENTRY SHOP | | | | | | | | | | | | | | |
| STORES & PURCHASES | | | | | | | | | | | | | | |

**Continue over.........**

(General Administration of Cost Accounting at the Company).

Spreadsheet (6-8)

DATE: COST ALLOCATION: THE STEP-DOWN ALLOCATION SHEET EL-NASR AUTOMOTIVE MANUFACTURING CO.

| | CARPENTRY SHOP | STORES | PURCHASES | MARKETING | MANAGING | TRUCKS & TRACTORS | DIESEL ENGINES | PARTS | PRESSING | TOOL SHOP | PASSENGER CARS | PETROL ENGINE | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | XX | XX | XX | | | | | | | | | | XXX |
| | X | X | X | X | X | X | X | X | X | X | X | X | |
| | | | | X | X | | X | | X | | X | | |
| | | | | | | X | X | X | X | X | X | X | |
| | X | X | X | X | X | X | X | X | X | X | X | X | |
| | | | | | | X | X | X | X | X | X | X | |
| | | | | | | X | X | X | X | X | X | X | |
| | | | | | | X | | | | | | | |
| | | X | | X | X | | X | X | | X | X | | |
| | | | | | | X | | | | | | | |
| | | X | X | X | X | X | X | X | X | | X | X | |
| | | | | X | X | X | X | X | X | X | X | | |
| | -XX | | | | | XX | | | | | | | |
| | | -XX | -XX | | | X | X | X | X | X | X | X | |
| | | | | | | XXX | XXX | XXX | XXX | XXX | XXX | XXX | XXXXXXXX |

(General Administration of Cost Accounting at the Company).

Twenty Four cost centres are involved: cost centres of medical, social, training, transport, industrial security , vocational T. A., vocational T. B., supplying industries, R & D, planning, computer centre, inspection, industrial services, oxygen, carpentry shop, stores and purchases , which are production support centres, and cost centres of Trucks & Tractors, Diesel Engines, Engineering Parts, Pressing, Tools shop, Passenger Cars and Petrol Engines, which are operating centres. Each production support centre incurs own manufacturing overhead costs. In addition, the operating centres have own manufacturing overhead costs. By the time cost centres (departments) stores & purchases are being apportioned to the centres, all operating centres in addition to stores & purchases have also received charges from cost centre (department) industrial services.

These would have been cost centres classified at levels above cost centres stores & purchases. The cumulative cost in cost centre stores & purchases; this cost is to be apportioned to the operating centres. At the end of the process, no cost remains in cost centre stores & purchases, it has all been allocated to the operating centres. Apparently, this method is neither precise nor accurate because it ignores the reciprocal services among production support for each other.

## 6.5 Evaluating the Effectiveness of the Cost Accounting Systems

### 6.5.1 Relevance of Apportionment and Allocation Techniques Used at the Company

Undoubtedly, apportioning the manufacturing overhead costs on an actual basis affects the accelerating of the output provided by the system. So, it is necessary to use a predetermined basis. Also, using the Step-down method overlooks the reciprocated services that are provided by the production support centres to each other, which could be considered and dealt with mathematically by means of computer facilities available at the company. The total cost of the production support centres is sometimes apportioned on just one production centre (as in the case of the of truck & tractors, diesel engines and 1500 engines hangars), and sometimes on all production centres (as in the machined parts hangar). This apportionment, using just one basis, is not relevant, due to the different nature of the services performed in the production centres.

Also, there is no separation between variable and fixed manufacturing overhead cost. A blanket application rate is calculated for each hangar. So far, the old system has assumed that the factory processes are uniform and that all operate at full capacity. This can be a dangerous assumption as the company is using a uniform factory overhead rate. The cost system which can only accept a single plant-wide overhead rate, has caused some anomalies when a product passes through some factory departments but not others. Overhead costs typically are greater in fabricating departments, because of the depreciation on the machinery, than they are in non-machining departments such as assembly. However, at present, all jobs are burdened with the same overhead rate. Furthermore, labour hours do not provide a good overhead base in machine-intensive operations because labour is not a significant cost driver. Jobs requiring substantial machining operations typically are charged with few direct labour hours, and consequently they are not carrying their fair share of overhead costs. When the NC and CNC equipment is used, some jobs may not require any direct labour.

However, manufacturing overhead costs are charged to the batches planned to be produced and for which job orders are issued, not to the actual batches. When the planning department issues a job order to produce a certain quantity of a certain part, this job order is a target for the hangars. The actual produced quantities may be lower or higher than the targeted quantities. This should be considered when manufacturing overhead costs are charged to the products.

Evaluating the products in progress -in both fabricating and assembly- by the standard cost of the material only, is not accurate because the fiscal year will be charged by higher burdens. Apportioning the unabsorbed overheads and direct labour costs of the manufacturing hangars- to the production centres of trucks & tractors and passenger cars led to the cost of a machined part in the parts' hangars being reduced and increased the cost of an assembled product in the production centres of Trucks & Tractors and passenger cars.

### 6.5.2 Inflating the Production Cost by Non-productive Labour Cost

Changing the competitive environment has made the company miss its monopolistic position at the market and has caused declining demand for its products. This has led to the appearance of idle production capacity at most of the company's plants. (see Table 7-7 in chapter seven).

The absorption costing used by the company led to the total cost including the un-productive (or unabsorbed ) fraction, not just of the machining capacity but also of the human resources. The surplus labour meant the labour structure did not represent the true labour cost charged to the production because these overmen did not meet fiscal production. Inflating the production cost by unabsorbed labour cost resulted from several reasons: Firstly, the applied incentives system which was not linked with the production but related to political decisions by the state. Secondly, the increased volume of labour force caused by the Governmental employment policy at that time. Indeed, direct labour cost did not decrease at the company, as it was inflated by the surplus labour cost. The company could not lay off the overmanning because of the Egyptian employment law.

Although the production method has changed, the direct labour content did not decrease. Apparently, increasing fabricating and using advanced machines like NC and CNC machines led to decrease in the relationship between direct labour and products and increase in the relationship between indirect labour and products. Also, it weakened the causal relationship between using direct labour cost as an allocation basis and manufacturing overheads.

Another limitation which made production cost overestimated is that while the company distinguished among the different skills of labour to calculate the average of actual wage rate, it did not consider a different specification of each job in different locations at the company. Also, it was difficult to use a Job Card (JC) to make control for an actual operating time spent by a worker on a machine. So, it was also difficult to determine a responsibility for waste time and a product cost would not be counted based on the actually exploited human capacity. Actual direct hours were not accumulated accurately, therefore it was badly reflected in calculation of both direct labour costs and overhead rate as well as on a product cost at the end.

Total costs were allocated to the products regardless of the production quantities, even if only one unit was produced. This situation has led to weakness in the competitive position of the company at the market because of the competition. The company has lost a fraction of its market share, particularly after increasing the competition at the Egyptian automotive market. The company must compete directly against other competitors. Bidding on custom work always involves risk; if the bid price is too high, the job will be lost to a competitor. While if it is too low, the company may win the contract but subsequently achieve a large loss. However, the company might lose money on unrealistically low bids more than it might lose jobs to competitors because of excessively high bids. This is because the company wanted to maintain its factories in operation all the time if possible so as to keep its labour busy and to avoid un-employment.

Currently, as the economic policy has changed, the company has some autonomy to make its operational practices. It has made some decisions to dispose of the current surplus labour like Early Pension and to appoint only the required labour in the future as illustrated in table (6-9).

Table (6-9)

Effect of implementation the early pension on the annual wages at the company.

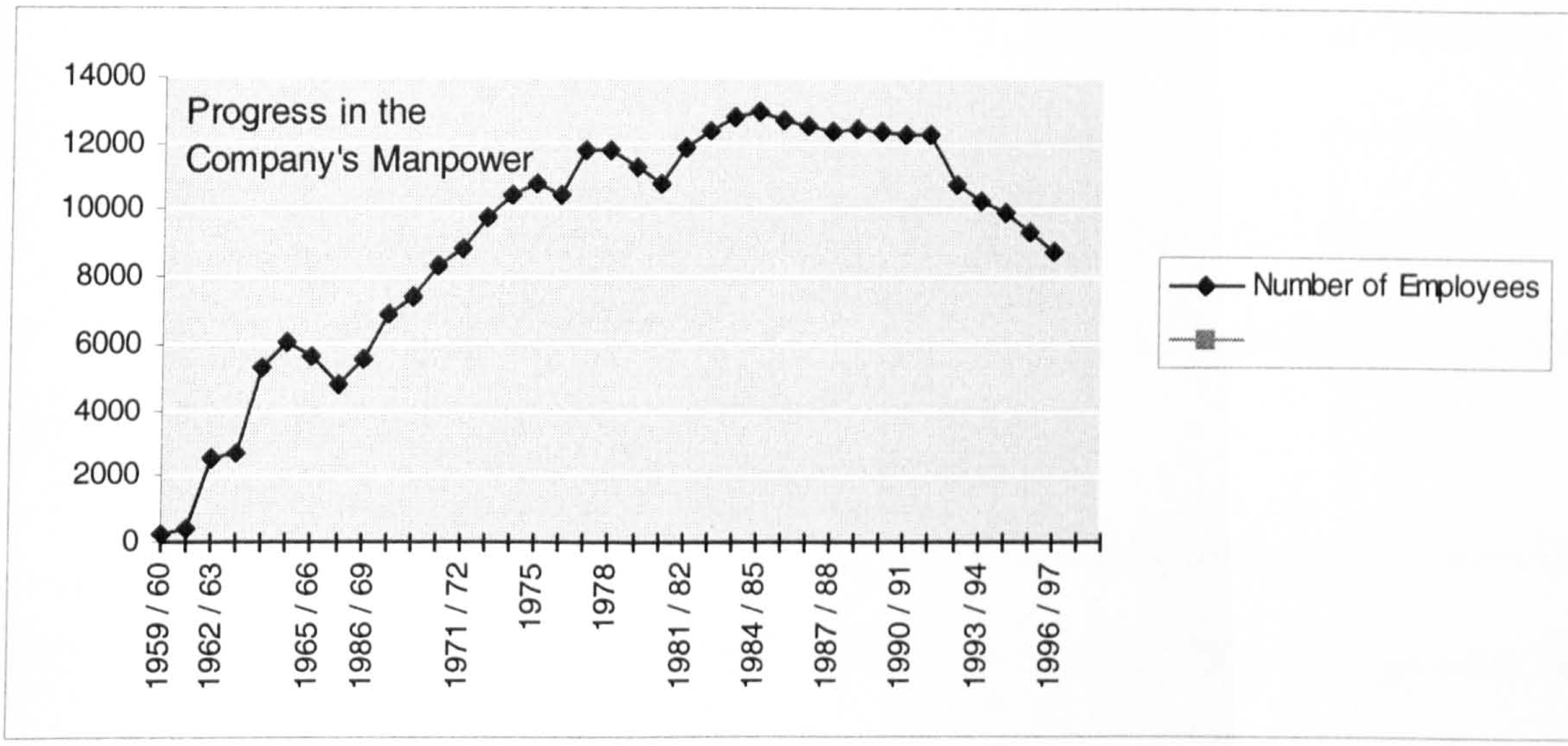
| | Before implementation the Early Pension | After implementation the Early Pension | Difference (labour saving) |
|---|---|---|---|
| Total of employees | 9375 | 8447 | 928 |
| Total of annual wages | 101,422,000 EGP | 99,873,000 | 1,549,000 |

(General administration of costing & budgeting, performance assessment reports, 1997).

Figure (6-8) shows developing the labour force at the company.

Figure (6-8)

Developing the labour force at the company




(Information Centre at the Company, 1997).

Consequently, the accumulation and control, directly and immediately on the production line, of the exploited cost of both machining and human work is very important to determine precisely the true exploited cost of the production, whether for the machined parts or for the assembled products. Controlling the production costs has become a requirement to avoid the upstream costs resulting from un-productive machined and human capacity. This is significant for making such decisions as product pricing and make or buy.

### 6.5.3 Cost Accounting Systems and Operating Budgets Process

There was no role of the cost accounting system in preparing operating budgets. Operating budgets were prepared as a work plan that was derived from the corporate budget of the holding company. Setting operating budgets was based on arbitrary estimates of resources by using past experience and modified by the current conditions. Therefore, the cost accounting system of the company did not play an effective role in preparing the operating budgets because there was no cost standard costing in this phase of developing a cost accounting system in the company.

Operating budgets were prepared by the main departments at the company without any participation from the lower-level management. Building-up these budgets was according to estimates provided by the directors in the major departments for planning, production, factories engineering, sales, purchasing. The main purpose of setting these budgets was to get the required resources for the coming year from the holding company as representative authority of the state.

The principal objective from preparing the operating budgets was to make comparisons of the results between the affiliated companies in the same industry and also to make comparisons of the results between the current year and the past years of the company. However, the numbers included in these budgets were aggregated, so they did not serve for the control purposes effectively.

In addition, operating budgets were static because they were prepared based on a single activity of production that was used to prepare the burden rates. The following budgets were established: production budget, materials budget, wages and salaries budgets, sales budget and investment budget (see Appendix C).

The author views that preparing static budgets is resulting from stability of both production and market conditions due to static economical environment at that time. A product market was guaranteed and there was no strong competition. Today, the environment has changed, it has become more dynamic, therefore it is better to prepare flexible budgets with multi production levels to comply with the expected changes.

The purpose for which the budgets were prepared led to motivating the managers to set loose budgets in order to obtain many resources from the holding company as possible for achieving positive results. Also, the budgets are missing the realistic and attainability because there is no participation of operators and supervisor in the workshops to prepare them. The recent attitude that has been widely and successfully used in Japanese companies, is to involve shop-floor workers in problem-solving.

Setting budgets was based on the past experience, they were not prepared according to the production and markets plans and thus they did not take the potential changes into account. In addition, they were not determined in light of the company strategy in the long term, because they were principally not prepared for the operating purposes and there was no precise scientific study of the requirements of resources. Preparing budgets must take into account the availability of the foreign currency and materials, production capacity, production lead time, purchasing lead time and delivery lead time and the expected market circumstances. However, this point will be elaborated in Chapter Nine.

### 6.5.4 The Role of Cost Accounting System in Decision Making at the Company

Decision making of product pricing is one of the most important managerial decisions because it affects directly on the production operations and the mix of production, sales and profit. Cost data plays a vital role to assist management to make this type of serious decision. The importance of the role depends on several considerations such as demand, competition and the society conditions. As mentioned in chapter Four, the company had a monopoly of the Egyptian automotive industry. While price competition did not exist at that time, the company selected absorption costing and cost-plus method for pricing its products. The company intended to recover all its products' costs and obtain a return. At that time, absorption costing was a suitable method that kept pace with the prevailing circumstances. Selling price covered the cost of both exploited and un-exploited (machining & human) capacity. So, the company did not care to analyse its production capacity, and because it was the market leader in this field until early the 1980s, its accounting systems appeared quite adequate. Managers did not need advanced information systems in order to achieve their corporate objectives and to maintain their market position.

During this period little consideration was apparently given to information systems. The lack of motivation to develop information systems was described to me in a number of ways by the cost managers at the company's factories, they commented:

> in that era the company was highly profitable; it was monopolistic. The common comment was 'the company was making a lot of money, why worry?
>
> The company never really saw a need for advanced information system. It did not see a need for it because it was making acceptable profits because it was rising the prices up, so it did not really need to control or reduce their costs
>
> If you had poor systems and the prices were high, so the customer paid. So you improved your efficiency and brought the price down, to what benefit?
>
> And if we are overmanned, so what? The customers will pay. Now those days have changed (An interviews with the Cost Managers at the company, July, 1998).

When the company incurred losses during the years from 1981/ 82 until 1983/ 84, the total losses were 44.8 Million L.E. Starting from 1985/ 86 and thereafter, the company changed its pricing policy with the aim of moving from loss into profit and saving the hard currency used to buy import production requirements, as well as improve the company's liquidity position. This required some strategic decisions to be made by the company. For example, pricing the products, particularly those making losses, based on their exploited costs. Giving new names to some old products and making minor modifications in their form and specifications to increase their prices. Giving facilities in its payment conditions of some products that faced marketing difficulties. For example, in the interview with the director of cost accounting in the general administrative of financial sector in the company, he said:

> Investigation of the extent to which the products' selling prices covered to their total costs, 53 % of the products achieved profits. These were all models of buses, "Satorn lorry with box", tipcart lorry without box, lorry with water dam, 4x4 3 ton military car, "Regatta passenger car" and air engine. 42 % of the products achieved losses. There were "Satorn lorries" with winch, 2 x 4 heavy lorries, tractors, and passenger cars (except "Regatta") 5 % of products broke even. This was the standard "Satorn lorry" without box. The heavy lorry achieved the highest losses (17.5 %) because the local content in its manufacture was decreased and associated import costs were increased (An interview with the Director of Cost Department at the company, July, 1998).

Nowadays, the company's competition environment has changed because there are new competitors entered in the Egyptian automotive market. Cost factor is one of the competition factors, which companies try keep reduced as much as possible. Consequently, in-depth cost data analysis is needed to achieve that objective. The cost accounting system applied at the company was not relevant for that purpose because it provided total cost data but it did not analyse this function. Indeed, the observation that cost accounting system was poor only arose subsequently, when increased competition focused attention on the need to control costs. But more importantly for control purposes, there was also a lack of basic information about production activities. As the senior manager of production planning explained:

> Nothing to inform you where the product was, the stage of manufacture, how much material they had utilised, how much scrap they had used, what labour hours they had spent. There was nothing fed into the accounting system or costing system on a periodic basis to measure actual against standard. Nothing at all (An interview with the Senior Manager of Production Planning at the company, August, 1998).

Cost accounting system provided little information on the sources of competitive advantage. Product costs are often so inaccurate they encourage management to adopt strategies that inhibit the improvement of manufacturing. Managers are encouraged to manage the allocation and absorption of overhead rather than strive to eliminate waste and improve operational performance. Particularly, manufacturing overhead represents a minor fraction of total product costs (only 6 %) as shown in Figure (6-2). Therefore, there is no need to use sophisticated allocation methods (like ABC) in order to obtain accurate product cost. Rather managers should concentrate on exploring and eliminating non-added activities which drive these overhead costs, to get them down.

Cost accounting system provides little insight into the operating activities (e.g. scheduling, suppliers..etc) that generate the overhead costs. Under the cost accounting system's practices costs, these activities are lumped in the overhead and charged as incurred to the products rather than control them. There is no direct way of seeing the activities which caused these costs. Non-value added activities analysis may be helpful to visible cost reduction potential.

### 6.5.5 Cost Accounting System as a Closed System

It is obvious, as explained above, that the original cost accounting system is affected by the old manufacturing environment described in chapter five. We can visualise the original cost system as a close system that does not interact with the surrounding internal and external environment. The system operates to achieve the goal of the company. The company in the old environment adopted a cost-leadership strategy. This strategy requires reducing costs. Therefore, the traditional goal of a company is determined, based on increasing production whether it can be marketable or not. Increasing production means assigning a large amount of fixed costs on a large quantity of units to reduce the product cost. Thus, a company adopted a narrow perspective of cost control or reduction. Maybe the main reason for success of this strategy in the past, was that the external environment was relatively static and deterministic in the markets and was unreliable in the supply system but the internal environment was characterised by uncertainty. Building-up inventory buffers in that environment was planned through production planning and control system and the original cost system. Figure (6-9) shows visualisation of a company as a closed system in the old environment.

Figure (6-9)

Visualisation of a company as a closed system in the old environment

## 6.6 Summary

The case study introduced in this chapter describes El-Nasr Automotive Manufacturing Co. Since, 1960, the company had established a cost accounting system which did not aim at operation effectiveness. It was not helpful for controlling manufacturing resources because it was designed, basically to calculate the products costs for inventory valuation. Deficiencies of the system were due to the arbitrary procedures of collected and allocated manufacturing overhead costs to the products through both production and production service centres. The prevalent circumstances at that time precluded seeing these deficiencies. It appears that this market dominance had allowed the company to show a growth in profitability, but only at the expense of its customers. Its monopoly position had allowed it to act as a price setter, and it was thereby able to export the costs of its own internal inefficiencies to its customers. In a sense this market control took the place of effective internal control and there was an accompanying lack of information systems around production and finance, and more significantly little perception of the need for or value of such information.

Cost accounting system provided feedback to managers and employees that is not timely and too aggregated. This is because there was no information network with a computerised data-base. Therefore, the communication among departments was very weak. Cost reports were prepared twice a year which led to non-effective and late operational control. Thus, the information included in these reports missed its value because the managers received it late. Furthermore, the system provided too aggregated information because the company had a monopoly and there was no need to make more cost analysis. With the variety of manufacturing needs increasing, the system's inflexibility became more manifest. The purpose is to analyse quickly and accurately all the information needed for production. When the Cost accounting system was viewed with that in mind, all batch processing formula lacked flexibility. The new, complicated and diversified manufacturing demands were even more impossible to incorporate. Information needed for production such as the different batches produced, work hours, production costs, purchased orders, stock, etc. were carried out on separate processing systems.

At the divisional level there was an increasing awareness both of the need for enhanced internal control of operations, and also of lack of effective information with which to exercise such control. In particular, as we described earlier, the ease and rapidity of carrying out cost analysis that copes with cost pressure factors caused by unreliability of raw materials, changing energy prices, increasing labour costs and sluggish operating rates, are important functional conditions in cost systems. At the same time, the system was needed that could quickly adapt to the constantly changing business environment. It became apparent that the company needed to Data-Base to cover all its activities including the cost accounting system. It also required to upgrade its cost system through integrating with manufacturing activities.

With the competitive changes of the early 1990s there was a growing awareness of the need for improved information systems for the internal control of operations throughout the organisation. However, there were very different, if related, perceptions of the precise nature of these information needs. The improved management information was defined largely in terms of the physical control of production; tracking the progress of particular orders; scheduling production, checking physical stocks and meeting delivery promises.

Therefore, the next chapter will deal with the developments in the information systems at the company in order to overcome some shortcomings of the original CAS and solve some of the production problems faced by the company.

# Integrating Cost and Production Systems

# "OMAC"

The new competitive environment has made production flexibility increasingly important to El-Nasr Co. attempting to match production to the current customers' needs. The key objective of the improvements made to the production planning and control processes is to ensure material availability and reduced inventories. This was one of the most important problems the company suffered as explained in chapter Five. Measuring material and components availability can be quite straightforward in the new system as shown in table (7-7). The new system is called the **O**n-line **M**anufacturing **C**ontrol (OMAC) established in 1989 by ICL Co. (a computer vendor) and implemented at El-Nasr Co. in 1990. OMAC is an MRPII system which takes a much wider view of the manufacturing process and includes all the resources necessary to manufacture and supply the product. It also attempts to provide information regarding the achievability of the generated production schedule.

As the company is using the OMAC system to plan and control production, it has become able to detect parts shortages before an order or schedule is launched on the shop floor. Stock balances on each part or product are recorded within the system, and when the schedule is released onto the shop floor, the system can check the available materials and reporting shortages. This information can then be shown on a printed report of availability of the materials, components, WIP, and finished products, as will be explained later.

When the manual system was used to control inventory, the stock figures held in the system might not be accurate, the system may show that sufficient parts are available yet the material, in fact, may not be available in the stockroom as shown in table (5-3). These stock-outs can be recorded and tracked in the OMAC system. The objective is to maintain 100 per cent material availability, nothing less than this is acceptable.

OMAC system is an effective attempt by the company to overcome some manufacturing problems, explained in chapter Five, which have led to increasing costs and have caused weakness in the competitive position of the company. The OMAC system is a natural development of using the small package system which was implemented in the 1980s and is an essential need for installing an integrated computerised costing. Figure (7-2) shows the major components of the OMAC system. The implementation of the new system was gradual. The company selected the Bus factories to begin the implementation, then it generalised the system to the remaining factories at the company. To implement the system, the company was segmented into sites to facilitate application of the system. The computer network was expanded to include all stores and the remaining departments, including the cost accounting departments.

It is worth mentioning that the OMAC system is a computerised integrated system and it has many capabilities. The company has not implemented all the capabilities of OMAC. For example, the OMAC system includes a JIT subsystem and 'What-If' module to simulate the changes in the real world. The company plans to use them in the future but it does not apply in the current circumstances.

## 7.1 Computerisation Development at the Company

El-Nasr company is among the leading companies using computers in Egyptian industry as claimed by the interviewees and the leaders in the other companies visited by the author in the pilot study. A number of applications have been implemented for administration (e.g. payroll and other personnel routines), finance (e.g. cost accounting) and production (e.g. stock control). A major emphasis for the further development of the company's computing facilities lies on production control applications.

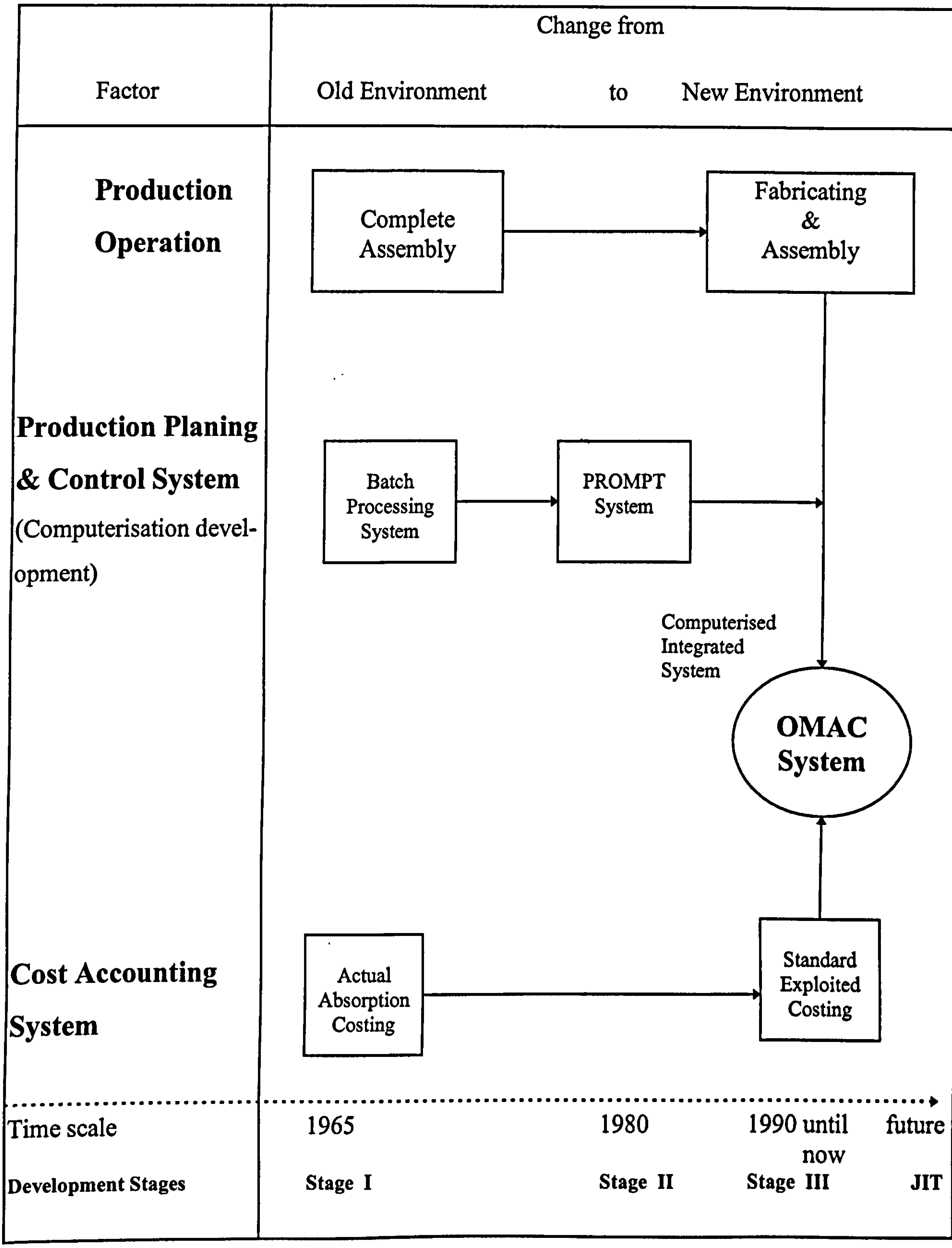
The implementation of a production planning and control system that utilises the data storing and processing facilities of a modern computer system has a high priority at the company. This is because of the major problems explained in chapter Five. The system is intended to improve the co-ordination of the information flow including material flow for the final assembly of the products. For example, very schematically, the problem to be solved is to determine when, what and how much material must be acquired to meet a given production plan. The company's top management, through the production management, has therefore been concerned with testing and adopting different systems for their material requirements planning. Three phases have been tried, each one having some unique characteristics. On a relatively high ambition level, the integration of different plant functions into information networks has been technically successful through the advances in computer and communication technology. One such product that has been adopted by the El-Nasr company is the OMAC system.

With the basic structure of OMAC as the advanced system, and also as a reference model for production control systems in general, we will be able to evaluate the different systems that have been tested and partly adopted by the company. Evaluating the characteristics of OMAC will be in the light of the improvements in cost and material flow.

However, the company's development as a computer user can be described in three phases as shown in figure (7-1).

Figure (7-1)

Summary of the changes at the company's environments



### 7.1.1 Phase I: Batch Processing System

El-Nasr Co. adopted the Batch Processing system in the 1970s. According to this system, the independent programs were prepared by the programmers at the company's computer centre (IBM). There was no central database for the storing of, for example, production data but each application uses its own data files. For example, there were programs for stores, job orders, costing. In this phase the computerised cost accounting system was not partially for operational control rather it was for preparing the company's financial statements by inventory evaluating and sold goods costing.

During this phase the integrated solution strategy did not apply for a number of reasons such as lack of knowledge about the advanced computerised system, inadequate and insufficient vendor support, insufficient computer capacity and a systems architecture regarded as too sophisticated to be compatible with the present production situation at the company.

### 7.1.2 Phase II: PROMPT System

A shift from a centralised to a mixed centralised/decentralised approach where the MRP system (together with other routines for manufacturing planning) is supplemented by a local (decentralised) system for stores control. This stores control system is a module in a minicomputer-based production control system called Production Reviewing Organisation of Monitoring of Performance Techniques (PROMPT from ICL) adopted by El-Nasr Co. in the 1980s. The two systems are not hardware connected. The decentralised approach is planned to include also personal computers in order to acquaint users with the company's computer applications.

### 7.1.3 <u>Phase III</u> Integrated OMAC System

The long-range computer strategy started in the 1990s is an integrated system of the On-line Manufacturing Control (OMAC from ICL) system for support not only of the company's production planning and control but also covers all the manufacturing resources at the company.

## 7.2 About OMAC

OMAC is an applications software tool for use in manufacturing companies; it supports the management of the manufacturing process from creation of part data to the generation of information for financial ledgers. OMAC is a versatile tool to help a company control all aspects of its manufacturing environment, from the creation and use of the basic product data (parts and structures) through management of the manufacturing process itself, provisioning, factory scheduling, control of product costs, to the generation of information for financial ledgers.

OMAC is a real time system: data is validated as soon as a user sends it from his/ her terminal. Once accepted, it is immediately available for inquiries. This means, for example, that a change in the stock situation for a part is seen straight away by a buyer placing orders for that part. There is also an off-line facility for interfacing with other systems so that data can be accepted from them.

OMAC is available to suit individual requirements. This provides varying degrees of ability for a user to adapt the system specifically to his/ her own demands, if they are not met exactly by the standard package. OMAC uses the well-established Integrated Data Management System (IDMS-X). This ensures that data is stored efficiently and consistently and provides full security against loss of information. System access is controlled by personal identification numbers (PINs) and passwords, so that the ability to examine and change sensitive data can be limited to people responsible for those areas.

### 7.2.1 Data Requirements

For any control system to function properly, a large amount of data has to be provided. There must be reliable procedures to ensure that the data are both accurate and input in a timely manner. This approach would be motivated for two reasons: (i) control must be based on reliable and relevant data. Keeping track of events is therefore a necessary step before subsequent steps such as comparison with standards and execution of corrections can take place. Unless collected data are correct, no relevant control is possible. (ii) the establishment of a reliable data acquisition system is a logical first step in building a computerised control system.

If the base data are not accurate or out of date the system may make recommendations which do not reflect the true situation. This may lead to over-ordering of parts or stock-outs. In addition to the basic data such as parts, product structures, costs and operations, OMAC also requires parameters to control such things as ordering methods, batch rules, stock default situations and exception reporting. These parameters must be carefully evaluated in order that they can be set for each part to provide the level of control required but minimise the amount of effort required to run the system. For example, the MRP batching rules, if incorrectly set, can dramatically increase the time taken for the MRP processor to run as well as the time taken to manage the output from it. All parameters must be reviewed on a regular basis to ensure that they still reflect the current situation, as requirements change.

### 7.2.2 The Goals of OMAC

When the interviewees were asked to specify the major goals of OMAC system, planning managers on different levels agreed the most important goal is co-ordinating and integrating the manufacturing activities in the company. They pointed out different sub-goals like, high resource utilisation; controlling costs; increasing productivity. Raising the efficiency of the manufacturing process through materials should be available in due date and in the scheduled quantities. Material flow should be efficient in terms of timing and co-ordination with assembly.

The idea that employees in different positions will react and take measures as appropriate is fundamental to the integrated communication-oriented systems. The high costs often involved for hardware and software to permit interaction with users are thought to be justified by the possibility of further reducing work-in-process and inventories and by better utilising available resources through a better command of the information flow.

### 7.2.3 New Concepts by OMAC System

The OMAC system brought new concepts that were not used by the previous systems before. These concepts assist the computerisation and integration of the OMAC's subsystems. The computerised system packages include these concepts, which the user has to understand very well in order to manage and run the system. For example, such concepts achieved improvements in the information flow throughout the company through General Data Base and Manufacturing Data Base, and co-ordinating between the company's activities and exercising comprehensive control through using Single Code Number of Account (SCNA) at the company level. SCNA is dedicated for each factory, department, shop, cell, store at the company. This facilitates the communication between the sites and prevents the duplication and repetition in handling data. Quick Communications are made not only between stores and shop floor but also between the departments with each other; for example, the inquiries about purchased orders or production orders or any adjustments in the standards. Up-dating the financial and manufacturing information is feasible. Making the manufacturing decisions rapidly; for example, the decision to continue or stop producing a certain part, cancelling a certain production order in process and starting the work on another one.

Considering all related variables synchronised when calculating the material requirements of such variables as Purchased orders, stock balance, production lead time and purchased lead time and available production capacity. That is because the computerised OMAC system includes programs of such sub-systems as purchasing, storing, production, costing. Capability to calculate the cost of any small or big part on shift by the computer facilities and computerised Family Tree.

Reducing the paperwork volume in comparison with the old system. Tight control for material, parts and spares stores, for example controlling the sorts of slow movement and controlling the storekeepers. OMAC system does not give any scope for fraud by the storekeeper, by cancelling or adjusting the store transactions. If a document is missed, the computer will expose and print the date of issuing this document. All data are registered in the computer and available to all departments and sites in the company. Consequently, any change made by anyone in any parameter in the program, will show to all departments and sites. This is because communications network through terminals is widespread throughout the company. Overcoming the problem of shortage of the materials and parts on the production lines.

Controlling the capacity bottlenecks and making the decision of redistributing the loads among machines by using the computerised concept of Alternative (ALT). This concept is used in both loading a Work Centre (W.C.) and when preparing a new batch of a certain part. An Alternative in a work centre means that when job orders are being loaded for a work centre and its capacity is insufficient, the computer, automatically, looks at ALT 1, ALT 2, ...(i.e. Alternative work centres). The computer loads the extra job orders to ALT 1. If ALT 1' s capacity, also is not enough, the computer automatically transfers into ALT 2 and so on. An Alternative is used also when preparing a new batch of a certain part. It means that when preparing a certain new batch, the computer looks at the origin balance of that part and if it is not enough, the computer again looks at ALT 1, ALT 2, .... (Alternative part balance) and reserves it for that new batch. This concept is very important when making Work To List. It means that after preparing job orders for a certain batch and distributing operations on work centres, it is possible to obtain a report about the loading priorities of each work centre according to the time determined for each operation.

Following-up the assembly operations is the concept of Work-In-Progress (WIP) in the OMAC system. Following-up the operations on a part is through the Job Card (J.C) to accumulate the time of each machine and operator and the reasons for breakdown as will be explained later.

### 7.2.4 The OMAC Subsystems

OMAC consists of a number of separate subsystems, each covering a particular aspect of the manufacturing process. Manufacturing Database (MDB) is mandatory for all users but other subsystems can be implemented separately as required, enabling a user to increase his/ her use of the product as he/ she becomes familiar with individual subsystems. Some subsystems depend on others for information, and so may not operate fully unless the other subsystems are in place. The OMAC subsystems are known by three letter abbreviations, as shown in Table (7-1).

Figure (7-2) shows the major components of OMAC and the main information flow between them. The relationships between OMAC's functional areas and individual company functions (such as purchasing or planning) are determined. The important point is that the different functional areas are covered and that responsibility for each of them is clearly defined.

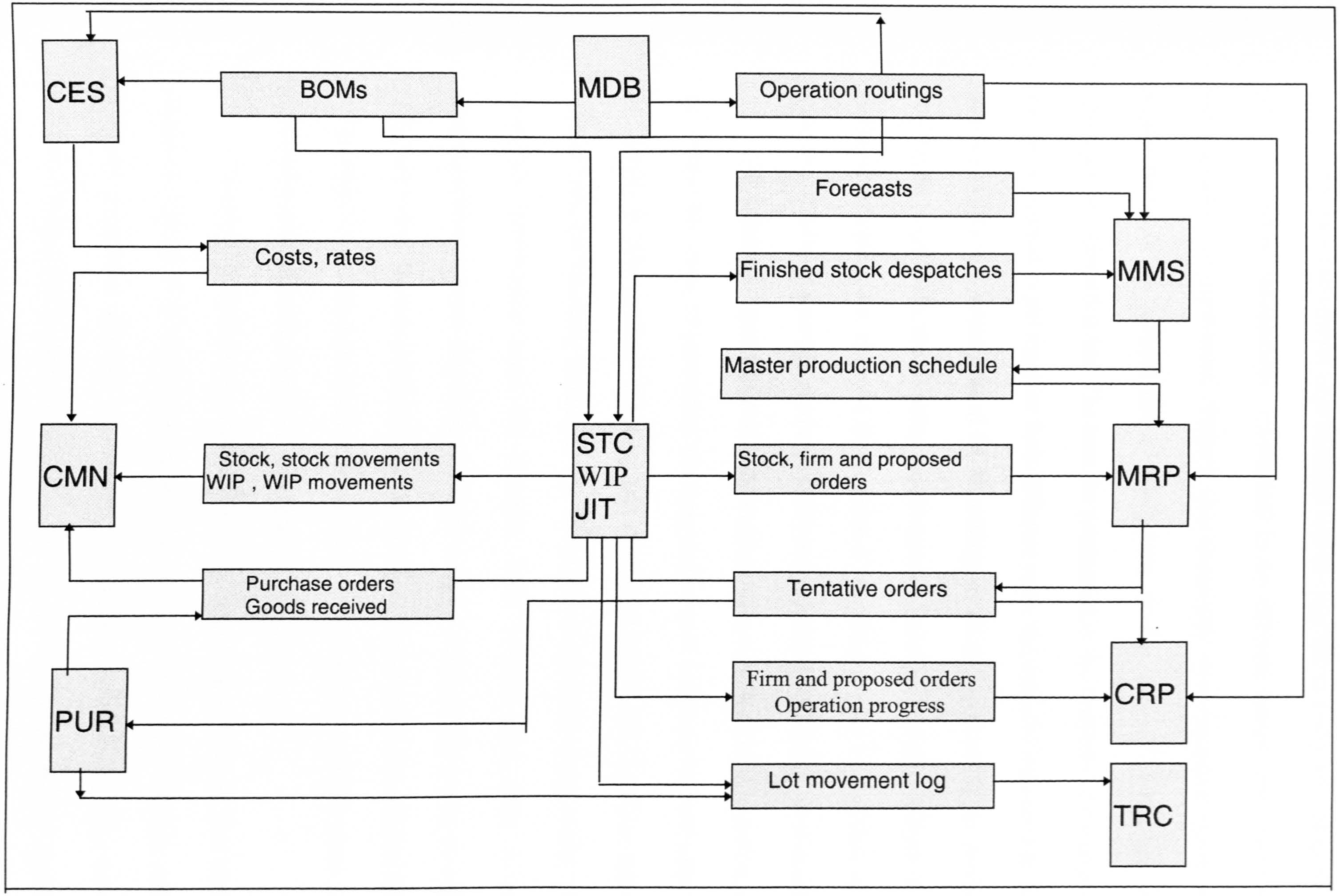
Table (7-1)

The OMAC subsystems

| Abbreviation | Subsystem |
|---|---|
| MDB | Manufacturing Database |
| MMS | Master Manufacturing Scheduler |
| MRP | Material Requirements Planning |
| STC | Stock control |
| WIP | Work In Progress control |
| JIT | Just In Time manufacturing control |
| PUR | Purchasing control |
| CRP | Capacity Requirements Planning |
| CES | Cost Establishment |
| CMN | Cost Monitoring |
| TRC | Lot Traceability |

OMAC, focusing on rapid information exchange and immediate reaction to deviations, is real time oriented and disseminates information, through its integrated approach, between departments. OMAC is aimed at reciprocal interdependence and addresses the need for mutual adjustment between functions and sub-systems, for example the planning of material requirements and available production capacity. Such interdependencies are analysed below.

Figure (7-2) The relationships between OMAC subsystems



## 7.3 Production Planning and Control

Planning and control of production can be regarded as a way of coping with co-ordination but not uncertainty. Uncertainty in the different markets that surround and exert influence on production. There is also uncertainty in the technical system of the organisation: in the performance of equipment, in the skills of employees, in the relevance of information etc. The base for production is the products. This means that the way a product is put together from different parts, the material requirements for the product and the equipment needed for its making are all fundamentals of the production and define, in principle, the planning requirements. Uncertainty in one or more of these fundamental issues, for example from where a specific part can be acquired or what parts are included in a certain product, contributes to lower performance in production.

Production is interrelated with external markets, e.g. the resource market, and it lies within the scope of production planning and control to reduce the influence from uncertainty in this market. Planning and control of production therefore means to interact with the boundary functions, e.g. the purchase and sales departments. As all concerned departments need, for example, basic product data, there is pooled interdependence between departments. There is also a standardised way to co-ordinate so that this basic resource is available to all concerned departments, for example through part numbers by which each item in the total set of thousands of different items can be individually referred to by designers, purchasers, tool makers etc.

Planning of production assumes that the production goals are set, that items are adequately specified so that the right material can be acquired beforehand, and that sufficient production capacity is available. Difficulties in planning arise due to a number of factors such as uncertainty in markets to uncertainty in production capacity or simply because goals are not realistic. For co-ordination by production planning it is therefore imperative that planning parameters such as acquisition lead times are correct. Due to the large number of planning parameters and to the necessity of a uniform handling of data, standardised routines for the creation and maintenance of this data are imperative. Planning results in planned production times, equal to the sum of standard times. As plans are executed, actual performance is compared to what was planned as indicated in figure (7-3).

Uncertainty that is not eliminated through co-ordination by planning may require specific measures as events occur which violate the plans. Such measures may be pre-defined and the most adequate measure be selected, for example re-routing of shop orders in case of sudden machine failure. For events which cannot be predicted, such as an unplanned rush order, co-ordination may be based on *ad hoc* measures such as negotiations between departments as a means to reduce uncertainty.

Production planning and control can thus be seen as a way to reduce uncertainty. Uncertainty is regarded as a determining factor for how computers can be utilised at El-Nasr Co. As however uncertainty takes different shapes in different contexts, the tasks for production planning and control may vary. In the case of El-Nasr Co. the resource market, finance market, and product market are not stable or uncertain, production planning is primarily not only the planning of material acquisition and supply but also is geared to flexibility and to adaptation of production to meet changes in demand.

The planning and co-ordination of activities as material, which could be described as the industrial production at the company, is transformed into products involves the interaction of many different departments and functions. A schematic overview of this interaction from a production management perspective can be described as follows: Sales and forecasts together constitute the basis for a production (assembly) program from which the requirement for parts, components and subassemblies (material) is determined. The production program also defines the production resources (machinery, manpower etc.) to be used and is the basis for scheduling of production activities and material acquisition.

Since material requirements lead to the ordering of material from external as well as from internal sources, production planning and control takes place on two levels: final assembly planning and control and manufacturing planning and control. In a time perspective, final assembly is a brief production phase as compared to manufacturing, and hence planning and control on the two levels exhibit different characteristics.

The overall objective for production planning is to ensure the availability of required resources in such a way that customer commitments are met and own costs are kept within given limits. A basic problem is, however, that the total production time, taken as the time from issuing a material order till the finished product is entered into the product store, often exceeds the delivery time, defined as time between customer orders and delivery. Industrial production has a general built-in planning problem due to the uncertainty in predicting both market demand and supplier systems.

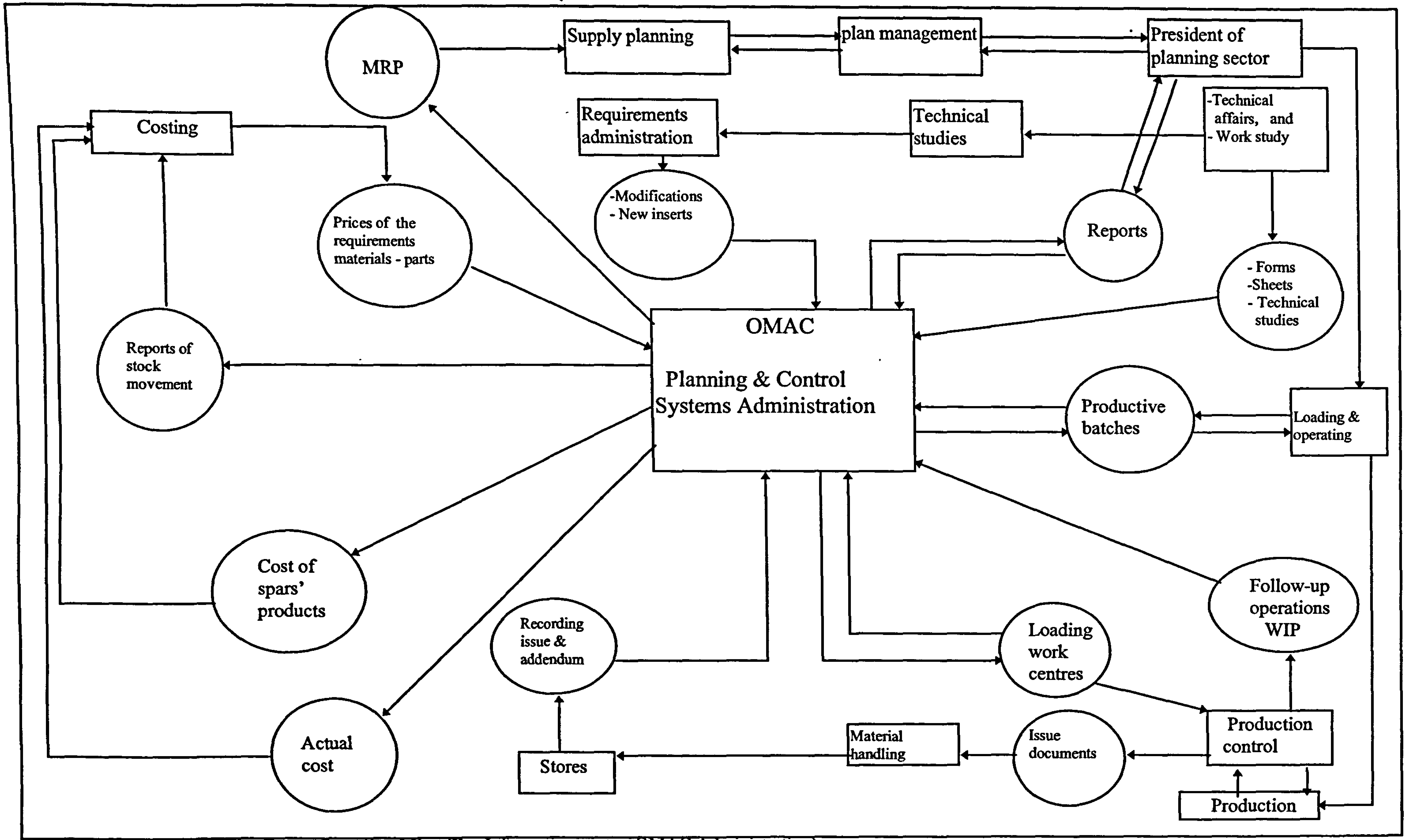
Managing the production control involves the two types of uncertainty, demonstrated in chapter Nine, that we are concerned with in this study, i.e. external uncertainty that stems from an unpredictable environment, and internal uncertainty arising from the technical system where functions are interdependent to varying extents. Through boundary units within the Supply and Stores division (Local and Foreign Purchase department, Supplier Industry department), the company seeks to adjust manufacturing resources including materials requirements to the constraints and contingencies of the external supply system. Through scheduling and planning of activities in the in-house manufacturing system and of material movements within the company, the company seeks to reduce internal uncertainty that affects the production control.

The production control is here regarded as a flow of parts, components and semi-finished goods that arrives from the suppliers at the goods receiving area, and is split up and forwarded in smaller, but still identifiable quantities, to stores and shops within the factory. During the manufacturing process some of the original items lose their identity as they are joined together with other items to form more complex parts and finally end up in the final product, the vehicle. From the product structure, however, all individual items are traceable, something that is of vital importance for the company's production control. The production control is associated with a flow of information (see figure 7-2) essential for the co-ordination and control of materials supply.

As the demand background for the company's vehicle production is not particularly highlighted in this study, the starting point of the production control is arbitrarily set at the production program specification, stating what the company is to produce. This operative target is in the form of a master production schedule that spans over two years and is divided into periods. The master production schedule is based on actual orders, forecasts, strategies which emanate partly from the Egyptian ministry of industry, and on available stock. The master production schedule sets the target for final assembly requirements and is the basis for purchase as well as in-house manufacture of parts. Figure (7-3) shows the major streams of the material/information flow.

Material/information flow in the OMAC system

Figure (7-3)




(Information sector, Computer centre, Microfilm-Information centre, OMAC Administration).

### 7.3.1 Interdependence

The study shows that there is interdependence within the organisation, between activities, as well as between the organisation and its environment, and the flows of material and information must be co-ordinated both in the exchange with the environment and as they pass through the organisational structure. The environment in this context, where the focus is on the production and material as well as cost flow of El-Nasr Co., is the material and equipment market in Egypt and abroad, part of the Egyptian environment. The principal feature of this environment, from the point of view of the study, is that basic production inputs such as vital components and equipment cannot be supplied by the local market but must be imported using scarce financial resources that compete with other urgent demands of the company. The company is exposed to influence from the environment in both ways so that, for instance, the acquisition of material and production equipment is constrained by the country's scarcity of convertible currency and contingencies make the prediction of lead times for material supply difficult.

For interdependence between the organisation and its environment the rational way to cope with environmental uncertainty under the assumption of cause/effect understanding, can be to use the boundary system as buffers for external influence. An example is the ordering of material by the purchase department that negotiates with suppliers and other external parties involved. The rational behaviour may also be, if environmental influence cannot be successfully buffered, that the core technology, in this context represented by the company's production functions, adapts itself to reduce the impact of uncertainty. Such adaptation may be the deliberate extension of lead-times through earlier release of shop-orders, thereby having more active shop-orders to select from if and when re-routing of orders is called for due to machine failures or material shortage.

The planning process involves the establishment of schedules and targets to govern the actions of the interdependent units. Planning in the OMAC system is appropriate to more dynamic situations than is standardisation.

Finally, the other type of co-ordination is mutual adjustment or `co-ordination by feedback` that involves the transmission of new information during the process of action.

Co-ordination of activities to master uncertainty, through OMAC, thus requires a high flow of information and the amount of information needed depends on how much uncertainty there is before the activities are performed. Not only the amount of information but also reaction time characterise this type of co-ordination. For example, interdependence between material stores and the shop floor is sequential, as a shop order cannot be released until the material is available. Standardised routines apply, but since the order specifications (quantities etc.) are different for each order, each material requisition is individually scheduled. Reports on released material are fed back to the Stores Control department for updating of stores levels and lead time for this reporting is short enough in OMAC system to reflect the actual stores level. This in turn has impact on the material requirements planning through the balance-on-hand record.

We can note for OMAC the implicit assumption that local authority, on different levels, will react to events reported through the computer system. For MRP we note that the planning of material needs is based on the availability of standards. And for the combined MRP/Stores Control system, the inventory reports to the MRP system, giving latest balance-on-hand status, assume a sufficiently high degree of correspondence between actual inventory levels in the physical stores and what is reported to the computer system. Again, what is assumed in the Stores Control and MRP concepts is also assumed in OMAC. The availability of standards as reference values is fundamental also throughout the OMAC concept.

### 7.3.2 The Job Flow

Materials are requested (by the operations room) from local storage (in hangar) or, if not available there, from the main (or 'principal') storage. The control storage that belongs to the planning department serves as a further back-up (whereas hangar and principal stores belong to the supply and stores departments). It should be noted that all material for an order is released in one batch.

Tools are requested (by the operations room) from the tool store according to formal requisition in work order documents. Tool requirements are determined through Tools Requirements Planning routines at the planning department.

The job flow of a work order may be interrupted by a rush order with higher priority. This happens frequently even if no figures are available about causes of delays for interrupted jobs. 'Accepted parts' means completed or partly completed work orders. On average 80 % of all work orders are not completed in specified quantity when the job is terminated.

### 7.3.3 Information Flow

Associated with the job flow in the previous section is a flow of documents (or formal information flow). The documents which are described below have two major functions. First, to convey the intentions of the planners in terms of operations sequences, materials and machines, i.e. to serve as the production planners' co-ordination tools. The second function is to convey back to the planners, cost analysts, and stores control the actual outcomes of the production plans in terms of produced parts, actual production times, quality results etc. OMAC overcomes a chronic phenomenon from which the previous system suffered. That is due to reasons varying from ignorance and neglect among operators and foremen in their completion of feedback documents, to inadequate reporting routines and procedures. The returned documents are, however, seldom of limited use to the planners due to missing or unreliable data or simply because data is obsolete due to late reporting. A short description of the documents used at El-Nasr Company follows next.

Requests for in-house manufactured parts emanate from the Material Requirements Planning department, where factors such as urgency or priority, price, quality and availability on the market determine the source of supply. Decisions about in-house production are also guided by the long-term strategy of building up and increasing own competence. In the short-run, decisions are to a great extent based on expected available production capacity. As it turns out , the lack of fit between planned and actual capacity is a hampering factor for in-house production.

A request for production results in a work order, a set of working order documents that gives the order an identity. These documents are the following:

- Progress sheet (or production order)
- Material Release order
- Delivery notes of accepted parts
- Job Cards, one for each operation
- Inspection Card
- Product Drawing
- Routing Sheet, one for each operation

### 7.3.3.1 The Progress Sheet

The progress sheet is the main order document, and prior to order start its content is entered into the company's computer. Transactions related to the working orders, such as material release notes, delivery notes (of finished parts), inspection notes, notes on completed operations etc. are reported back to the computer for updating of the main order-data. Feedback transactions vary significantly in timing and reliability.

Not until the progress sheet is finally returned to the planning department and a copy received at the cost centre is a work order regarded as completed. Table (7-2) shows the form of the progress sheet.

Table (7-2)

Progress sheet of job order's operations

| El-Nasr Automotive Manufacturing Company | | | | | | | | Form No. (1 Job Order) |
|---|---|---|---|---|---|---|---|---|
| Batch No. | Stage | J.O series | Movement Code | Store No. | Part Name<br>Part No.<br>Part series | Unit Code | Required Quantity | J.O. series<br>Batch No. \| Stage |
| | | | Specifications & Dimension of Raws (No. of Raw-in-process) | | | | | |
| Movement Code | Store No. | Series of Raw-in-process | | | | Unit Code | Required Quantity | Issued Quantity |
| Production control | | Inspection | Store No. | No. of Spoiled Document | Spoiled Quantity | Store No. | No. of Add Document | Good Quantity |
| No. of Operation | No. of Machine | Setting-up Time | Operating Time | Description of Operation : | | | Good Quantity<br>Inspection | Spoiled Quantity<br>Spoiled Document |
| No. of Operation | No. of Machine | Setting-up Time | Operating Time | Description of Operation : | | | Good Quantity<br>Inspection | Spoiled Quantity<br>Spoiled Document |
| No. of Operation | No. of Machine | Setting-up Time | Operating Time | Description of Operation : | | | Good Quantity<br>Inspection | Spoiled Quantity<br>Spoiled Document |
| No. of Operation | No. of Machine | Setting-up Time | Operating Time | Description of Operation : | | | Good Quantity<br>Inspection | Spoiled Quantity<br>Spoiled Document |
| Explanation | Finished by | Confirmed | Date | | | Adjusted No of Operating Sheet | | |
| Operating Sheet Date :<br>Signature : | | | | | | | | Job Order |

(General Administration of Production Planning at the Company).

#### 7.3.3.2 Material Release Order Card

Issued in six copies to be used according to the job flow. The card contains three types of information: First, identification of the work order and corresponding process sheet, the basic order document. Second, specification of material to be released with quantity required. Third, delivery notes, e.g. released quantity, from store. After completion, the card is returned to stores control department (in the materials requirement department) and cost centre (in the financial department) for updating of inventory levels and for calculation of product costs. (availability of material is checked by the operations room before a shop order is released and its registration has been made in work order and follow-up cards).

#### 7.3.3.3 Delivery Notes

The delivery notes are issued in six copies and contain, in addition to identification information, the quantity of parts finally delivered (after inspection) to stores. This quantity is reported to the cost centre, stores control and the planning department.

#### 7.3.3.4 Job Cards

Issued in copies according to number of operations. The card has the following types of information: an identification part that ties the card to a work order and the corresponding process sheet, a description of the actual operation with operation (standard) times, and a section to be completed by the operator. This section contains the actual start and end time of the operation, rejected quantity due to machine or material causes as well as repairable quantities in cases of rejected parts.

Table (7-3)

Job card (J.C.)

| Job Card (J.C.) | | | | | | El Nasr Automotive Manufacturing Company | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| hangar of Part | Operating sheet | | No. operating order | | store No. | part series<br>part No. | code | Quantity of order | Internal reform | Demanded department |
| | No. | Stage | issuing month | covering series, months | | | | | | |
| | | | | | | part name | | | | |

| Operation No. | No. actual machine | Setting-up time | processing time | whole time | Description of operation | Good quantity from the preceding operation |
|---|---|---|---|---|---|---|
| | | | | | | |

| Operating | No. of operation | No. of new machine | No. of old machine | Hangar | Shop | Loading centre | Operating station | Estimated starting | Estimated ending | Actual starting | Actual ending |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Current | | | | | | | time | time | time | time | |
| Preceding | | | | | | | Spoilage quantity In-process | | Applicable to reform Raw | Good quantity | |
| Subsequent | | | | | | | | | | | |

| | Inspection | Operations room | Computer centre |
|---|---|---|---|
| Remarks | | | |

(General Administration of Production Planning at the Company).

Table (7-4) shows the reverse side of J.C. which shows data such as date, hour, number of a worker, shift code, breakdown code, inspection as shown below. It is used for determining the actual hours spent by a worker on a machine and for controlling the good & spoilage quantities produced by the operator and those which are applicable to reform. Also, it explains reasons of breakdown confirmed and signed by an inspector.

Table (7-4)

The reverse side of J.C

| Date | | | Hour | No. of | Shift code | Break-down | | Inspection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Week | Day | | Worker | | code | | Good | Spoilage | Reform | Sign | |
| | | | | | | | B | | | | | |
| | | | | | | | F | | | | | |
| | | | | | | | B | | | | | |
| | | | | | | | F | | | | | |
| | | | | | | | B | | | | | |
| | | | | | | | F | | | | | |
| | | | | | | | B | | | | | |
| | | | | | | | F | | | | | |

| 1- First shift | 3- First watch | Production control | Shop supervisor |
|---|---|---|---|
| 2- Second shift | 4- Second watch | | |

Reasons of breakdowns :

1- tool 2- mentainance 3- workers 4- raws 5- inspection S- setting-up

6- electricity/air/steam 11- ending of shift/watch 12- operation finish 13- cancel an order for operating another.

14- cancel an order because of a problem in operating

(General Administration of Production Planning at the Company).

The completed job cards are collected on a weekly basis and processed by computer, and the information is forwarded to the departments concerned.

### 7.3.3.5 The Inspection Cards

The inspection card accompanies the job as a more detailed carrier of inspection data, i.e. giving results for each inspection step carried out. The result for all steps in terms of accepted/rejected/reworkable parts is entered on the job card of the inspection operation. Important feedback information is for instance why parts are rejected.

### 7.3.3.6 The Routing Sheets

The routing sheets indicate the machine centres through which the orders will be routed and describe the operations in detail: set-up time, processing time etc. The times specified are mostly taken from the machine suppliers' manuals and used as planning standards.

Table (7-5)

Operation list summary

| PAGE | |
|---|---|
| PROCESS SH. NO | |
| STORE | 200 |

El-Nasr Automotive Manufacturing Company

Operations Planning

Hangar (2)

**OPERATION LIST SUMMARY**

| PART SERIAL | | PART NO. | | SET. T |
|---|---|---|---|---|
| PART DRAWING NO. | | PART NAME | | ENGINE |

| OP SEQ. | WORK CENTRE | | | | | M/C ing TIME | | | OPERATION | | LABOUR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H. NO. | CODE | W. S. | L. C | ST. | M/C NO. | SET-UP | OP | CODE | TITLE | CODE | NO. |
| | 02 | | L. | 01 | A | | | 30.3 | | | | |
| | | | | | B | | | 38.2 | | | | 2 |
| | | E | | | C | | | 9. | | | | 2 |
| 010 | | 105 | | | D | | | 16.1 | | | | 1 |
| 020 | | 107 | | | E | | | 26 | | | | 1 |
| 030 | | 108 | | | F | | | 18.8 | | | | 2 |
| 040 | | 110 | | | G | | | 26.8 | | | | 1 |
| 050 | | 115 | | | H | | | 30.3 | | | | 2 |
| 060 | | 120 | | | J | | | 30.3 | | | | 2 |
| 070 | | 125 | | | K | | | 30.3 | | | | 2 |
| 080 | | 130 | | | L | | | 30.3 | | | | 2 |
| 090 | | 135 | | | M | | | 30.3 | | | | 2 |
| 100 | | 140 | | | N | | | 30.3 | | | | 2 |
| 110 | | 145 | | | P | | | 30.3 | | | | 2 |
| 120 | | 150 | | | Q | | | 30.3 | | | | 2 |
| 130 | | 155 | | | R | | | 30.3 | | | | 2 |
| 140 | | 160 | | | S | | | 30.3 | | | | 2 |
| 150 | | 165 | | | T | | | 30.3 | | | | 2 |
| 160 | | 170 | | | U | | | 30.3 | | | | 2 |
| 170 | | 175 | | | I | | | 30.3 | | | | 2 |
| 180 | | 180 | | | | | | | | | | 13 |
| 190 | | 185 | | | | | | | | | | |
| 200 | | | | | | | | | | | | |
| Standard production of assembly line of engines: 16 engine/a shift. | | | | | | | | | | | | |
| PREPARED | | CHECKED | | | | | | DATE | | | | |

(General Administration of Production Planning at the Company).

### 7.3.3.7 Shop Floor Reporting

Shop floor reporting means, in this context, all kinds of feedback information generated and disseminated as a work order progresses through the factory. The formal routines of shop order documents have been listed. Through these documents, departments concerned are informed about the performance of planned activities and the occurrence of unplanned events. Formal feedback through documents and routines ('standardisation') has a high standing among planning managers as an important tool to monitor shop floor events and activities. Again OMAC overcomes the problem of long reporting lead times and left-out information (e.g. on inspection cards) which reduce the usability of the data and increase the risk for decisions based on inadequate information.

In parallel to the formal shop floor reporting system there are informal systems, the existence of which we can observe through the fact that control actions are taken on a short-term basis, e.g. when rush orders are handled or when material shortage is made up through the local hangar (buffer) stores. These informal control structures are fundamental although difficult to identify and articulate.

### 7.3.4 The Material Flow

The material flow can be (logically) divided into two parts, the materials requirements planning part, where needs are defined and sources of supply are identified, and the material acquisition part, where materials are ordered and supplied, either from external suppliers or from in-house manufacturing. For the illustration the material flow in the OMAC system, will be divided into four phases:

(1) The calculation of materials requirements, i.e. the material requirements definition phase

(2) The scheduling of material requirements, i.e. the material requirements planning phase (MRP).

(3) The materials ordering phase

(4) The materials supply phase

#### 7.3.4.1 The Requirements Definition Phase

For the definition of material requirements, information from several sources within the company is used:

- the capacity planning;
- the master production schedule provides the time-phased plan for end products;
- the MRP tree (or the groups index file) provides information on the structural design of the products i.e. what items belong to a product and on which level;
- the parts list provides detailed information about each item;
- the stock file provides information about open orders (i.e. already released orders) and about stock on hand.

##### 7.3.4.1.1 Capacity Planning

Proper capacity planning of El-Nasr Company's manufacturing resources is of decisive importance for the material flow, since the decision about source of material supply (import, local supply or in-house fabrication) is partly based on expected available capacity (except for those parts and materials which for cost or quality or other reasons are imported). Misfit between planned and actual capacity therefore has a double impact: it not only leads to in-house production disturbances but it also calls for *ad hoc* solutions as supply from an alternative source is required. Input to material requirements planning from capacity planning as shown in figure (7-2) is based on 'long-term machine centre loading' (once a year) whereas 'short-term machine centre loading' executed every second week, modifies already issued work orders. Long-term machine centre loading, also called job-shop loading, is thus the basis for capacity planning. In conjunction with the production plan a load calculation is made to show which load the planned orders will result in per machine centre and period during one year. Load in hours is calculated from operation times, i.e. standard times for machine set-up processing, tear-down and tool-changing. These standard times are often provided by the machine supplier but are not necessarily fully adequate for the El-Nasr Company's conditions. The load calculation identifies which machine centres are under-loaded or overloaded. In case of over-load, the loading section suggests external supply for the parts in question whereas under-load may lead to additional in-house production. New shop-loading routines, based on computer simulation, have been developed for El-Nasr Company's production. The routines are based on assumptions regarding jobs, machines and times.

#### 7.3.4.1.2 Master Production Scheduling (MPS)

The master production schedule is a prerequisite for the planning of material requirements. It is a moving two-year plan that specifies the planned production output of trucks, buses and tractors from the El-Nasr Company with regard to availability in stock, orders or requisitions. The master production schedule, based on forecasts, contracts and commitments to the Egyptian planning ministry, is established by a planning committee and shows the planned requirements for each product and all spare parts for the following twenty monthly production periods. The master production schedule is broken down into assembly parts requirements and thereby controls the acquisition of purchased as well as in-house made parts. The material requirement is here reported as it would be at the start of the final assembly, i.e. regard is taken to lead times for acquisition and manufacturing.

#### 7.3.4.1.3 Material Requirements Planing Phase (MRP)

Planning of material requirements is performed with the aid of the company's computer-based MRP module. The module is regarded as vital by the production planning management for all material acquisition activities, for external as well as internal supply. The output of the MRP processing constitutes the basis for initiating purchase and manufacturing orders.

MRP, in its present version as used at the company, is aimed at planning of future material needs, whereas Stores control is a repetitive and standardised routine for the registration of inventory transactions in the physical stores. Its main task is to provide the MRP system with inventory information (balance on hand). For MRP we note that the planning of material needs is based on the availability of standards. OMAC is aimed at fast information dissemination between different company functions in order to enable a quick reaction to disturbances in the material flow. As commented by the planning manager for the description of MRP module, he stated:

> The OMAC/ MRP application program is designed to calculate the material plan based on need, keep the plan valid, notify planners of changes and exceptions to the plan, and provide them with tools to respond quickly to changes and exceptions (An interview with Planning Manager, July 1998).

The program algorithm for the calculation of material quantities and delivery periods is based entirely on lead times, for purchase orders as well as for in-house production, and the estimated lead times are specified for each component in the parts lists. The lead time standards are extremely uncertain as references due to unpredictable events. As a consequence, computerised material requirements calculation as a planning tool is hampered in efficiency by a number of factors that cannot be controlled by the company.

Planning of material requirements, in this case, means that the release of purchase and manufacturing orders be properly placed on a time scale. Item quantities required for different periods, calculated as in the previous phase, are compared to stock on hand and to already released orders. The MRP thus has two functions: one where the required parts, sub-assemblies etc. are identified in relation to their position in the final product structure, and another where the time-span of the requirements is forecasted. The first planning step, calculation of materials requirements, is largely dependent on production capacity in the OMAC system, but independent of suppliers' reliability etc. It reflects the material content of the product in terms of volumes and sources of origin. The calculation of material requirements for a specific end product does not change from one updating of product data to the next. The result of this step is therefore crucially dependent on the reliability of the stored product data.

The second step is the time setting of materials requirements, and divides the material needs into time periods as appropriate with respect to lead times, inventory levels and earlier material orders. The calculation of order issuing dates for purchase and for own production is based primarily on the previous step where standard lead times are given for each part.

For materials classified as imported in the parts register, the corresponding need for hard currency is determined and totalled for each period. This is a dynamic phase, as it needs to continually reflect changes in capacity and other resources in order to modify lead time specifications. The tool used for this is a computerised MRP module in the OMAC system.

It worth mentioning that depending on open orders, the offsetting will or will not result in a net requirement for the specific item in the specific period. The summary of net requirements for all items gives the total requirements per period. These requirements are further processed in the next phase of the material flow: the material ordering.

### 7.3.4.2 The Material Acquisition Phase

#### 7.3.4.2.1 Material Ordering.

Material acquisition is used to denote the activity of issuing an order for material. As this order can have three different addresses (local supply, foreign supply and in-house supply) the activities resulting in these orders are somewhat different and will therefore be treated separately. The activity of issuing an order for import or local purchase is based on a decision by the Planning Division (Materials Requirements department) from where the request is submitted to the Supply and Stores division, Supply department. The decision is based on available stock and on rules applied by the Supplier Industry department, which has as its objectives to support national industry and to promote the expansion of this industry in accordance with the industrial development strategy of Egypt.

The material supply phase covers all activities related to delivery of materials and parts to the company's assembly stores (in Hangar 3 for purchased material, in Hangar 6 for in-house production). For purchased material this means activities starting with shipping from the supplier to registration of material in storage, and for in-house manufacturing it means the fabrication process from the first operation to registration in storage. As in the previous sections, local supply and import will be treated separately. While supply from local suppliers is discussed in Chapter Five, supply from own fabrication will be covered below.

##### 7.3.4.2.1.1 Supply from In-house Manufacturing

Primary uncertainty is here shifted from external to internal factors caused by the interdependence of functions in the technical system. Such interdependence can be observed between machine reliability and maintenance or machine capacity and manufacturing planning. Uncertainty that stems from this interdependence is reduced through the co-ordination of interdependent activities. Co-ordination is also here, however, hampered by greatly varying lead times as indicated in chapter Five.

A reduction of the uncertainty related to the in-house made parts is a challenge to the El-Nasr company's production management. To a great extent this uncertainty stems from the fact that the company's manufacturing faces the same material supply problems as assembly and, in addition, has difficulties with unreliable production equipment. The co-ordination of shop operations, and in particular the prediction of lead times and completion dates, is difficult for a number of reasons such as the discrepancy between standard and actual times and uncertainty of machine availability. This will be covered in more detail below.

#### 7.3.4.2.1.2 Supply from Foreign and Local Suppliers

Sourcing from external suppliers and the related problems are explained in details in Chapter Five.

## 7.4 Cost Accounting System

OMAC provides facilities to create and monitor data relating to product costs, stock and inventory value, work in progress value and other valuations. There are also facilities to clear invoices relating to purchase orders and to transfer information to ledger systems. These facilities are provided by means of the Cost Establishment (CES) and Cost Monitoring (CMN) subsystems.

### 7.4.1 Product Costing

The new system involves standardisation of the physical quantities of inputs required to achieve a certain batch of output, such as the expected amount of raw materials and parts required, the number of labour hours to be used, or the number of machine hours that are necessary. Estimates of raw materials often are based on the specifications of a prototype, and time and motion studies are used to estimate the labour required. Figure (7-6) shows the standardisation of the time and the labour of Cabin Painting process.

Table (7-6)

List of standard times and productive capacity

(fiberglas/ sheet-iron) cabin painting.

(Tools Engineering Sector - Work Study Department)

| Description of Operation | Operation Time (Minute) | | | | Total (Minutes) | No. of Workers | Standard Time of Station (Minute) | Production/ Shift (7 hours) | Worker/ Hour | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Engine cover | Finders R.h & L.h. | Ceiling | Sides R & L | | | | | | |
| Prepare & Cleaning | 28 | 48 | 20 | 18 | 114 | 2 | 57 | 7.5 | 1.9 | 1. Dry oven operation of parts is after operations of both praim paint and final paint according to the prepared parts to painting and their quantities. 2. Operations for Fiberglas are the same ones for sheet-iron parts except cleaning. |
| Praim Paint | 12 | 20 | 10 | 8 | 50 | 1 | 50 | 8.4 | 0.83 | |
| Pasting | 23 | 34 | 18 | 20 | 201 | 3 | 67 | 6.3 | 3.35 | |
| Emery | 27 | 37 | 20 | 22 | | | | | | |
| Pasting | 30 | 46 | 22 | 24 | 122 | 2 | 61 | 6.8 | 2.00 | |
| Emery & Air Dry | 34 | 54 | 24 | 28 | 140 | 2 | 70 | 6.0 | 2.33 | |
| Final Paint | 14 | 22 | 12 | 10 | 58 | 1 | 58 | 7.2 | 0.96 | |
| Total | 168 | 216 | 126 | 130 | 685 | 11 | | | 11.37 | |

(General Administration of Production Planning at the Company).

After the physical quantities of the materials and labour requirements have been estimated the prices and rates for each input factor are obtained in order to determine the standard direct cost. Machines' hours are estimated and assigned directly to the work centre in which these machines are settled. They are charged to each product according to the number of hours spent. Next, the other common manufacturing overhead costs are estimated by the same method used in the original system explained in chapter Six. A Cost Type includes all these estimates of direct materials, direct labour, machines hours' cost and other manufacturing overhead which are settled and up dated on the computer frequently.

The CES subsystem provides extensive cost manipulation facilities, which rely on the presence of the bills of material and operation routings set up using MDB. The basic data for product costing is the bill of material and a set of cost elements. These elements are typically material, labour and overheads costs. Costs are expressed at each level in the bill of material in terms of these elements. Once all the cost elements have been set up, the costs are rolled up using the processes provided in CES, so that individual costs are accumulated level by level using the bill of material to arrive at the total product costs. A user can make inquiries on the accumulated costs for each assembly or component of the product. As an alternative to labour and overhead costs per part, a user can define rates per hour on the work centres and the system will calculate the processing costs of the parts directly, using the operation times.

The system allows him to transfer costs between cost types and manipulate them in the process. For example, a user can take this year's costs and add a percentage to form the basis for next year's budget costs.

To aid the process of cost manipulation **What-if** facilities are available, but not used at the present, to simulate changes and see their effect, without actually applying them. The facilities include simulation of changes to costs, BOM structure and scrap allowances. By using these facilities it is very easy to evaluate the effect of such things as enforced design changes, currency fluctuations or manufacturing operation changes.

Costs can be rolled over into the stock record for each part so that basic cost information is available to users without access to the detailed CES data. By this means the purchasing department, for instance, can monitor the costs being used for purchased parts to highlight any anomalies.

## 7.5 Improvements of OMAC System

In this section we will briefly touch on the OMAC improvements that are currently being implemented by the company. The improvements are concerned with the periodic reporting and on-line access, focus on part costs cost estimation, and variance identification. We will briefly discuss these improvements.

### 7.5.1 Continuous Improvement

OMAC has the ability not just to store exact production instructions but also to analyse production faults and to record, retrieve and print reports. Thus it could give continual feedback to improve the next production run. OMAC was implemented along with a shop floor control and statistical process control to assist individuals keep production processes on control. It could integrate the accounting system with the manufacturing system using the same data of transactions. This data forms the closed loop inherent in the OMAC system; its main effect is that management is given information about the result of changes, in sufficient time to take action to minimise or eliminate any problems caused by those changes. By tracking changes it could be achieving continuous improvement in the next operating cycle. The information processing capabilities provided by the OMAC system make tracking costs to production easy and economical. An improvement is also achieved in production scheduling by estimating the size and time of orders by a more accurate manner.

Scheduling labour within work centres to meet on-time delivery becomes better.

### 7.5.2 Focus on Part Costs

The primary orientation of the OMAC system is to provide information on a part-by-part level for accumulation at the product- (or contract-) reporting level. The part-cost orientation of the OMAC system provides information concerning value added and value lost in the process, allowing for product cost control at the most detailed level. Also, the system is directed toward capturing costs at the operational process, aggregating these amounts for part-costing and for contract-reporting purposes. Because data are collected at the process, it is possible to pinpoint specific manufacturing steps that require attention, both as they relate to a particular part and to the process overall. Scrap, yield, rework, labour, machine utilisation, and so forth will all be visible at the process level.

Separation of manufacturing-tracking from product (or contract) cost-tracking in the original system is not allowed in the new one, because the OMAC is an integrated system. Data provided for production-order scheduling are also captured for cost management purposes. The same information provides the basis for contract-order monitoring. Each of these functions retains its own characteristics and is not compromised by the needs of another function. Thus, for example, management can establish a production-order tracking procedure that fits manufacturing needs with assurance that product-cost tracking also will meet accounting requirements.

### 7.5.3 Cost Estimation in the OMAC System

The company must estimate work requirements most often because they usually must prepare a bid on each item for which a customer requests a quotation. These estimates must be accurate. If a bid is too high, the company will not be awarded the contract. If the bid is too low, the company may receive the contract but lose money on the work. Estimates of the time to perform each production step are used to estimate the labour cost and to determine the investment in production capacity that will be required for a given output. The company may prepare new cost estimates from time to time as internal improvements are made or as prices change, to re-evaluate such decisions as make -or-buy.

People involved in estimation study the blueprints and specifications for the end item and its components. The cost of each item shown on the bill of materials for the product must be determined. Each component of the end item must be purchased or manufactured, so make-or-buy decisions must be made--perhaps by requesting bids from suppliers and comparing them to estimated costs. The purchasing department obtains prices of all items to be purchased and the raw materials for all items to be manufactured.

### 7.5.4 Variance Identification

OMAC is a real time system that requires predetermined estimates of actual results. Differences between the predetermined estimates and actual results are reported as variances - planning gaps. These differences, by carefully listing 'causing' factors, reveal in detail the reasons for the variances. Variances computed by OMAC include those caused by yield, scrap, machine utilisation, labour efficiency, labour utilisation, set-up usage, lot size, order activity, spending and volume. Appendix (D) shows patterns of efficiency variances that are discussed in chapter eight.

To meet the need to reduce costs and minimise the amount of expensive inventory and work in progress in the factory, a user must have some means of monitoring values and variances. These facilities are provided by CMN. The system allows for the valuation of stores stock, work in progress, goods inwards and unmatched GRNs. These reports would normally form part of the management reporting within a company. The processes use data continuously accumulated within the system, so the effort to obtain information is limited to entering a request for the relevant report. It is also important to monitor the variances associated with the valuations, in order to obtain early warning of adverse situations so that action can be taken to avoid them or to minimise their effect. The CMN subsystem provides a set of variance reports covering manufacturing and purchase price variances. These also use data accumulated by the system. It is important to run these reports at regular intervals in order to obtain the maximum control and to ensure consistent data.

### 7.5.5 Periodic Reporting and On-line Access

The system makes decision support in the form of periodic reports and on-line access. It provides periodic reports in a predetermined format. The files in real time are updated as often as the reports are issued (daily, weekly, monthly, quarterly, or annually). In addition, the system provides on-line access to detailed transaction files (e.g. inventories accounts, cost records). On-line access is by the special programs, communications devices, phone lines, terminals, and space. If files are to be accessed, they must be updated continuously and kept available. Thus, the system, based on on-line access and periodic reporting, is far more fast than the old one. In addition to periodic reports and on-line access, the system has the capacity to issue special reports and analyses. Issuing such reports is usually a continuous process because the programs must be manipulated in some way. The data from the system plus external data are combined in a report that often includes discussion and recommended actions. A trained staff is available to support special analysis of decisions.

### 7.5.6 Nominal Ledger Interfaces

OMAC provides facilities to help a user transfer financial information from OMAC to a ledger system using the Nominal Ledger interface (NLI). If NLI is in use, the system records each stock or work in progress movement at the time it occurs, valuing each movement using standard costs copies from CES or entered directly into stock records. These movements are coded by means of a user-defined Account Distribution Code table, so that they can be allocated to the correct ledger accounts.

The financial data is transferred to the ledgers on a periodic basis (probably daily). Users can automatically create journals for their ledger systems without a high level of manual input. These features facilitate the automatic maintenance of accounts such as labour recovery, stock adjustments and dispatches, and data are held in such a way that analysis to any level is possible.

### 7.5.7 Invoice Matching

The matching of invoices to goods received notes before payment is an essential control for any company, and for the company who purchase a high proportion of its components, it is a major task. The user of OMAC has facilities to automate this process, thus freeing staff to exercise control and address the exceptions. Batches of invoices are entered into the system via the Cost Monitoring subsystem (CMN) and the orders and GRNs are then matched as required. The matched invoices are then passed to the purchase ledger system to generate payments to suppliers. Credits notes can be handled and invoices may be unmatched if problems arise after matching has occurred.

### 7.5.8 Shrinking Stock

By the OMAC system, it is possible to know exactly both store movements and purchasing orders at any time on the monitor. It is also possible, through the monitor, to know immediately if there is a shortage in a batch and the condition of purchasing orders. In other words, a printed report can be obtained about all parts shortages and whether purchasing orders have been issued and registered. Further, stock balance, addendum, and issue from store by a storekeeper are held on the monitor. Consequently, it is possible to obtain a quick and precise evaluation of inventory, liquidity, and financial position.

Also, the OMAC system supports decision making by providing the required information on time. The computer network facilitates communication with the system from everywhere in the company. Information is not monopolised by some persons or a certain department, as in the past. As a result, it is easy to exercise control over the company's resources. For example, every workday morning, the operator can obtain a printed report about the previous day's movements store, (i.e. issue and addendum). That report will be compared with the documentation received from the storekeeper. Therefore, the OMAC system does not give any scope for fraud by the storekeeper, by cancelling or adjusting the store transactions. If a document is missing, the computer will have registered and printed the date of issue of the document.

All data are registered in the computer and available to all departments and sites in the company. Consequently, any change made by anyone in any parameter in the program, will show to all departments and sites. For example, when a storekeeper registers issued orders in the monitor with serial numbers, they are available to all departments in the company. These departments can make enquiries or access the program easily. By the monitors, it is easy to control late-issued orders. For example if the production operator does not issue the material from the stores on time, he will not have the capability to do that afterwards, when the production is finished.

In the interview with the Director of Production Requirements Planning, he indicated that:

> The OMAC achieved great benefits for the company. For example, there are some raw materials and components such as pipes, bars, sheet metal,...etc. that affect the outside form of a product. The accelerating development of products causes changes in their forms and their models. If materials are stored for a long time, they become unusable due to these changes. The OMAC system enables the management to exercise direct control over these materials and follow them up to make rapid decisions about them, e.g. not to issue new purchase orders and to decide how to dispose of the current stock (Interview with the Director of Production Requirements planning, July, 1998).

### 7.5.9 Eliminating Bottlenecks

Another improvement is explained by the Director of Production Requirements Planning. In the old system, the problem of imbalance in the loading of the job orders to machines, led to imbalance in the production line and bottlenecks resulted. In the past, all job orders might be loaded to just one machine in the work centre, while other machines were not loaded. This gave the impression that the centre's capacity was fully exploited, although there were other machines in the same work centre that were idle. The capacity of both the work centre and the production line were constrained by this fully-loaded machine's capacity, which constituted a bottleneck. Deviations in operating times and loads distribution in the old system caused the problem of production line imbalance. In that system, one machine might be overloaded by, For example, 300 %, while another was partially loaded or not loaded at all. The OMAC system has re-balanced the production line by loading all work centres and machines equally. It is possible to make the operating time constant throughout the work centres and create balance on the assembly lines. For example, when a product is finished in the last station, another product is started at the first station in an assembly line.

### 7.5.10 Overcoming the Problem of the Idle Capacity Caused by the Materials and Parts Shortage

Owing to the fact that a big fraction of the overhead expenses at the company is fixed, due to the tendency to increasing automation, the assumption is not valid that the reduction in fixed cost of a unit can be achieved by an increase in output, because the fixed overheads are then spread over a bigger volume of output. The best solution to make reductions in this type of costs is to analyse and control them to determine the exploited production capacity and to know the real reasons behind an idle productive capacity and treat them.

Table (7-7) shows reducing the idle capacity caused by the shortages of material and parts on the production lines. From the table, we can find out that there was no shortage of imported material and parts in some factories like Trucks & Tractors, Diesel Engines, Petrol Engines and Special parts during the study years, but there was a little shortage in the passenger cars factories during the years of 1990/91 and 1991/92. Idle hours in these factories were 80 h. and 110 h. successively.

The shortage of local material and parts decreased in all factories generally during the study years. For example in the interview with the manager of production requirements planning, he indicated:

> the main problem which caused stopped the production lines, was the shortages of the local requirements. The yearly stopping of the factories, particularly the Special parts' factories was approximately wobble among 50,000 and 60,000 hours before applying the OMAC system directly (An interview with the Manager of Production Requirements Planning, July, 1998).

From Table (7-7), we can notice that the shortages of the local material and parts caused stopping in the Special parts' factories 6901, 6743 and 5978 hours during the years of 1990/91, 1991/92 and 1995/96. This indicates the improvement resulting from applying the OMAC system. If we make comparison between idle capacity caused by shortages in the material and parts before applying the OMAC system and after installing the new system in Table (7-7) below, we can realise the improvements obtained by that new system.

Table (7-7)

Analysis the reasons of the un-exploited productive capacities

(Stoppage hours)

| | * Shortage of Local Components & Materials | | | | ** Shortage of Imported Component | | | | Absence & Holidays | | | | Maintenance, Renew & Replacement | | | | Electric Cut | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 |
| Lorries | - | - | - | 131 | - | - | - | - | - | - | - | - | 101 | - | - | 300 | - | - | - | - |
| Buses | 10 | - | - | 10 | - | - | - | - | - | - | - | - | - | 160 | 115 | - | - | - | - | - |
| Tractors | - | - | - | - | - | - | - | - | 280 | - | - | - | - | - | - | - | - | - | - | - |
| Passenger | - | 5 | 7 | - | 80 | 110 | - | - | - | 63 | - | - | - | - | - | - | - | - | - | - |
| Diesel Eng. | - | 5 | - | - | - | - | - | - | - | - | - | 60 | - | - | - | - | - | - | - | - |
| Special parts | 6901 | 6743 | 5978 | - | - | - | - | - | 13859 | 10938 | 11388 | 332 | - | - | - | - | 5634 | 6511 | - | - |
| Petrol Eng. | - | - | - | - | - | - | - | - | - | - | - | 9<br>- | - | - | - | - | - | - | - | - |

| | Tools | | | | Inspection | | | | Cancel an order and operate another one instead | | | | Drop of Market Share | | | | Limits of Bank Credit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 | 91 | 92 | 96 | 97 |
| Lorries | - | - | - | - | - | - | - | - | - | - | - | - | 791 | - | - | 904 | 200 | - | - | - |
| Buses | - | - | - | - | - | 101 | - | - | - | - | - | - | 1234 | 1701 | 802 | 987 | 731 | 451 | - | - |
| Tractors | - | - | - | - | - | - | - | - | - | - | - | - | 807 | 615 | - | - | 284 | 421 | - | - |
| Passenger | - | - | - | - | - | - | - | - | - | - | - | - | 628 | 612 | 206. | - | 197 | - | - | - |
| Diesel Eng. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 5 | 31 | - | - | 53 | - |
| Special parts | 491 | 834 | 178 | 110 | - | 976 | 490 | - | - | - | - | - | 548 | 10310 | 147 | - | - | 8000 | 1993 | 8131 |
| Petrol Eng. | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -<br>- | - | - | - | - | - |

(General Administration of Cost Accounting & Budget, Performance Assessment, 1991, 1992, 1996, and 1997).

* The shortage in the local components & materials due to shortage the liquidity and the sudden rapid orders.

** The shortage in the imported components & materials due to the shortage in the foreign currency.

## 7.6 Summary

This chapter discussed the company's different systems to overcome the manufacturing and cost problems explained in chapters Five and Six. Apparently, the OMAC system is fully integrated, with a common set of information, entered at once and accessible to all, controlling manufacturing resources and supporting decision making. OMAC can support factual world-based decision making across a wide range of organisational activities. OMAC system resides on PC networks, and depends on data down loaded from networks. This system requires that data and information be transferred to it from numerous existing software packages such as the general ledger, bills of material, production scheduling, engineering, MRP, factory floor labour , and sales and customer systems.

In the old previous system, these data and information exchanges were usually accomplished by writing special software routines that collected the data and information required and then downloaded it to the PC. Later, local area network and more advanced data exchange technologies through OMAC are used. In the old system, these exchanges which took a long time were only semi-annually or quarterly. In addition, there is infrequent and limited transfer of data and information from cost system back to the company's other systems.

The integrated reporting environment demands much greater and more frequent data and information exchanges between cost system and other systems. The flow from cost system back to other systems reflects the greater integration of cost information into the company's ongoing reporting systems. In the integrated system these exchanges take a very short time not just monthly or weekly or daily but also on time. Thus, the OMAC system allows flexibility because it responds to changes in manufacturing environment. It is characterised by on-line interactive processing in which system processing flow is in terms the user can readily understand.

In general, beside the improvements illustrated above, the following advantages are concluded:

- The new system allows the use of new concepts which had not been known in the old system such as: Single Code Number of Account; Work Centre; Work In Progress; Cost Type; and Alternative. The document cycle through the new system is shortened.
- Overcoming the problem of idle productive capacity, particularly resulting from shortage of materials and components on the production line.
- Sometimes, customer orders, are not only in the form of finished products but also semi products (like chassis) and machined parts. The OMAC system allows, the company immediately and accurately, to know the cost of such these products.
- Determining the exploited machine and human capacity, especially which is concerned with direct and indirect labour cost through using the standard costs for control.
- Separating the idle capacity and its costs in order to use the exploited costs as a guide to determine selling price in customers' offers in light of the strong competition.
- Separating product costs from marketing, managerial and interest costs in the cost summary sheet and attention to knowing how the product's selling price covers both its product costs and total costs.

However, although OMAC has achieved some success in overcoming some production problems facing El-Nasr Co., it has failed to solve all these problems. This point will be elaborated in chapter nine. A summary of improvements is provided in Table (7-8) that show a comparison of the old and new systems adopted at the company.

The close relations between the ordering system on the shop floor and acquisition or abandonment of the production capacity and between make or buy decisions have increased the importance of these decisions. For example, a decision to buy follows each purchase order and a decision to make follows each production order. A scale of such decisions is that the company comprises thousands of components, each one of which is either made or bought. The next chapter will deal with production capacity measurement and increasing the significance of make or buy decisions in the company.

Table (7-8)

Summary of the changes in the cost accounting system

| Factor | Change From | To |
|---|---|---|
| Cost Structure | Predominately direct labour cost and overhead | Predominately purchased and fabricated parts and components |
| Accounting Basis | Actual | Standard |
| Cost Accumulation Method | Absorption | Exploited |
| Mechanical of the system | Non-computerised | Computerised |
| Communication | Too Late | On Shift |
| Link with the other Sub-systems. | Isolated | Integrated |
| Efficiency Measures | Financial | Non-financial (Production capacity analysis) |
| Cost Centre | Department | Work Centre |
| Cost Object | A product | A part & A product |
| Depreciation Method | Straight | Machine hours |
| Calculation the requirements of materials & parts | Listing | Computerised MRP |
| Labour Costing | Total Labour cost (Productive and non-productive) | Productive labour cost |
| Overhead | Total Overhead (Manufacturing, Marketing & Administrative) | Manufacturing overhead |
| Product costing | Cost sheet | Cost Type |
| Reports & Financial statements | Manual | Computerised |

Chapter Eight

# Production Capacity Measurement and Importance of Make or Buy Decisions

Changes in the competitive environment have led the company to switch from facilities-constrained to demand-constrained production, in which there is over-capacity. In such an environment the issue of measuring and analysing capacity and reporting the cost of idle and misused capacity is very important. When the company had a monopoly, it adopted absorption costing in which idle capacity costs were a part of the unit cost of the product. Recently, to be competitive, more cost analysis is required for such other important purposes as decision making. For example, measuring unused capacity and understanding its causes may help in make or buy decisions. Awareness of available unused capacity is useful in planning new product offerings, particularly when the company decides to make the production in question. If future products can use existing unused capacity, then there is little need to build or invest in new capacity. Good capacity information is essential for sound product planning. The cost of idle capacity can be separately reported as an expense line-item at the plant level, particularly with availability of sophisticated computerised facilities at the company.

This chapter is divided into two main sections: the first investigates measurement and analysis of production capacity at the company. The second discusses the importance of make or buy decisions at the company and the role of cost accounting systems in this matter.

## 8.1 Production Capacity Planning and Capacity Measurement

It is useful to explain the relationship between capacity planning and capacity measurement. Capacity planning is an ex-ante to capacity measurement. It is based on the production schedule and resource planning at the company, using the OMAC system.

The process starts with the preparation of a production schedule, based on business, market, and production planning in the long-term. The production schedule is a detailed programme showing how a production plan is implemented. Next, the required level of capacity to implement this schedule is determined. Production planning is concerns with answering the question whether the available capacity matches requirements. The aim is to reach a satisfactory capacity plan or adjust the production schedule to be acceptable and compatible.

Capacity measurement seeks to answer the question of to what extent the planning capacity is exploited. It is, however, based on assumptions: it may assume the full utilisation of capacity without any allowances, i.e. theoretical or optimal capacity. It also may assume that there are imperative allowances, i.e. maximum capacity. It may assume that there are bottlenecks, i.e. available capacity. Lastly, it may assume that there are fluctuations in the expected demand, i.e. production programme capacity. Figure (8-1) shows the relationships between the production schedule, capacity planning and capacity measurement.

Figure (8-1)

The relationships between production schedule, capacity planning and capacity measurement

| **Time horizon** | **Production schedule** | **Capacity planning** | **Capacity measurement** |
|---|---|---|---|
| Long-term | Business planning<br>Production plan | Resource plan | Theoretical production capacity<br>Maximum production capacity |
| Medium-term | MPS | Rough-cut capacity plan | Available production capacity |
| Short-term | MRP | Capacity requirements plan | Production program capacity |
| Execution start | Shop / purchase orders | | Actual production capacity |
| | Production activity control | | |

As explained in Chapter Seven, proper capacity planning of El-Nasr Company's manufacturing resources is of decisive importance for the material flow, since decisions about sources of material supply (import, local supply or in-house fabrication) are partly based on expected available capacity (except for those parts and materials which, for cost or quality or other reasons, are imported). Also, production capacity plays a significant role in the process of planning the quantities produced. Misfit between planned and actual capacity therefore has a double impact: it not only leads to in-house production disturbances but it also calls for *ad hoc* solutions as supply from an alternative source is required. Therefore, measuring the production capacity is a serious issue worth attention in this research.

## 8.2 Concepts of Measuring Production Capacity at the Company

This section explains the conceptual basis of accounting for the production capacity at the company, how capacity is measured and its relation to manufacturing overheads. The old-established Egyptian unified accounting system (EUAS) imposed on the ex-public sector companies including El-Nasr Co. the requirement to prepare reports of production capacity. These reports are part of the performance assessment of the Egyptian ex-public manufacturing enterprises. Each company had to prepare these reports according to the concepts mentioned in the EUAS. These concepts are compatible with the ones in the literature. The EUAS determined the form and the content of these reports, as shown in Appendix (D). These reports just contain statistical data, without any in-depth analysis of the relationships between the concepts included. The author will expose the close relations between them.

At the case company, production capacity is affected by several complicated aspects including available production factors, different operating conditions in each hangar, and the contracts entered into with the licence companies -- and thus the imported production requirements. These affect the production capacity in the company's hangars to different degrees, depending on the local machining content of each product. Production capacity includes a group of production factors at the company that combine and react in the light of existing possibilities and capabilities in order to create a certain production volume within a certain period. It is measured in suitable units according to prevailing conditions. There are several determinants that lead to different levels of production capacity, for example, the deviation in utilisation of production capacity, inefficient planning capabilities, and fluctuation of demand. However, there are five concepts of production capacity, of which the company only applies the last four, in accordance with EUAS:

- Theoretical production capacity
- Maximum production capacity,
- Available production capacity,
- Production program capacity and
- Actual production capacity.

Each of these concepts is explained below.

### 8.2.1 The Theoretical Production Capacity

The theoretical production capacity assumes full operation of machinery, equipment and personnel without considering any allowances, breakdowns or obstacles for any reason, for example, stopping due to setting-up the machines, regular maintenance, week-end holidays and formal vacations. It called theoretical or optimal capacity because it is difficult (or even impossible) to achieve in practice.

### 8.2.2 The Maximum Production Capacity

The EUAS defines the maximum production capacity as:

> The production capacity determined within a certain period according to the characteristics of the production factors assuming that there are regular maintenance, work force with production efficiency and availability of production requirements with determined features (Central Agency of Accounts, 1967).

The maximum capacity of each production process at a plant is measured according to its productive capability, regardless of imbalance in production capacities among processes. It is useful to show the relationship between the theoretical and the maximum capacity as follows:

| Maximum capacity = theoretical capacity - imperative allowances |
|---|

Imperative un-exploited capacity represents the difference between the maximum capacity and the theoretical capacity of the factory due to purely technological external constraints that cannot be avoided. On the one hand, machinery and production lines may be designed to produce at a limited capacity that is not partitive while the targeted production is less than that capacity. On the other hand, the factory may be forced to rely on local supplying industries to satisfy its needs due to the existence of constraints on importing. This results in inability to operate at full capacity. In both cases, expected imperative un-exploited capacity arises. The consequent burdens are part of the production cost.

It is useful to explain the relationship between this maximum production capacity and the production concepts in the OMAC system. Maximum production capacity is related to the manufacturing strategy of the company in the long-term. For example, the adoption of a local manufacturing strategy determines the machines and expansions in the factories in the future. Maximum production capacity is determined based on the machines' specifications (hours, speed, etc.) from the equipment vendors.

### 8.2.3 The Available Production Capacity

According to the EUAS, available production capacity:

> Expresses the production within a certain period and after deducting bottlenecks, stops and real delays that have no relation with external conditions. For example, demand drop for products, bottlenecks between processes, lack of production requirements, lack of manpower, vacations time, normal absence and the required time for maintenance jobs. available production capacity measures by the capability of the weakest process at the plant (Ibid).

Bottlenecks represent imbalance of production capacity among processes. These bottlenecks mean that maximum capacity is not exploited for some processes. Thus, we can explain the relationship between available capacity and maximum capacity as follows:

(i) in the case of bottlenecks existing between the processes:

$$\boxed{\text{available production capacity} = \text{maximum capacity} - \text{bottlenecks}}$$

Bottlenecks express the difference between the maximum capacity and the available capacity. They arise due to technical and organisational conditions when the company is unwilling or unable to realise perfect co-ordination and balance between the processes' capacity. The burdens of bottlenecks are considered unavoidable overhead costs if they are due to technical factors related to capacity, whereas they are losses in case of inefficiency of planning capability resources or uncontrollable conditions.

(ii) in the case where there are no bottlenecks among processes:

$$\boxed{\text{available production capacity} = \text{maximum capacity}}$$

(iii) in the case of existence of spare capacity between processes:

This capacity represents the difference between the maximum capacity and the available capacity. It arises as a result of several conditions such as economic circumstances, as in the case of insufficient demand for the company's products or insufficient current production factors on processing at full capacity. Consequent burdens are included in production overhead costs. Also this type of un-exploited capacity arises in the case of the company having greater capacity than the current demand, in order to meet future expansion.

It is useful to explain that the concept of available production capacity is related to the Master Production Schedule (MPS) in the OMAC concepts. Production capacity is controllable within the company and in practice a question of balancing the work flow. The work load is determined by time period for each machine centre, based on planned order schedules. The result is a prediction of which machine centres will be overloaded and which will be under-loaded. Based on this, appropriate measures can be taken to balance capacities and loads. Capacity shortage is primarily an effect of currency shortage for the import of machines, spare parts, spare tools, repair tools. It is, also, the effect of inadequate or faulty maintenance procedures or lack of specialised skills. Uncertainty about available capacity in coming time periods and unpredictability about which machines will be in operation severely reduces the benefit of detailed planning. Production capacity is thus only to a limited extent controllable within El-Nasr Co.

Also, tool availability is ensured through better planning of tool usage. Tool requirements are scheduled in accordance with planned production. Tool stores can be notified in advance of planned requirements which allows time for tool maintenance and, if needed, for the acquisition of new tools. Tool recall procedures also ensure that tools are returned at the proper time for repair and overhaul, thus improving product quality, reducing scrap and increasing the productive life of tools. However, availability of tools is hampered by a general shortage of tools caused by financial constraints. For the same reasons as mentioned above, planning is hampered by unpredictability which means that tools must be available on an *ad hoc* basis rather than as planned long in advance.

El-Nasr Co. has started in-house production of machine tools and is therefore less exposed to external conditions, provided material and equipment needed for this production is available (which also needs foreign currency and skilled personnel). The potential for improving tool requirements planning by computerisation is substantial. A prerequisite is, however, that routines and procedures be established for the reporting of tool usage.

### 8.2.4 The Production Programme Capacity

According to the EUAS:

> Production programme capacity expresses the expected activity that will take place to match estimated sales during the next year (Ibid.).

The company considers a year as a suitable period for use, because overheads must be related to producing units in the period in which they arose, as well as the relative ease of estimating for one year.

The relationship between the production programme capacity and the available production capacity is :

(i) in the case where the estimated demand is more than the available production capacity:

| production programme capacity = available production capacity |
|---|

(ii) in the case where the estimated demand is less than the available production capacity:

| production programme capacity =<br>available production capacity - un-exploited capacity caused by dropping the estimated demand. |
|---|

Expected idle capacity represents the difference between available capacity and production programme capacity. It is limited to setting budgets for the next period. It may arise as result of special economic conditions of the company, like reduction of demand on available capacity or inability to provide production requirements. Consequent burdens are considered as losses. Expected idle capacity may also arise because of political, economic or public social conditions. In such cases, consequent burdens would not be treated as part of manufacturing overheads.

In some cases the idle capacity is intended by the company. This capacity arises due to economic reasons expected by the company, e.g. if demand for products were less than supply or if it desired to achieve monopoly and control on the market in a certain way. Then, consequent burdens are treated as part of manufacturing overheads.

### 8.2.5 The Actual Production Capacity

The EUAS defines the actual production capacity as representing:

> the part of production factors that was really exploited during a certain period (Ibid.).

The difference between the production programme capacity and the actual exploited production capacity represents the efficiency and wastage production capacity at the company as follows.

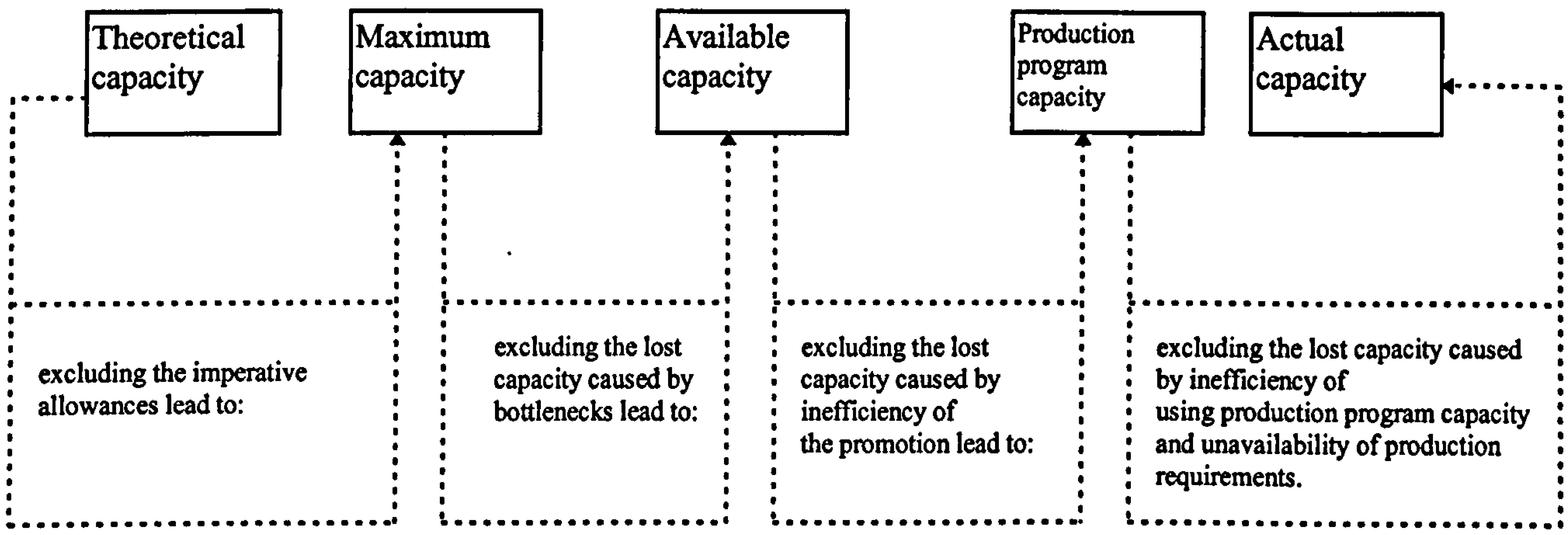
| |
|---|
| actual production capacity = production programme capacity - un-exploited production capacity |

Un-exploited idle capacity represents the difference between production programme capacity and actual capacity. It often arises as a result of production shortage to satisfy market demands, as a result of which the identified production programme cannot be realised. If that is due to misuse of resources, the consequent burdens are unavoidable costs. In the case of uncontrollable or unexpected conditions, the consequent burdens are considered as losses.

Figure (8-2) shows a summary of the relationships between the different levels of production capacity.

Figure (8-2)

A summary of the relationships between production capacity concepts




The measurement of actual exploited capacity is by output measurement (i.e. production volume) and input measurement (i.e. operating hours). In my view it is useful to use this dual measurement because the production units alone do not indicate the efficiency of achievement. The planned production volume may be achieved by using more operating hours than standard, conversely, the operating hours measure may show that actual hours equal the standard, but with actual production units achieved being fewer than planned.

The available production capacity is the main factor which govern preparing the planning budget at the company.

The available production capacity is the main factor which govern preparing the planning budget at the company, so the officials in the cost and budget sector prepare the budget based on data of the available production capacity. Thus, the available production capacity used as a base of comparison (An interview with the Manager of Cost Department in the company, July 1998).

## 8.3 Measuring the Production Capacity at the Company Level

The four concepts of production capacity applied at the company are measured at the whole company level by using the production units (Lorry, Bus, Tractor, Passenger Car, and Engine). This measurement does not show the capacity deviations inside the production stages, as measurement at the stage level would do. There is no unified measurement of capacity, because there are several products and several different models of each product in the company. Thus, products are classified in homogeneous groups by the materials and parts used and joint production lines. A pattern of each group is selected as a representative to measure the group's capacity. For example the SATURN lorry is as a typical product. The other lorries produced, i.e. Heavy and Modified lorries, equal 2.3 and 1.65 of the typical product. These equivalent quantities are determined roughly by the company management.

Capacity measurement time differs from one hangar to another and inside each hangar it differs from one line to another and from one stage to another. For example, the Trucks & Tractors hangar might sometimes operate just one shift, and operate two work shifts at other times. While the passenger car hangar operates one work shift in the single lines, it operates two work shifts in the joint line to produce two models or more, to overcome bottlenecks.

As mentioned above, the company has selected four levels of production capacity: maximum capacity, available capacity, production programme capacity, and actual capacity. It has also selected the fiscal year as the capacity measurement unit to avoid seasonal and periodic fluctuations and to harmonise actual and planned annual production data.

### 8.3.1 Analysis of Production Capacity at the Hangars Level

This section deals with measurement and analysis of production capacity at the level of the company's hangars.

#### 8.3.1.1 Trucks & Tractors Hangar

Truck & Tractor hangar (No. 1) is one of the most important hangars at the company. It is dedicated to assembling Lorries, Buses, and Tractors by using parts machined inside the company (such as pressings, parts, engines, and truck shops), and locally purchased parts, as well as imported parts. The hangar's products are assembled through lines for preparation and assembly of Lorry and Bus chassis; also, Lorry and cabin assembly, Bus assembly, and Tractor assembly. Welding and Fitting shops attached to the hangar produce and weld various parts. The saddle department is concerned with upholstery. These shops were not included in measurement of the hangar's capacity, since they are manufacturing shops for parts.

In general, the company uses the finished product (Lorry, Bus, and Tractor) as the unit of measurement of the hangar's production capacity. The capacity is measured to determine the exploited and un-exploited capacity. Tables (8-1) and (8-2) show analysis of the hangar's production capacity during the years from 1990/91, 91/92, 95/96 and 96/97.

From Table (8-1), we can notice that both production programme and actual production were lower than both maximum and available capacities for Lorries, Tractors and Buses during the study period (except production programme of buses in 95/96 and 96/97). This means that the exploited capacity of both products was lower than the full capacity, because both maximum and available capacities were estimated under highly positive or favourable expectations and emphasised average rather than heavy production. Table (8-2) reveals the reasons for un-exploited capacity in the Truck & Tractor hangar. From Table (8-2), the increase in idle capacity for both Lorries and Tractors is because actual production was unable to achieved the production programme for these products, whereas it was constant for Buses, because the demand was relatively stable for these products. In-depth analysis reveals that part of the idle capacity is caused by the expected idle capacity by the management. The other part represents waste idle capacity; it is worth analysing this to find out the reasons behind it. From Table (8-2), we can see that the lowest percentage was decrease in the shortages of local parts for the three product groups. This problem was overcome entirely for Tractors during the period study, and was reduced to minimum levels, 0.5 % and 1.1 %, for Buses and 9.8 % for Lorriės. These results reflect the role of the OMAC system in solving this problem.

The main reason was the un-expected drop of market share. This was highest for buses, increasing during the period of study from 62.5 % in 1990/91 to 98.9 % in 1996/97. This indicates the weakness of the prediction ability of the marketing departments at the company. For Tractors, there were un-expected drops of market share of 58.9 % and 59.4 % in 1990/91 and 1991/92 respectively, though the problem disappeared in 1995/96 and 1996/97. For Lorries, the percentages were 72.5 % and 67.7 % in 1990/91 and 1996/97 respectively.

Other factors, such as bank credit limits, maintenance and absence, accounted for only an insignificant percentage.

Table (8-1)

Analysis of the production capacity of the
trucks & tractors hangar
during the periods 1991, 1992, 1996, and 1997
*(Measurement unit: lorry/ bus/ hours)

| Year | Maximum Capacity (1) | Available Capacity (2) | Capacity of Production Program (3) | Actual Capacity (4) | Un-exploited Capacity (5) = (1) - (4) | | Analysis of Un-exploited Capacity | | | | Analysis of Idle Capacity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Saved (6) =(2)-(1) | | Idle (7) = (4) -(2) | | Expected (8) = (3) - (2) | | Waste (9) = (4) - (3) | | |
| **Lorry** | | | | | Units | % of Available | Units | % of Availa-ble | Units | % of Avail-able | Units | % of Availa ble | Units | % of availab-le | Hours |
| 1990/ 91 | 3000 | 2400 | 1700 | 1149 | 1851 | 77.125 | 600 | 25.00 | 1251 | 52.13 | 700 | 29.17 | 551 | 22.96 | 1091 |
| 1991/ 92 | 3000 | 2700 | 1700 | 1911 | 1089 | 40.333 | 300 | 11.11 | 789 | 29.22 | 1000 | 37.04 | (211) | - | - |
| 1995/ 96 | 3000 | 2400 | 1125 | 1127 | 1873 | 78.042 | 600 | 25.00 | 1273 | 53.04 | 1275 | 53.13 | (2) | - | - |
| 1996/ 97 | 3000 | 2400 | 1125 | 890 | 2110 | 87.917 | 600 | 25.00 | 1510 | 62.92 | 1275 | 53.13 | 235 | 9.79 | 1335 |
| | | | | | | | | | | | | | | | |
| **Bus** | | | | | | | | | | | | | | | |
| 1990/ 91 | 3000 | 2000 | 1500 | 1056 | 1944 | 97.20 | 1000 | 50.00 | 944 | 47.20 | 500 | 25.00 | 444 | 22.20 | 1975 |
| 1991/ 92 | 3000 | 2000 | 1500 | 847 | 2153 | 107.65 | 1000 | 50.00 | 1153 | 57.65 | 500 | 25.00 | 653 | 32.65 | 2413 |
| 1995/ 96 | 1500 | 1200 | 1300 | 681 | 819 | 68.25 | 300 | 25.00 | 519 | 43.25 | (100) | - | 619 | 51.583 | 917.5 |
| 1996/ 97 | 1500 | 1200 | 1300 | 636 | 864 | 72.00 | 300 | 25.00 | 564 | 47.00 | (100) | - | 664 | 55.33 | 997 |
| | | | | | | | | | | | | | | | |
| **Tractors** | | | | | | | | | | | | | | | |
| 1990/ 91 | 6000 | 3200 | 2500 | 1103 | 4897 | 153.031 | 2800 | 87.5 | 2097 | 65.53 | 700 | 21.88 | 1397 | 43.66 | 1371 |
| 1991/ 92 | 6000 | 4320 | 2500 | 1616 | 4384 | 101.481 | 1680 | 38.89 | 2704 | 62.59 | 1820 | 42.13 | 884 | 20.46 | 1036 |
| 1995/ 96 | 4000 | 3200 | 500 | 803 | 3197 | 99.906 | 800 | 25.00 | 2397 | 74.91 | 2700 | 84.38 | (303) | - | - |
| 1996/ 97 | 4000 | 3200 | 500 | 869 | 3131 | 97.844 | 800 | 25.00 | 2331 | 72.84 | 2700 | 84.38 | (369) | - | - |

General Administrative of Production Control in Truck & Tractors Hunger, Performance evaluation, Planning Budget, for the finished years in 1991, 92, 96, and 97.
* The capacity measured based on one shaft in the different production types:
- Heavy and modified lorries: 2.3, 1.65 from SATURN lorry.
-Heavy & between cities buses, Cairo chassis: 1.33, 1.33, and 500 from modified bus.
- Roman tractor 66 P.H. from Yugoslavian tractor.
-Production capacity of the study period calculated based on the same capacity measurement basis.

## Table (8-2)
## Analysis the reasons of the production capacity of the truck & tractors hangar during the periods 1991, 1992, 1996, and 1997
*(Measurement unit: lorry/ bus/ hours)

| Year | Idle Capacity | | Analysis of Idle Capacity | | | | | Reasons of Waste Capacity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Idle (7) = (4) -(2) | | Expected (8) = (3) - (2) | | Waste (9) = (4) - (2) | | | Shortage of Local Parts | | Absence & Holidays | | Un-expected Drop Market share | | Limited bank credit | | Maintenance | | Inspection | |
| **Lorry** | Units | % of Availa-ble | Units | % of Avail-able | Units | % of availab-le | Hours | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste |
| 1990/ 91 | 1251 | 52.13 | 700 | 29.17 | 551 | 22.96 | 1091 | - | - | - | - | 791 | 72.5 | 200 | 18.3 | 101 | 9.2 | - | - |
| 1991/ 92 | 789 | 29.22 | 1000 | 37.04 | (211) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1995/ 96 | 1273 | 53.04 | 1275 | 53.13 | (2) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1996/ 97 | 1510 | 62.92 | 1275 | 53.13 | 235 | 9.79 | 1335 | 131 | 9.8 | - | - | 904 | 67.7 | - | - | 300 | 22.5 | - | - |
| | | | | | | | | | | | | | | | | | | | |
| **Bus** | | | | | | | | | | | | | | | | | | | |
| 1990/ 91 | 944 | 47.20 | 500 | 25.00 | 444 | 22.20 | 1975 | 10 | .50 | - | - | 1234 | 62.5 | 731 | 37 | - | - | - | - |
| 1991/ 92 | 1153 | 57.65 | 500 | 25.00 | 653 | 32.65 | 2413 | - | - | - | - | 1701 | 70.5 | 451 | 18.7 | 160 | 6.6 | 101 | 4.2 |
| 1995/ 96 | 519 | 43.25 | (100) | - | 619 | 51.583 | 917.5 | - | - | - | - | 802 | 87.5 | - | - | 115 | 12.5 | - | - |
| 1996/ 97 | 564 | 47.00 | (100) | - | 664 | 55.33 | 997 | 10 | 1.1 | - | - | 987 | 98.9 | - | - | - | - | - | - |
| | | | | | | | | | | | | | | | | | | | |
| **Tractors** | | | | | | | | | | | | | | | | | | | |
| 1990/ 91 | 2097 | 65.53 | 700 | 21.88 | 1397 | 43.66 | 1371 | - | - | 280 | 20.4 | 807 | 58.9 | 284 | 20.7 | - | - | - | - |
| 1991/ 92 | 2704 | 62.59 | 1820 | 42.13 | 884 | 20.46 | 1036 | - | - | - | - | 615 | 59.4 | 421 | 40.6 | - | - | - | - |
| 1995/ 96 | 2397 | 74.91 | 2700 | 84.38 | (303) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1996/ 97 | 2331 | 72.84 | 2700 | 84.38 | (369) | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

General Administrative of Production Control in Truck & Tractors Hunger, Performance evaluation, Planning Budget, for the finished years in 1991, 92, 96, and 97.

#### 8.3.1.2 Passenger Cars Hangar

Passenger cars hangar (No. 4) is one of the most important hangars followed by the Truck and Tractors hangar. It is dedicated to assembling passenger cars. Production depends substantially on the imported requirements from the licensed companies and to a lesser extent from the local supplying companies. Assembly of the passenger cars involves three stages: welding, painting, preparing and assembly. A car is painted before it is prepared and assembled.

The company uses the finished car as the unit of measurement of production capacity. Tables (8-3) and (8-4) show the production capacity levels and un-exploited production capacity and their reasons during the study period. From Tables (8-3) and (8-4), we can find that the exploited production capacity increased during the study period, from 72.1 % of available capacity in 1990/91 to 128.6 % in 1996/97, and from 68.4 % of the production program capacity in 1990/91 to 115.7 % in 1996/97. This was a result of frequent stoppage of the production during these years as a result of developments in the production lines and stopping the production of some models of the cars. The waste hours decreased from 43.2 % in 1990/91 to 10.1 % in 1995/96. The un-expected drop in the market share was the most important reason for waste idle capacity, increasing from 69.4 % in 1990/1991 to 96.7 % in 1995/96. Bank credit limits was another reason for waste idle capacity; this accounted for 22 % in 1990/91. Shortage of the local and imported parts accounted for a small portion of the waste idle capacity.

# Table (8-3)
## Analysis of the production capacity of the passenger cars hangar's products during the periods 1991, 1992, 1996, and 1997
*(Measurement unit: car)

| Year | Maximum Capacity (1) | Available Capacity (2) | Capacity of Production Program (3) | Actual Capacity (4) | | | Un-exploited Capacity (5) = (1) - (4) | | Analysis of Un-exploited Capacity | | | | Analysis of Idle Capacity | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Saved (6) =(2)-(1) | | Idle (7) = (4) -(2) | | Expected (8) = (3) - (2) | | Waste (9) = (4) - (3) | |
| | | | | Units | % of Available | % of production program | Units | % of Available | Units | % of Available | Units | % of Avail-able | Units | % of Available | Units | % of available |
| 1990/ 91 | 25000 | 10625 | 11210 | 7663 | 72.12 | 68.36 | 17337 | 163.2 | 14375 | 135.29 | 2962 | 27.88 | (585) | - | 3547 | 33.38 |
| 1991/ 92 | 25000 | 13500 | 11210 | 8405 | 62.26 | 74.98 | 16595 | 122.9 | 11500 | 85.19 | 5095 | 37.74 | 2290 | 16.96 | 2805 | 20.78 |
| 1995/ 96 | 15000 | 13500 | 15000 | 12141 | 89.93 | 80.94 | 2859 | 21.18 | 1500 | 11.11 | 1359 | 10.07 | (1500) | - | 2859 | 21.18 |
| 1996/ 97 | 15000 | 13500 | 15000 | 17361 | 128.60 | 115.74 | (2361) | - | 1500 | 11.11 | (3861) | - | (1500) | - | (2361) | - |

General Administrative of Production Control, Performance Evaluation Reports, Planning Budgets, the Engineering & Assembly Sector in Passenger Cars' Hunger for the finished years in 1991, 1992, 1995, and 1997.

* Production Capacity measured based on Tow shafts in the different types of passenger cars which calculated according to producing small car. SUPER FURA, Fiat 128, POLONIZE, and REGATTA equal 1.3, 1.5, and 1.5 from the small car.

-Production capacity of the study period calculated based on the same capacity measurement basis.

Continued over.......

Table (8-4)
Analysis the reasons of the production capacity of the passenger cars hangar
during the Periods 1991, 1992, 1996, and 1997
* (Measurement unit: machine hours)

| Year | Available, Productive, and Waste Hours | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Available Hours (10) | Productive Hours (11) | | Waste Hours (12) = (11) - (10) | | Drop Market share | | shortage of Imported Component | | Shortage of Local Components | | Maintenance, Replacement, and Renew | | Electric Cut | | Absence & Holidays | | Limited bank credit | |
| | | Hours | % of Available | Hours | % of Available | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste | Hours | % of Waste |
| 1990/ 91 | 2093 | 1188 | 56.8 | 905 | 43.2 | 628 | 69.4 | 80 | 9.0 | - | - | - | - | - | - | - | - | 197 | 22.0 |
| 1991/ 92 | 2093 | 1303 | 62.3 | 790 | 37.7 | 612 | 77.5 | 110 | 13.9 | 5 | .60 | - | - | - | - | 63 | 8.0 | - | - |
| 1995/ 96 | 2121 | 1907.5 | 89.9 | 213.5 | 10.1 | 206.5 | 96.7 | - | - | 7 | 3.3 | - | - | - | - | - | - | - | - |
| 1996/ 97 | 2121 | 2728 | 128.6 | (607) | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

General Administrative of Production Control, Performance Evaluation Reports, Planning Budgets, the Engineering & Assembly Sector in Passenger Cars' Hunger for the finished years in 1991, 92, 96, and 97.

* Production Capacity measured based on Tow shafts in the different types of passenger cars which calculated according to producing small car. Super Fura, Fiat 128, Polonize, and Regatta equal 1.3, 1.5, and 1.5 from the small car.

### 8.3.1.3 Machined Parts Hangars

The machined parts hangars include diesel engines, special parts, pressings, transport shops, petrol engines and tools engineering. In the light of the available data, the diesel engines, special parts and petrol engines are selected for measurement of their production capacity costs. These are the most important hangars and representative of the manufacturing activities in the company. For example, the parts produced by the diesel engines hangar are used in the assembly of trucks and tractors, as are the parts produced by the special parts hangar. Output from the petrol engines hangar is used in assembling passenger cars.

#### 8.3.1.3.1 Diesel Engines Hangar

The engine is used as the unit of measurement of the hangar's capacity. Table (8-5) shows measurement and analysis of the exploited and un-exploited production capacity in the hangar during the study period. From Table (8-5), we can see that the percentage of exploited production capacity in the Air coold engines department increased from 10.95 % to 97.6 % in the years 1990/91 and 1991/92 but decreased from 20.96 % to 12.60 % in 1995/96 and 1996/97 respectively, while in the Water coold engines department, the relevant percentages were .78 %, 6.62 % and 1.24 % respectively. The saved capacity of both Air cooled engines and Water coold engines arose because of insufficient demand for the products and reduction of the actual production quantity of trucks and tractors during the study period. There was idle capacity for Water cooled engines in 1995/96, caused by unexpected drop in market share. The waste idle capacity for Air cooled engines was caused by various reasons such as material shortage, which the only reason for the idle capacity for five days in

1991/92. In 1995/96, Bank credit limits were the only reason which caused lost idle capacity of 53 days; the major reason in 1996/97 was workers' absence.

## Table (8-5)

### Analysis of the production capacity and their reasons of diesel engines hangar during the period 1991, 92, 95, 97

(Measurement unit: engine/day)

| Year | Maximum Capacity (1) | Available Capacity (2) | Capacity of Production Program (3) | Actual Capacity (4) | | Un-exploited Capacity (5) = (1) - (4) | Analysis of Un-exploited Capacity | | | | Analysis of Idle Capacity | | | | Reasons of Waste Capacity | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Saved (6) =(2)-(1) | | Idle (7) = (4) -(2) | | Expected (8) = (3) - (2) | | Waste (9) = (4) - (3) | | Absence | | Limits of Bank Credit | | Parts shortage | | Market share drop | |
| Air Cold engine | | | | Engine | % of Available | | Engine | % of Availa-ble | Engine | % of Avail-able | Engine | % of Available | Engine | % of available | Day | % | Day | % | Day | % | Day | % |
| 90/91 | 500 | 5650 | 500 | 616 | 10.95 | (116) | (5150) | 91.15 | 4934 | 87.33 | (5150) | - | (116) | - | - | - | - | - | - | - | - | - |
| 91/92 | 500 | 500 | 500 | 488 | 97.60 | 12 | - | - | 12 | 2.4 | - | - | 12 | 2.4 | - | - | - | - | 5 | 100 | - | - |
| 95/96 | 550 | 2500 | 800 | 524 | 20.96 | 26 | 3000 | 100.2 | 1976 | 79.04 | 1700 | 68 | 276 | 11.04 | - | - | 53 | 100 | - | - | - | - |
| 96/97 | 550 | 2500 | 800 | 315 | 12.60 | 235 | 3000 | 100.2 | 2185 | 87.4 | 1700 | 68 | 485 | 19.4 | 60 | 59 | - | - | - | - | 31 | 41 |
| | | | | | | | | | | | | | | | | | | | | | | |
| Water cold engine | | | | | | | | | | | | | | | | | | | | | | |
| 90/91 | 500 | 5650 | - | 44 | .78 | 456 | (5150) | 91.15 | 5660 | 99.22 | 5650 | 100 | (44) | - | - | - | - | - | - | - | - | - |
| 91/92 | 500 | 500 | - | 331 | 6.62 | 169 | - | - | 169 | 33.80 | 500 | 100 | (331) | - | - | - | - | - | - | - | - | - |
| 95/96 | 5500 | 2500 | 800 | 31 | 1.24 | 5469 | 3000 | 100.2 | 2469 | 98.76 | 1700 | .68 | 769 | 30.76 | - | - | - | - | - | - | 147 | 100 |
| 96/97 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

General Administrative of Production Control in Diesel Engines' Hunger, Planning Budget of Production, Performance evaluation reports, for the finished years in 1991, 1992, 1996, and 1997.

#### 8.3.1.3.2 Special Parts Hangar

The special parts hangar (No. 6) produces most of the mechanical parts which are used for the Trucks & Tractors. This hangar consists of three major departments:

(1) The gears department which include machines to produce axes gears, engine gears.

(2) The lines department which contains lines to produce all parts for the front and rear axles of Lorries and Buses.

(3) The machines department which includes machines like automatic and non-automatic lathes and other machines to produce other parts for Lorries, Buses and Engines.

Machine hours are used as the unit of measurement of the hangar's capacity, because of specialisation of the machines in the hangar and heterogeneity of the output of the hangar. Tables (8-6) and (8-7) show the measurement and analysis of the exploited and un-exploited capacity in the hangar during the study period and their reasons, Tables (8-6) and (8-7) reveal that the production programme capacity expresses the standard time from the operating sheets. The exploited actual capacity increased in the years 1990/91 (55.6 %), 1991/92 (75.7 %) and 1996/97 (66. %) but it decreased in 1995/96 (47%). The highest percentage of the idle capacity was in 1995/96 (53.%), while the lowest was in 1991/92 (24%). By analysing this idle capacity, we find that expected idle capacity decreased from 39.6 % to 17.4 % in 1990/91 and decreased from 47.9 % to 29.7 % in 1995/96 and 1996/97 respectively. This is because there were no operating orders during these years. These percentages account for about half the idle capacity in 1990/91 and 1995/96 and about a third in 1991/92 and 1996/97. The waste idle capacity decreased during the years 1990/91 and 1996/97 to 4.8 % and 4.3 %

respectively. Shortage of materials was the main reason for this waste capacity in 1990/91 but both Bank credit limits and workers' absences were the major reasons of waste capacity.

Table (8-6)
Analysis of the production capacity and their reasons of special parts' hangar during the period from 1991, 92, 96, and 97
(Measurement unit: machine hours)

| Year | Available Capacity (1) | Capacity of Production Program (2) | Actual Capacity (3) | | Un-exploited Capacity (4) = (3) - (1) | | Analysis of Idle Capacity | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Hour | % of (1) | Expected (5) (Hours unloaded) | | Waste (6) | |
| | | | Hours | % of (1) | | | Hours | % of (1) | Hours | % of (1) |
| 90/ 91 | 589905 | 379013 | 327987 | 55.6 | 261918 | 44.4 | 233794 | 39.6 | 28124 | 4.8 |
| 91/ 92 | 645984 | 464037 | 489271 | 75.7 | 156713 | 24.3 | 112401 | 17.4 | 44312 | 6.9 |
| 95/ 96 | 390530 | 343813 | 183549 | 47.0 | 206981 | 53.0 | 186954 | 47.9 | 20027 | 5.1 |
| 96/ 97 | 266197 | 219256 | 175690 | 66.0 | 90507 | 34.0 | 78937 | 29.7 | 11570 | 4.3 |

Planning Sector, Loading and Operating the parts and Gears, for the finished years in 1991, 1992, 1996, and 1997.

Continued over..........

## Table (8-7)

### Analysis of the production capacity and their reasons of special Parts' hangar during the period from 1991, 92, 96, and 97 (Measurement unit: machine hours)

| Year | Analysis of Idle Capacity | | | | Reasons of Waste Capacity (7) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Expected (5) (Hours unloaded) | | Waste (6) | | Tools | | Limits of Bank Credit | | Absence of Labour | | Inspection | | Shortage of Material | | Electric | | Drop of Market Share | |
| | | Hours | % | Hours | % | Hour | % | Hour | % | Hours | % | Hour | % | Hour | Hour | % of | Hour | % (6) Hours |
| 90/91 | 39.6 | 233794 | 4.8 | 28124 | 1.7 | 491 | 4.5 | 1239 | 49.3 | 13859 | - | - | 24.5 | 6901 | - | - | 5634 | 20 |
| 91/92 | 17.4 | 112401 | 6.9 | 44312 | 1.8 | 834 | 18.1 | 8000 | 24.7 | 10938 | 2.2 | 976 | 15.2 | 6743 | 6511 | 14.7 | 10310 | 23.3 |
| 95/96 | 47.9 | 186954 | 5.1 | 20027 | .9 | 178 | 9.9 | 1993 | 56.9 | 11388 | 2.5 | 490 | 29.8 | 5978 | - | - | - | - |
| 96/97 | 29.7 | 78937 | 4.3 | 11570 | 1.0 | 110 | 70.2 | 8131 | 28.8 | 3329 | - | - | - | - | - | - | - | - |

Planning Sector, Loading and Operating the parts and Gears, for the finished years in 1991, 1992, 1996, and 1997.

#### 8.3.1.3.3 Petrol Engines Hangar

The petrol engines hangar used to produce a petrol engine of 1500 H.P. used in assembly of the Poland passenger car 125. After production of this model of car, was stopped, the engine was modified by increasing its capacity to 1600 H. P. to use in assembly of the passenger cars 'Air Conditioned Poloniez', 'Nasr Sahen', 'Nasr Dogan' and the Microbus. The hangar includes production lines for engine bodies, connecting rods, covers of main axles, connecting shaft, cylinder head, etc. It also includes assembly lines and conducts engine testing.

The engine is used as the unit of measurement of the hangar's capacity Table (8-8) shows the production capacity and related factors in the hangar during the study period. From Table (8-8), we can see that exploited production capacity shrank during the study period. This occurred because: firstly, the production plan for engines was reduced in line with the foreign currency available to import the production requirements; secondly this plan was related to the capacity for assembly of the 'Poloniez' passenger car.

The expected idle production capacity and available production capacity broke even, so there was no waste idle production capacity in this hangar during the study period.

Table (8-8)

Analysis of the production capacity and their reasons of petrol engines hangar during the period from 1991, 92, 95, and 97 (Measurement unit: engine/day)

| Year | Maximum Capacity (1) | Available Capacity (2) | Capacity of Production Program (3) | Actual Capacity (4) | | Un-exploited Capacity (5) = (4) - (1) | | Analysis of Un-exploited Capacity | | | | Analysis of Idle Capacity | | | | Reasons of Waste Capacity | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Saved (6) =(2)-(1) | | Idle (7) = (4) -(2) | | Expected (8) = (3) - (2) | | Waste (9) = (4) - (3) | | Parts shortage | | Maintenance | | other Breakdown | |
| | | | | Engine | % of Available | Engine | % of Available | Engine | % of Available | Engine | % of Available | Engine | % of Available | Engine | % of available | Day | % of Waste | Day | % of Waste | Day | % of Waste |
| 90/91 | - | 2550 | - | 479 | 18.78 | (479) | 18.78 | (2550) | 100 | 2071 | 81.22 | 2550 | 100 | (479) | - | - | - | - | - | - | - |
| 91/92 | - | 2000 | - | 20 | 01.00 | (20) | 01.00 | (2000) | 100 | 1980 | 99.00 | 2000 | 100 | (20) | - | - | - | - | - | - | - |
| 95/96 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 96/97 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

General Administrative of Production Control, Petrol Engines' Hunger, Planning Budget, Performance evaluation reports for the finished years in 1991, 1992, 1996, and 1997.

### 8.3.2 Implications of Production Capacity Measurement

Failure to exploit available productive capacity is one of the most chronic problems at that company. The existence of so much idle capacity at the company is surprising for two reasons: First, a developing country like Egypt has relatively little industrial production volume, a lack of many local industrial products, and an urgent need for industrialisation. Hence, it might be expected that this company would make full use of all existing industrial productive capacities to increase its industrial output. Second, the existence of idle capacity means that there is a side of fixed productive assets (a fixed capital) that is not exploited at all, whereas it is common for this company to suffer from the problem of shortage of the local savings necessary to form fixed capital. This means that the common idea concerning shortage of necessary capital for industrialisation conflicts with the failure fully to utilise existing fixed capital in industry.

In fact, there is a great variety of obstacles that have prevented the productive capacity in the company being used with the highest degree of efficiency. The most important of them are:

(1) The company's size is not commensurate with foreign and local market potential. Expansion was carried out at a time when the market was becoming saturated. The company faced difficulty selling its products as well as inventory increase and opening foreign markets.

> The low levels of production in the company cannot really be justified by the small size of the Egyptian market. Whereas local production more than doubled, imports increased by more than three-fold over the same period. Frequent changes of passenger car models produced by the company added to the low volume problems and contributed to the low level of local content reached by the passenger car project (An interview with the Manager of the Planning & Supply Division, July 1998).

(2) Reasons concerning machinery and capital equipment. The most important of them are:

- periodic obsolescence-the productive capacity of different stages is not suitable.
- shortage of some spare parts, some productive capacities are not partitive. To this can also be added reduced flexibility due to missing or inadequate machine tools.
- In line productions, like at El-Nasr Company where machines are interrelated to each other so that the output of one feeds another, machine availability is particularly important. Interdependency between machines reduces the availability of the line (even though availability of individual machines may be high) and leads to uncertainty in the technical system. Even for reasonably small risks of machine failures, the total risk becomes significant as long as jobs cannot be re-routed to other machines.

(3) Also, absence of preventive maintenance care and lack of technical efficiency of work. With the current machine maintenance approach, which is primarily ad hoc, no significant improvement in machine reliability can be anticipated. A maintenance programme with more focus on preventive maintenance would be an alternative.

(4) Factors uncontrollable by management. The most important of them are:

- Warehousing difficulties and accumulated inventory of finished goods due to non-equal and strong competition;
- Shortage or low quality of raw material and production needs, and irregular supply;
- A shortage of electric power and several electrical cuts;
- Failure to install some equipment on account of delay in construction of the necessary buildings.

(5) Parts and materials were not available on the production lines.

The most important consequences of idle productive capacities are: first, the decreasing productive ability of the company, and second, the increased cost of fixed productive assets per produced unit. Undoubtedly, dealing with the problem of unused capacities in the company will lead to increasing production and decreasing costs. This could enable the prices of products to be reduced, then the demand for them in the local market will increase and the company's competitive ability in the foreign international markets would increase.

Separating idle capacity can be useful for both pricing and operational reasons, particularly as the competition increases. The pricing of products will not be influenced adversely by falling demand. Separating pure idle capacity as a line-item allows the company to improve unit cost by removing equipment waste and hence improve throughput potential. This can be important even in periods of slack demand. If wasted capacity and idle capacity are merged and both are hidden in unit cost, strong incentives arise to make wasted capacity increase to fit the space allowed for it. If demand later increases, the plant then appears to have no capacity left. The actual capacity potential is misused, which can lead to unnecessary purchases of additional capacity when demand returns.

In addition, separating and reporting idle production capacity is one of the most important factors that affect make or buy decisions at the company, as will be explained in the next section.

## 8.4 Analysis of Factors Influencing Make or Buy Decisions

In the analysis of influential factors , consideration is given to two related decisions: first the sourcing of parts and components by the automotive assembler, i.e. whether these items are procured locally or imported; secondly, the make or buy decision, i.e. for a locally procured item whether the automotive company decides to make it itself or decides to purchase it from an independent local supplier.

Analysis of each type of decision taken at the company is provided below.

### 8.4.1 Import or Local Procurement Decision

In developing countries like Egypt the automotive industry has always started with the assembly of Knock-down vehicles imported from a licensed automotive enterprise, either in a SKD or CKD aspect. The company never considered this phase as a destination, but as an initial step leading to the local manufacture of parts and components, whether made in-house (by the assembler) or bought-in from local suppliers, resulting in the increase of domestic content of vehicles assembled locally.

Therefore, the government, through local assembly, has tried to increase local content over time. However, one must consider the risks of an import-replacement policy pushed too far and too fast. Local competencies may be too small to support efficient production for some capital-intensive items. Too much pressure to use local materials may lead to the utilisation of inefficient methods, poor components and a general lowering of quality requirements.

However, Egypt is open to foreign purchases of parts and components and less capable of wholesale import substitution and usually retains foreign relationships. The degree of foreign linkages, however, is very much affected by government policy on import substitution and should in the end be considered the single most important factor determining the depth of local content achieved by automotive producers. Given government policy, the decision whether an item is produced domestically or imported depends on such determinants as the relative costs, quality and risks involved. The decision of the automotive assembler will depend on costs of production (domestic and foreign), transportation costs, communication costs, and the relative technical competence of local suppliers. In a developing country like Egypt, the automotive company import parts and components which are subject to scale economies, advanced technology and standardised specification. Local procurement of items is used to buy very heavy components, those produced by relatively simple techniques and/or those not subject to large scale production economies. Obviously, the larger and more advanced the country, the higher will be local content. Given domestic facilities, the relative risk of disruption of suppliers (e.g. bottlenecks, labour strike) will also influence the local company's choice.

Fortunately, according to the interviewees, with no compulsive government policy in Egypt, the decision whether to manufacture an item domestically or import it depends on the automotive company's policy, relative costs of production, availability of technology, local technical facilities, size of the Egyptian market (with the lack of export opportunities) and last, the availability of foreign currency.

From the interviews, it was learnt that a decision to manufacture an item domestically depended, first, on its value, i.e. the company strives to manufacture locally parts and components that constituted a sizeable share in the total value of the vehicle in order to attain a high level of domestic content as soon as possible, in order to achieve the corporate strategy and to encourage the local supply industries. According to the Master Price List supplied to the company by licensers, different items are place into different classes based on their value. Parts and components with the highest value will be put in list A and given first priority for local production by the company. Other items will be put into different lists, B and C, according to their value. Items on list B will be given second priority and items on list C will be given least attention, as they are insignificant in relation to the total cost of the vehicle. If one of the components on the A list is not feasible for manufacture locally (for technical reasons or otherwise), it will automatically be replaced by another item from the B or C list. This strategy has been adopted only in the last few years, since the sophisticated OMAC computerised facility was installed.

According to company sources, at the beginning, they did not take into account this factor (i.e. the value of the item produced) to their consequent disadvantage. Therefore, a lot of time and effort was given to attempting to produce items that neither added much to the local content value of the vehicle, nor saved a great deal of scarce foreign currency.

However, one must emphasise the limitation of this method which ignores other economic and technical factors (technological capabilities of the country, economies of scale, capital requirements, skills, etc.), that are necessary to the efficient production of an item. This is especially true if we take into account that most items on the A list are very expensive to manufacture domestically, because of the high price of technology transfer and the fact that a parent company (licenser) may not want this advanced technology to be available to developing countries. El-Nasr Company was more successful in increasing and reaching a high level of local content for the commercial vehicle project, while the passenger cars and tractors projects did not go further than the assembly stage, with low levels of local content.

According to the interviewees, there might be an underestimation of the value of the local content of vehicles produced by them. The first reason is the way the estimates are made. Items produced locally are estimated according to domestic prices while imported items are estimated according to international prices. This, they claim, could lead to an overestimation of the value of imported items and the underestimation of the value of locally produced items. However, this argument could be reversed, i.e. it works both ways, given the possibility that some items are manufactured in Egypt at a higher cost and consequently become more expensive than their imported counterparts. Secondly, and this may be a more valid point, parent companies may deliberately try to underestimate the value of parts and components that have been successfully produced locally, and overestimate the value of the imported items. A clear example of this is the case of Fiat; at one time El-Nasr Company was importing a certain item (wheelrims) for use in the Fiat Nasr 128 passenger car with an estimated unit value of $ 10 in 1980. After the successful local production of this item by a local supplier (a public sector company - a military factory in this case) and the deletion of this part from the CKD set, this same item was priced at $ 7.50 in Fiat's Master Price List in 1988 (An interview with the Cost Manager at the company, August 1998).

### 8.4.2 Make or Buy Decision

If the first decision regarding the sourcing of parts and components by the automotive assembler, is that these items are to be procured locally, not imported, the second decision is the make or buy decision, i.e. for a locally procured item, whether the automotive company will make it itself, or purchase it from an independent local supplier.

#### 8.4.2.1 Making Some Parts and Components in the Company

Some parts, components, and intermediate products are produced by the fabricating plants in the company because it is the only producer of these items. For these products, managers do not have the option to source them from outside. Freedom to source is constrained by the corporate strategy and other operational considerations, explained later in this chapter. These products are transformed from the fabricating to the assembly plants at the company. Some of these items cannot be sold in the market and others can. Because the company monopolises production of these items, e.g. petrol and air engines, selling prices are set only by this company. Transfer prices of these products are set up on the basis of estimated costs.

For other parts, however, the company has to decide whether they should be produced internally or purchased from independent suppliers.

#### 8.4.2.2 Advantages and Disadvantages of Making-in and Buying-in

There are, however, certain costs and negative effects resulted from increasing manufacturing rather than buying-in. When a company decides to perform its various operations in-house and takes over the different production lines, it may over-extend its management, reduce its flexibility, increase risks to its own capital and also attract government intervention to restrict its monopolistic position (if the government has anti-monopolistic policies).

Buying from independent suppliers can have advantages that lead to the reduction of costs of production. For example, an independent supplier may reap the benefits of scale (if a particular item is subject to economies of scale) by selling to many customers. Also an independent small supplier may be able to reap certain economies of small scale (lower wages, less capital, simple technology, more flexibility, smaller overheads, etc.) by supplying some relatively simple items or tasks (e.g. machining) to the company more cheaply than large companies. Last, production of every item in-house may lead the company to undertake activities outside its main field of specialisation which could reduce efficiency. A company should specialise in activities for which its capabilities offer some comparative advantage.

#### 8.4.2.3 Factors Affecting the Decision to Make or to Buy at the Company

To make an item or to buy it concerns only El-Nasr Company, as it is the only automotive company in Egypt with in-house production facilities including machining and stamping. However, there are factors affecting the company's decision which parts to make and which ones to buy.

(1) Company strategy. The management of the commercial vehicles (CV) is more interested in increasing local content and seeking local suppliers, compared to the other products. Licences to produce the product play a significant role in this respect.

(2) The company will be influenced by what is conventionally made-in and conventionally bought-out.

(3) some items may require a higher degree of specialisation and skills than those available from local suppliers in Egypt, so the company needs to make them in-house, e.g. timing gears.

(4) Some parts and components are crucial, so the company prefers to see to their production, e.g. ball bearings.

(5) Local suppliers may be unavailable for some items, so the company has to produce them, e.g. injection pumps.

(6) Availability of investment funds may affect the decision to make or to buy.

(7) If a local supplier can reap economies of small scale production and can make an item cheaper, the decision to buy will be made by the company. A typical example is small machined items on general traditional machines.

(8) The company will also decide to make some items rather than buying them out if it feels that there is a great risk associated with buying-out, e.g. the local supplier can not provide the right quality or quantity of an item at the right time, as in the case of a possible labour strike.

(9) Existence of idle production capacity may lead to a decision to make in-house.

In Egypt, there is still no a compulsive government strategy to affect the company's decisions or influence it to buy from local suppliers and increase linkages, as occurs in the developed countries, e.g. in Japan. The decision to make or to buy at El-Nasr company is affected also by existence of idle capacity. When the company has some idle capacity , it decides to make some parts which are being bought-out locally, competing with local suppliers, ignoring all the negative consequences for local suppliers of unexpectedly dropping them without warning and for no fault of their own.

Because the company does not purchase parts and components on a regular basis, it suffers from troubles obtaining them from suppliers when capacity is limited, as explained in Chapter Five.

One may argue that the company could opt to replace imports to utilise its idle capacity, competing with imports and rising local content, instead of competing with local suppliers. However, another view is that to replace an imported component would take about a two-year lead time, which would be too long to keep under-used capacity at the factory. However, in order to achieve some degree of stabilisation in market for supplier industries and establish more trusting and long term permanent linkages, some parts should be guaranteed to be bought out from local suppliers, whatever the conditions are.

A source decision is taken by the committee on the basis of the company's best interests. For example, when capacity was available inside, it would not buy a product from outside.

#### 8.4.2.4 Decision Maker "Make/Buy Committee"

The changes occurring in the organisation structure of the ex-public sector from a centralised to decentralised management has affected the relationships of responsibility and power within the case company (see Figure 5-1). Individual sites are managed by Unit Managers and in line with the project nature of some of the work, major products are managed by Plant Directors. Whilst the company is totally anonymous, a balanced and critical view of the organisation policies, procedures and practices can be reported, both positive and negative points can be covered. In recent years much greater decentralisation of decisions has occurred in the company. The Board of Directors is responsible for establishing overall policies and strategies of the company, including policies for sourcing decisions. For a number of years this latter responsibility had been delegated to a Make/Buy Committee which dealt with issues such as current demand for manufacture or purchase of existing components and process requirements, and projecting the likely demand for outsourcing for the future projects. This committee was supposed to ensure effective application of sourcing policies and to resolve major sourcing issues. In practice, it was more like a power play between purchasing and manufacturing.

Issues were often dealt with on a one-off basis and there was a danger that no-one looked at an overall strategic position. Evaluation often started with whether the component or process was in-house at the present time, without questioning whether the technology was critical or considering the options in the context of the company's overall strategy.

A manager in the make/buy committee clarified:

> There was a hazard of making decisions which would maximise the reported profits and we were somewhat uncomfortable with this (Interview with the Manager in the Make/Buy Committee at the company, August 1998).

There was also no prompt to review the company strategy based on experiences of trying to execute it, and this is one of the key issues that require to be addressed.

### 8.4.3 Role of Cost Accounting System in the Process of Make/Buy Decisions

This is a large company and detailed financial planning is a complex process. The company maintained strategies, action plans and budgets in relation to products and components. However, the company adopted a financial or cost based approach based on limited analysis of the make/buy issue. The measurement of unit costs to make and the analysis of overheads were established in Chapter Six. Such cost comparisons to make or buy are fraught with difficulty, however; accuracy depends on the costing method used.

> Our fixed costs are too high, and are spread across the products and we are losing the competitive advantage particularly after the strong competition at the market. We need to make or buy review to give us the basis to focus on core components and processes enabling us to compete and grow the business (Interview with the Cost Manager at the company, August 1998).

The major emphasis is placed on the current or estimated standard cost of manufacture against the quoted or quotable purchase price from suppliers. The company places heavy reliance on the standard costing system through OMAC for control of work-in-process and cost control. There are concerns about how some of the costs in the decision are arrived at, i.e. what is the cost to make and what is the buying price? Estimates are based on standard costs for material, labour and overheads, the emphasis is still on full cost. The big problem with the current costing systems that are already in place is usually the arbitrary allocation of overheads. Furthermore the standard costing system that the company operates is based on labour hours, which are constantly shrinking.

Managers believe that the use of full absorption costs in all cases accommodates the uncertainties involved in the decision and ensures that overheads feature in any resultant cost reduction. Full absorption costing may present a slight disadvantage to the case to make in-house, but the management argued that this compensates for the uncertainties arising from estimated internal costs as opposed to known or negotiable purchase costs. The company is aware that there are internal costs associated with the buy decision, being increased costs of setting up agreements and liaison with suppliers, and these are also incorporated in the decision analysis.

In generating the costs to make, they propose to use their current standard cost system factored by relevant indices to reflect estimated future costs, and adjust for actual cost differences that are known to exist or are indicated by historical trends. The management recognise that costing and control, through OMAC, is at an elaborated level and that this makes it easy to understand costs for a specific component, process or purchasing activity.

This makes it all the more easy to estimate future costs at the level of detail required. However, it should be recognised that the marginal cost should also be examined, particularly in light of the strong competition and existing idle capacity.

It is easy to overlook the fact that the calculation of cost levels is heavily dependent on the level of utilisation of the factory. At high and low levels of utilisation the volume/cost sensitivity is particularly acute, and great care should be taken in coming to any conclusions here. The issue of temporary capacity imbalance affects make or buy decision. When unforeseen changes in demand occur, it may not be possible to make everything in-house, even though this might be the preferred option. Conversely, if load falls, the company may wish to bring in-house some work that had previously been out-sourced, without considering how this may damage important supplier relationships.

It should also be recognised that cost is not the only factor in the analysis. Where a strategic view is required, a more detailed examination is generated which takes into account cost, and other non-financial issues that affect the competitive position of the company. One possibility is to factor into the analysis non-financial issues where differences between make and buy have been revealed.

The investigation introduced in Chapter Five showed that the company looks at buying for price advantage as an internal cost reducing factor, rather than one which might enable the company to obtain a competitive advantage. The company has over-invested in components and ignored developing parts that could have become sources of competitive advantage. Generally this was the consequence of irrational or limited thinking about comparative advantage, supplier management and economies of scale. For example, rarely was there an effort to place parts in a strategic hierarchy, nor any discussion of supplier capabilities of process technologies at which the company could gain a competitive advantage.

### 8.4.4 Requirement of a Strategic View for Make/Buy Decisions

As appears above, the company deals with make/buy decisions in terms of financial analysis, that is, given that spare capacity exists, the decision is to manufacture all those components which were previously bought out. In the contemporary competitive and manufacturing environment, this approach may result in the decision remaining at an operational level, being routinised and open to the criticism that it lacks the long-term view. The decision needs to be elevated to ensure that it is visible and considered at the strategic level.

Cost consideration is not the major factor in a make/buy decision. With customers' increasing demand for better quality products and shorter lead times at lower prices, cost is but one of the many important factors that need to be considered. With the increasing trend towards modern manufacturing management techniques such as Just-In-Time, factors such as supplier reliability, quality, responsiveness and speed of delivery are vital to the company's overall operation. When all these factors are taken together, a make/buy decision can be complex. Thus, the importance of this decision increases because it will not only affect the product costs but could also affect market share and profitability.

Make or buy provides the rationale for investment in manufacturing capability in the long-term. Central to the manufacturing strategy of a business, it aligns the choice of which parts of the product to make and which manufacturing processes to have in-house, with the goals of the business.

## 8.5 Summary of Make or Buy Decisions

Make or buy decisions are important because they can be determinants of profitability and can be significant to the financial strength and operations of the company, affecting production methods and capabilities and competitive position. There are no clear conclusions to be drawn on the implementation of make or buy decisions, but generally it appears that the company seems to lack strategic direction.

There is an emphasis on short-term cost-based criteria and this can be fraught with difficulty.

A range of operational criteria affect whether to make or buy; quality and lead times are critical to be competitive. Although the long term impact of make or buy decisions is recognised, the company still takes a much too short term view of the consequences. Cost considerations must be kept in perspective, and must not be allowed to dominate the choice of strategy options. Cost is only one factor of many that determine customer choice and the company needs to weigh up the other, less tangible but equally important issues.

Although a wide range of factors is recognised as having an effect on the make or buy decision, the issue of matching company capability to what is really required to be successful in a particular business is at the core of a good make or buy strategy.

Chapter Nine

## Analysis of the Current Situation at El-Nasr Company

Cost accounting systems have traditionally played an important role in providing managers with information needed for external and internal purposes. Although these systems are widely used, little is known concerning their relation to production planning and control systems and relevance at manufacturing companies in developing countries. The environments of these companies have changed, they are characterised by strong competition, sophisticated product and process technologies, diversified product portfolios, and greatly enhanced communication systems.

In this thesis I have discussed the effect of the changes in the contemporary manufacturing environment on designing cost accounting systems in a single large and leading company as a representative of the Egyptian automotive industry. Our main concern has been to analyse and evaluate the relevance of these systems to the manufacturing environment and proposing a model to assist the Case Company in achieving the strategic cost reduction goal. Specifically, in this study, I attempted to explore how cost accounting systems are used in a single large company that competes in multiple and uncertain environments. And how this environment contributed in developing cost accounting systems. A proposed model is presented to illustrate that cost accounting systems may be usefully differentiated according to the degree of integration with other systems.

I started in Part One of this thesis by the literature review. Chapter One is dedicated to introduction including research methodology and a case study approach and the reasons for use of it in this study.

Chapter Two dealt with the contemporary changes in the manufacturing environment. This chapter examined the shortcomings and the changes in the traditional manufacturing environment. The chapter introduced extensive survey and comparison between the systems of production planning and control systems. The chapter concluded that traditional production techniques and managerial philosophies have become obsolete and they are an obstacle to competing in the markets today. Today, the markets have become global. If a company has the desire to survive and continue in the global market and to capture a fair market-share, it must dispose of its traditional competitiveness and manufacturing strategies and adopt advanced techniques and sophisticated managerial philosophies.

Chapter Three investigated the traditional and innovative cost accounting systems. The literature in the area supports the view that conventional cost accounting systems (CASs) were less relevant when they are supposed to help not only control and measure but also cost reduction. In this chapter the researcher introduced comprehensive survey and comparison not only between traditional and contemporary cost accounting systems but also between cost accounting systems and production planning and control systems. The theoretical contribution of the researcher is to examine the relationship and the relevance between both systems through introducing matrix that contain combinations of these systems.

However, this chapter concluded that the inter nature of the CAS is a function of the lack of awareness of effect of production developments on CAS and dealing with the rigid structure of the CAS in isolation. Therefore, it is better for an organisation to adopt a strategic perspective and to look at CAS as related.

Part Two of this thesis is dedicated to the empirical study, Chapter Four dealt with giving a general background of the industry. The transition effect of Egyptian economy on the ex-public sector's changing the competitive and manufacturing environment was explained. We started by tracking the industrial development strategies in Egypt. Egypt has implemented several alternative industrial development strategies. Each policy was discussed briefly in this chapter, and we also tried to highlight the most important constraints and challenges facing the Egyptian economy at present. In this chapter also, we examined changing the competitive environment of the Egyptian automotive industry. The Egyptian automotive industry is facing challenges and limitations.

This chapter concluded that Egyptian cars are still far from international competition. Too small production numbers, particularly in passenger cars, are threaten the market share, which experts see in increasing the "local content" rate as well as to improve quality of products and of producers. Therefore, a supplier industry has to be developed on a long term basis, which will finally lead to a cost reduction. Also the local industry is interrupted by low volumes that do not justify investments in high technology equipment to produce world class quality components. It may be clear the fact that the majority of Egyptian automotive industries still need a lot of financial support and development to catch up with international standards. External just as internal order management, planning capabilities and constant product quality are as important as cost awareness and cost reduction. Another factor is to structure automotive companies in a more efficient way by using modern management techniques and information systems. Also staff and worker education plays an important role. To improve quality levels of products as well as to ensure constant company quality levels, different certification programs have been started and already successfully implemented by some companies. In sum, Egypt is an interesting market for car producers since a new generation of automotive supplier companies is going to grow up. Market pressure is realised by new local car competitors which provide better products for lower prices. Through GATT, Egyptian car producers are forced to deepen and strengthen their production- and supply chains and to improve products and processes.

In Chapter Five we discussed the manufacturing environment and the production problems facing the company which affected both the manufacturing and cost and which could add to the constraints preventing the efforts of cost reduction. We concentrated in doing so on the difficulties caused by the weakness of the planning capabilities at the company and by the local suppliers.

The leading problem at the company is the flow of materials and parts on the production lines. As parts for final assembly come from in-house production in addition to the other two sources, import and local supply, focus on the material flow also includes the company's own part production. The need for timely supply of materials leads back to the material requirements planning. Difficulty in predicting situations and events that cause deviations from this planning is a major problem. Such events are of external as well as internal nature and the situations may occur inside as well as outside the company: continuous changes in the products' designs; transportation capacity becomes insufficient, money transfer to a foreign supplier is suddenly stopped, priority in the allocation of foreign currency is changed etc. The uncertainty in planning caused by these external events and situations has its parallel also in internal events and situations: unreliable reporting procedures create in themselves uncertainty about, for example, actual inventory levels and production capacity.

Uncertainty is thus reduced by adapting the production organisation to the environment and by co-ordinating production activities. Co-ordination needs do however vary in accordance with the type of interdependence so that higher co-ordination needs lead to higher demand on information exchange and communication. The demand corresponds to possibilities found in computer-based production information systems.

Gradually the company used different information systems of production planning and control to keep pace with its different circumstances and growth stages. These systems were used through the growth stages of the company. While both Batch Processing system and the small package computerised Prompt system were used in the old manufacturing environment, the large package integrated 'OMAC' system is used in the new manufacturing environment.

In Chapter Six the author investigated the current cost accounting practices at the company to evaluate the extent of relevance of the existing systems. We declared that since 1960, the company had established its cost accounting system (CAS) which did not aim at operation effectiveness. It was not helpful for controlling manufacturing resources because it was designed, basically to calculate the products costs for inventory valuation. Deficiencies of the system are due to the arbitrary procedures of collected and allocated manufacturing overhead costs to the products through both production and production service centres.

The prevalent circumstances at that time precluded management seeing these deficiencies. It appears that this market dominance had allowed the company to show a growth in profitability, but only at the expense of its customers. Its monopoly position had allowed it to act as a price setter, and it was thereby able to export the costs of its own internal inefficiencies to its customers. In a sense this market control took the place of effective internal control and there was an accompanying lack of information systems around production and finance, and more significantly little perception of the need for or value of such information.

The CAS provided feedback to managers and employees that is too late and too aggregate. With the variety of manufacturing needs increasing, the system's inflexibility became more manifest. The purpose is to analyse quickly and accurately all the information needed for production. When the CAS was viewed with that in mind, all batch processing formula lacked flexibility. The new, complicated and diversified manufacturing demands were even more impossible to incorporate. Information needed for production such as the different batches produced, work hours, production costs, purchased orders, stock, etc. were carried out on separate processing systems.

At the divisional level there was an increasing awareness both of the need for enhanced internal control of operations, and also of lack of effective information with which to exercise such control. In particular, as we described earlier, the ease and rapidity of carrying out cost analysis that copes with cost pressure factors caused by unreliability of raw materials, changing energy prices, increasing labour costs and sluggish operating rates, are important functional conditions in cost systems. At the same time, a system was needed that could quickly adapt to the constantly changing business environment. It became apparent that the company needed to data-base to cover all its activities including a cost accounting system. It also required to upgrade its cost system through integrating with manufacturing activities.

We explored in Chapter Seven how the company has installed integrating cost and production system OMAC including MRP in order to overcome these production problems. We argued that with the competitive changes of the early 1990s there was a growing awareness of the need for improved information systems for the internal control of operations throughout the organisation. However, there were very different, if related, perceptions of the precise nature of these information needs. The improved management information was defined largely in terms of the physical control of production; tracking the progress of particular orders; scheduling production, checking physical stocks and meeting delivery promises.

The company has realised that developing their manufacturing techniques, production planning and control system, and cost accounting system are very important in keeping pace with these changes in their environment. Consequently, the company realised it is very necessary for integration and computerisation of these aspects in an integrated system. The integrated system that is able to simulate the changes in their environment (i.e. what if analysis), synchronise and thus, to come to a greater understanding of these changes. The new system in this case study is such a computerised integrated system abbreviated OMAC. In OMAC , cost control system is built on production control system. OMAC is providing timely and accurate information to facilitate efforts to control costs, to measure and improve productivity, and to devise improved production processes.

Thus, this case study confirmed understanding production control as relating to the control of production costs. This involved understanding production control in terms of accounting-based meanings. Although the importance of cost measurement and control was defined, production control was expressed primarily in such non-financial terms as controlling the throughput of jobs, tracking individual customer's orders, ensuring the availability of materials and meeting delivery schedules.

At this stage we must emphasise the overall conclusion. That is the effect of the establishment of the computerised integrated system on the cost control function was to some extent effective but on the cost reduction goal was rather limited.

Chapter Eight presented measurement and analysis of the production capacity and raised the importance of make or buy decisions. This chapter illustrated different concepts of production capacity that are used at the company. Analysis of production capacity and factors which caused reduced efficiency were explained. El-Nasr Co. suffered from idle capacity resulting from various determinants such as shortage the foreign currency. As already noted, the decision for in-house production is based (primarily) on expected capacity. The relatively high rate of production disturbances such as machine breakdowns, electricity failures etc., makes these capacity assumptions hazardous. Managers should be looking for opportunities to exploit it and should consider it when decision making.

Make or buy decisions were discussed in this chapter because they are affected directly by production capacity. Make or buy decisions are important because they can be determinants of profitability and can be significant to the operations of the company, affecting production methods and capabilities and competitive position. There are no clear conclusions to be drawn on the implementation of make or buy decisions, but generally it appears that the company seems to lack strategic direction. There is an emphasis on short-term cost-based criteria and this can be fraught with difficulty. A range of operational criteria affect whether to make or buy; quality and lead times are critical in order to be competitive. The decision needs to be elevated to ensure that it is visible and considered at the strategic level.

In Chapter Nine the author explained that despite the fact that OMAC has achieved some success, it is not able to overcome all production problems. Therefore the author suggested a model to fill the gap and assist the company to be successful. The suggested model is based on reduced uncertainty caused by internal environment of the company by making improvement in cost control and budgeting. As well, the model undertakes the strategic dimension in consideration of reducing uncertainty resulting from the external environment of the company by enhancing interrelationships with suppliers. The ultimate consequence is make improvements in the company's situation by reducing costs.

The apparent weaknesses in the Company's product costing and cost control systems are expected to have an impact on its financial results. These results have not been healthy. Like many companies in the ex-public industrial sector, this Company has suffered from financial difficulties. Though the Company attempted to compete favourably within this market through the 1990s, it has encountered the problems of fewer orders in its backlog and declining profitability. For example, the Company's net sales of buses fell from a high of L.E. 156.3 million in 1991/92 to a low of L.E. 96.6 million in 1996/97. Declining sales is caused in part by distortions of costs in the quoting process, have taken the Company from a high profitability level of L.E. 7.9. million in 1991/92 to a low profitability of L.E. 3.5 million in 1996/97.

The Company's cost accounting systems are responsible for these bad financial results because these systems did not establish for the purpose of strategic cost control.

Another potential problem with this Company's cost allocation process is that overhead is calculated based upon direct labour cost, which can not possibly be the single or most important driving force behind the incurrence of the manufacturing costs. Strategic cost drivers are alternatives that, explained later in this chapter, would assist to understand cost behaviour. Also, direct labour cost represents only 4 %, yet it is being used as a basis of allocating costs. Thus the potential for misquoting in various products is quite great.

Since the early 1990s, dynamic factors have reshaped the Egyptian competitive marketplace. More than ever before, the company must seeking a competitive advantage in order to survive. To remain competitive in the domestic and world markets, the company must continually improve its activities and business processes. As the company failed to reduce costs as rapidly as its competitors, it found its profit margins squeezed and its existence threatened. An efficient cost accounting system would one assist management to highlight areas that need to improve such as suppliers and scheduling. The company must learn to be proactive in the way it manages costs. It must seek to potential opportunities across the entire value chain to reduce costs.

This chapter aims at answer the following questions posed on page 95 within the context of the El-Nasr Company:

- what are the implications of the Case Company's contemporary manufacturing environment to cost accounting systems?
- How can the company control its costs in an increasingly complex technological environment?

- what is the extent of consistency between the CASs and the other operating systems, such as production planning and control, at the company?; and
- how it might be developed to support organisational strategic cost control in the new manufacturing environment?.

## 9.1 The Implications of the Company's Contemporary Manufacturing Environment to CAS:

The current CAS developed by El-Nasr Company to serve two purposes. Firstly, product costing for inventory valuation, pricing decisions, and profitability determination. Secondly, providing information for controlling costs using OMAC system.

The product costing system, as explained in Chapter Six, is based on arbitrary allocation procedures. This system was established under conditions of monopoly, low level manufacturing technology and limited information technology. In the absence of competition, lack of knowledge of accurate product costs may not be critical to profit maximisation because the company's monopoly position would not require information to minimise product costs. As long as the company could pass on inefficiencies to the customers in higher prices, there was limited incentive to reduce costs. The second condition under which product costing information would be adequate is when the company's manufacturing processes were largely labour intensive, particularly in the assembly plants, product costing do not present much unrealistic information. Finally, when information technology was limited, development of an integrated CAS would not be cost effective, i.e. the benefits drived from better cost information would not be worth the cost of system development and maintenance at that time.

Major changes, explained in Chapter Seven, in all of these operating conditions in the contemporary manufacturing environment have made the product costing system less relevant. The company committed to continuous development of its products by providing innovative designs. The strong competition has forced it to produce higher quality products in relatively shorter time periods. It developed its capabilities in order to effectively compete in the marketplace. For example, it invested in advanced manufacturing technology as NC and CNC machines and in information technology as OMAC system.

These changes impacted on the CASs in many aspects: changing production cost structure; controlling for manufacturing resources become more significant; associating product costing with a product life-cycle; and increasing the importance of strategic cost reduction.

## 9.2 Controlling Costs in an Increasingly Complex Technological Environment

The new manufacturing environment of El-Nasr Co. is more complicated than formerly, because it has to deal with numerous domestic and foreign vendors who are supplying materials and parts; is diversifying products and models, each of which consists of thousands of parts; and establishing several decentralised stores. The new manufacturing environment has two serious consequences: Firstly, the cost structure changed, while both materials and parts' costs and overhead costs have increased, direct labour cost has diminished, because of the gradual trend towards increasing local manufacturing content and using advanced automation in the production process. Secondly, controlling the cost of materials, parts and overhead costs has become more difficult and significant.

In such an environment, product volumes are unpredictable because of the relative competitiveness of product markets. The production process has more variability in its materials flow, it has complex product flows, varying rates of resource usage, and many inventory control points. This variability makes it necessary to track physical flows or stocks on an ongoing basis for materials management or production planning. The same variability makes it necessary to track costs and variances at each stage of the process. As a result, the company has installed a computerised integrated system to control and regulate the flow of materials and components on production lines, and to control its manufacturing resources.

## 9.3 Consistency Between the CAS and the Other Operating Systems

The OMAC system is fully integrated, with a common set of information, entered at once and accessible to all, controlling manufacturing resources and supporting decision making. OMAC can support factual global-based decision making across a wide range of organisational activities. OMAC system resides on PC networks, and depends on data down loaded from networks. This system requires that data and information be transferred to it from numerous existing software packages such as the general ledger, bills of material, production scheduling, engineering, MRP, factory floor labour , and sales and customer systems.

The integrated reporting environment demands much greater and more frequent data and information exchanges between cost system and other systems. The flow from cost system back to other systems reflects the greater integration of cost information into the company's ongoing reporting systems. In the integrated system these exchanges take a very short time not just monthly or weekly or daily but also on time. Thus, the OMAC system allows flexibility because it responds to changes in manufacturing environment. It is characterised by on-line interactive processing in which system processing flow is in terms the user can readily understand.

Although OMAC system has achieved some improvements, it still suffers from some shortcomings. One of the obvious difficulties in using the OMAC system for control at El-Nasr company is the essential assumption that, at planning time, the stored product data does reflect the true situation, not only for what material is available and how much but also concerning lead times, price, supplier etc., for all parts in a product structure. If the material planning process could not be based on this assumption, computerised materials planning would be largely nonsense. At El-Nasr Company, this dilemma is largely suppressed. As the computer program is ready to calculate order release dates, the computer cannot identify, for example, reliable and less reliable lead times or whether a reported stores level is correct or not. The effect, as shown in Chapter Five, is occasional great difference between planned and actual delivery dates of material. The computer system as an integrated part of the decision process at El-Nasr Company by providing the required information on time therefore does not provide reliable guidance for production management. It accordingly cannot contribute to improve the customer's service.

It was thus observed that the production management at El-Nasr Co. has a tendency to ignore the fundamental nature of many of the obstacles to production. Instead of regarding them as characteristics of Egyptian industry, obstructing the effective use of computerised control, there is a conception that the influence of the obstacles can be removed or eliminated by the computer systems. This means no consideration is given to external constraints such as suppliers' reliability, foreign currency shortage etc. but production at the company is regarded as a closed sub-system, constrained only by internal uncertainty such as machines' reliability. We can therefore say that the computerised OMAC system seems to work well when it deals with constraints rather than situations largely because the situations assumed by the computer system in question are mostly irrelevant and inadequate for El-Nasr Co.

Furthermore, OMAC is a complex and detailed system to collect, track, and report information which may not be necessary. The elaborate tracking of labour and reporting of labour variances is in vain, costly, and not needed, because the percentage of direct labour costs to the total manufacturing cost is dropping rapidly. As shown in Chapter Six, it has been reduced from 6% in 1987/88 to nearly 4 % in 1996/97. In the OMAC production control system, keeping track of labour hours is easy because detailed labour information is required by the shop floor control system. In order to keep track of the progress of the planned production schedule, it is necessary to report the completion of each detailed job step with the product routing. The labour costs, machine costs, and set-up costs are entered at that time.

Undoubtedly, shrinking the direct labour cost to only around 4 % makes it that this kind of detailed shop floor control is not required, making it also unnecessary to engage in the non-value added and fruitless activity of tracking and recording all that detailed information. If tracking the production steps and detailed labour hours on the shop floor is unnecessary, then it is further unnecessary to maintain a work order-style of production control. The abandonment of labour reporting and work order control goes a long way towards significant reductions in overheads within the production plant. The company consumes much more time and effort keeping the production systems going. The elaborate planning, tracking, recording, correcting, re-routing, rescheduling, and monitoring that goes into a production planning system is not required for modern manufacturing.

As the company's environment has changed, its strategies and structured have evolved. Therefore, CAS needs to develop to provide information relevant to the current environment. Cost management information is currently viewed from a strategic perspective.

### 9.4 Importance of Strategic Control for Cost Reduction

In spite of the company exercising control, through OMAC, over its costs on the production line directly, it has little control over many upstream supplier costs. The company has to pay special attention to materials and components which represent over 89% of its costs (including inward shipping costs and duty). Overhead costs, including direct and indirect wages constitute only around 11% of the manufacturing costs. The accounting system has been kept simple on the grounds that, whilst accuracy is desired, overheads only constitute a small percentage of total product cost (around 6%). A 1% cut in materials/components has nearly 18 times (89% / 5%) the effect of a cut in direct labour cost and well over 8 times (89% / 11%) the effect of a 1 % cut in overhead/labour costs, even when taken together; managing supply chain costs has consequently become the most critical element in overall cost control.

The focus on the strategic cost control viewpoint appears to reflect a greater concern with influencing cost behaviour, rather than with ensuring that cost information is as precise as possible. For El-Nasr Co., as we have seen in Chapter Six, the emphasis in respect to overhead allocation is on simplicity, it would be suggested that using a sophisticated system like activity-based costing is unnecessarily complicated for an overhead cost component of only 6 % of total product cost. However, as detailed, overhead allocation systems were generally based on conventional direct labour basis. However, the company requires amendment in its cost system not only in using a more realistic and acceptable basis such as a material basis to allocate overhead cost, but also in adopting a broader strategic viewpoint, even where this might entail some loss of precision in product cost information. Precision of product costs have become of less significance to pricing decisions in recent years. The reason for this is that increasing competition and uncertainty in markets have made the prices of a wider range of products more market-driven than cost driven. Consequently, there is now significant change in the way that products are marketed. This change in emphasis has led to significant competitive pressures for the company. The company would be much more concerned about market share. El-Nasr Co. would rather seek progress through more positive, more sustainable opportunities of active cost reduction in order to give it a competitive advantage and to enhance profitability.

The company should focus almost exclusively on controlling up-stream suppliers costs, as these represent over 89% of total manufacturing costs. Strategic cost control viewpoint would provide the essential focal point co-ordinating all cost reduction efforts not only for El-Nasr Co.'s internal departments but also for suppliers. Supplier cost controls must form a central and integrated part of any realistic costing system.

### 9.4.1 Analysis of Strategic Cost Drivers at the Case Company

Redesigning the current CAS requires drop the level of analysis to organisational activities which cause costs (e.g. cost drivers) from its current emphasis on incurred costs. In the case of El-Nasr Co., it is facing many activities that do not add value to the company but generate costs. Figure (9-1) shows the causal effects of the non-value-added activities on the ultimate goal of the company. The source of these non-added-value activities is uncertainty and failure of the internal control systems to solve all manufacturing problems facing the company. The need for timely supply of materials leads back to the manufacturing resource planning. Difficulty in predicting situations and events that cause deviations from this planning is a major problem. Such events are of an external as well as internal nature and the situations may occur inside as well as outside the company: transportation capacity becomes insufficient, money transfer to a foreign supplier is suddenly stopped, priority in the allocation of foreign currency is changed etc.

The uncertainty in planning caused by these external events and situations has its parallel also in internal events and situations: unreliable reporting procedures create in themselves uncertainty about, for example, actual inventory levels and production capacity. Two main types of uncertainty, resulting from both internal and external environments of the company, are discussed in detail below.

#### 9.4.1.1 External Uncertainty

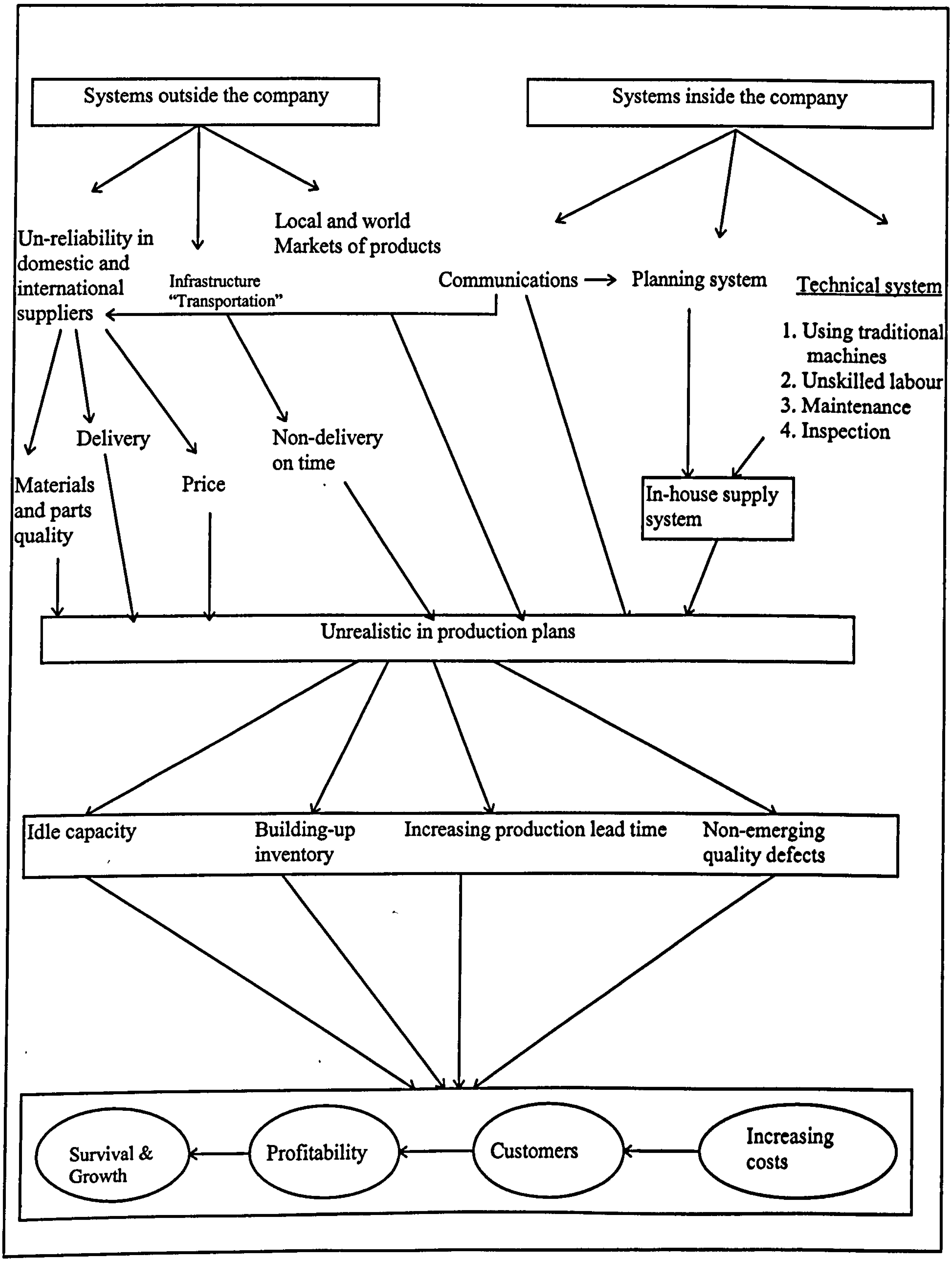
The major source of uncertainty of production for the case company is its environment. The external environment comprises three components: Product Market, Financial Market, Resource market or suppliers. However, as for El-Nasr Co., the situation has changed in the old environment from the new one.

##### 9.4.1.1.1 Product Market

In the old environment, what was produced was sold. Therefore market demand was in practice predictable, since import restriction (quotas, duties etc.) had in practice created a monopolistic market situation for El-Nasr Co. Manufacturing resources requirements could therefore in practice be determined for an equally long period.

Figure (9-1)

Causal effects of the manufacturing variables on costs and profitability at the company



Today, changes have happened in the product market particularly under the new economic policy in Egypt. Competition has become very strong as new competitors have been entering the market as illustrated in Chapter Four. Therefore, uncertainty has become high, that increases planning and control problems. Thus, it requires a high degree of information processing.

#### 9.4.1.1.2 Resource Market (Suppliers)

Resource market means availability of materials and equipment by suppliers. Due to uncertainties in the supplier system, as explained in Chapter Five, which here also includes own fabrication, the planning problem persists. The constrained currency situation led to a delayed renewing of machines and equipment as well as to forced limitation of materials import. Also, uncertainty resulting from local suppliers. Difficulties are in meeting production targets in terms of delivery dates and quality standards explained in Chapter Five.

#### 9.4.1.1.3 Finance Market

In the old environment, finance market was restricted and the company obtained its requirements from hard currency from the state. Requirements planning for import is, however, subjected to hard currency shortage. Because the currency situation fluctuates, the allocation of hard currency to the company is not fixed but a new application for currency is submitted for every production period. Uncertainty in the finance market resulted from a chronically insufficient and irregular supply of hard currency. As a matter of fact, in developing countries such as Egypt financial and also infrastructure constraints made the planning problems of the industry even more difficult.

At present, the Government has restructured a finance market and has relatively lifted its hands from most companies. Companies have faced another problem, that is they have to obtain hard currency at a real exchange rate from a free market instead at a formal one supported by the state. This situation affected the liquidity situation at the company and led to raising the production costs (see Appendix B).

#### 9.4.1.2 Internal Uncertainty

The company encountered another type of uncertainty resulting from the internal environment of the company. It results from weakness of such internal systems as the technical system including planning, traditional machines, unskilled labour, maintenance, inspection.

As already noted, the decision for in-house production is based (primarily) on expected capacity. The relatively high rate of production disturbances such as machine breakdowns, electricity failures etc., make these capacity assumptions hazardous. Even though many machine centres are equipped with similar machines, the total utilisation of around 58% means that on average only one out of two machines is available. To this can also be added the reduced flexibility due to missing or inadequate machine tools. In line productions, like at El-Nasr Company where machines are interrelated to each other so that the output of one feeds another, machine availability is particularly important. Interdependency between machines reduces the availability of the line (even though availability of individual machines may be high) and leads to uncertainty in the technical system. Even for reasonably small risks of machine failures the total risk becomes significant as long as jobs cannot be re-routed to other machines. Expected available capacity as a decision parameter for in-house production therefore seems a too simple criterion as long as this relatively great risk for disturbance is not included. With the current machine maintenance approach, which is primarily ad hoc, no significant improvement in machine reliability can be anticipated. A maintenance program with more focus on preventive maintenance would be an alternative.

Emergency maintenance at El-Nasr Co. involves repair of a machine that is already down or malfunctioning, whereas planned repair involves maintenance related to, for instance, the installations of new machines. In El-Nasr Co., emergency maintenance represents around 78% of all maintenance orders and repair activities. It is stated by the maintenance engineer in Parts Fabricating Plant that:

> It was difficult to implement production plans and schedules to meet the market demands because no one knew when the machine would break or stop. Emergency repairs were 70-80% of maintenance work. The sudden stoppage of one machine may result in the stoppage of a complete production line or even the whole factory (Interview, August, 1998).

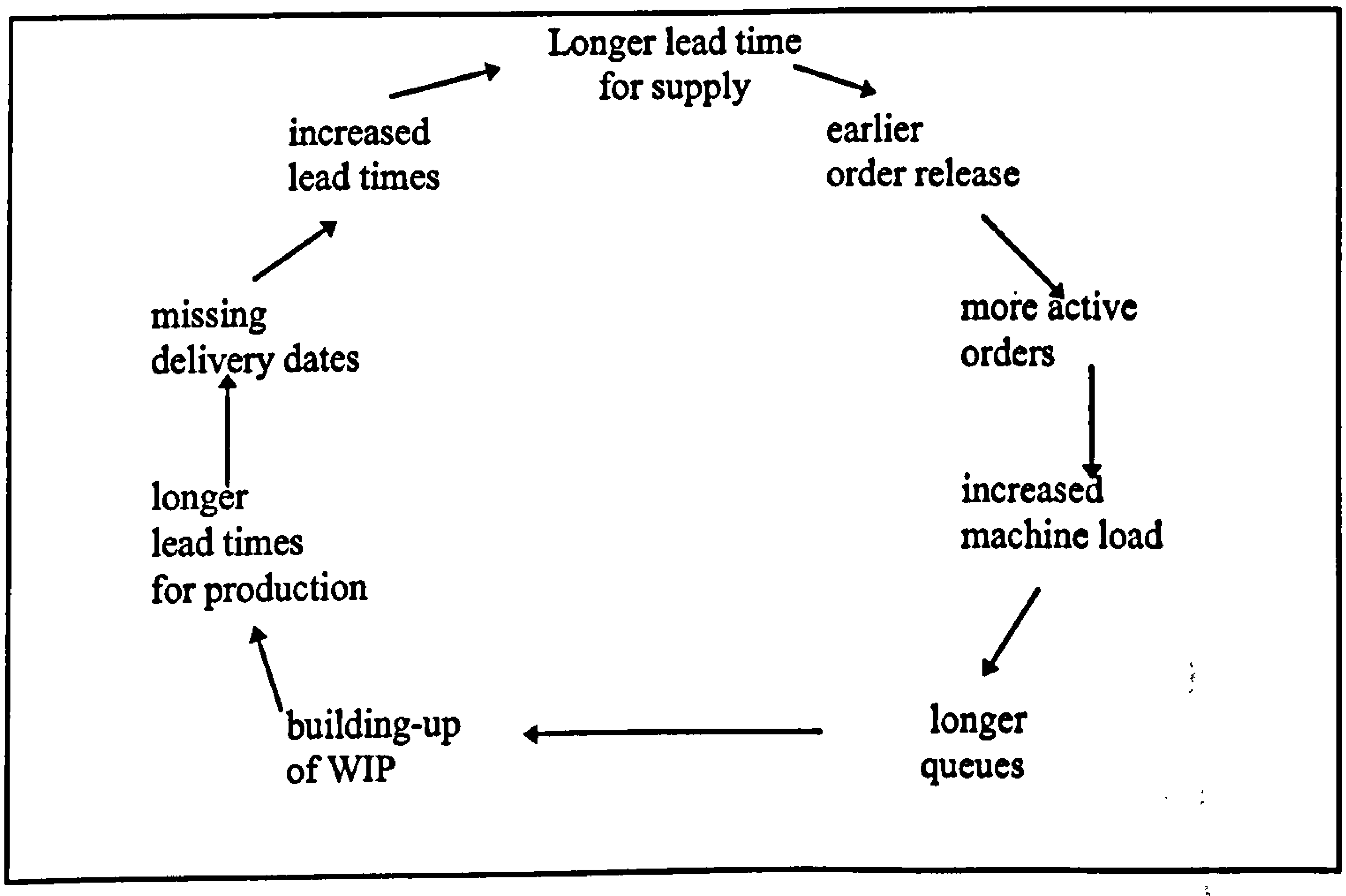
However in-house production of spare parts is a strategy recently introduced at El-Nasr Co. to overcome the negative effects of currency constraints and to improve the maintenance situation. The researcher, however, suggests that the improvement of machine availability through preventive maintenance could have a significant impact, not only on maintenance costs but also on total production capacity. Furthermore, reliability of the machinery system was increased by replacing computerised numerical control machines (CNC) for some traditional machines. But still the company holds many traditional machines in the fabricated factories. Also, there are many production lines which are not fully automated in the assembly plants.

#### 9.4.1.2.1 Consequences of Uncertainty on Lead Time

Lead times may be of two kinds: purchase and manufacturing lead times. Standards for lead times used in material requirements planning are usually held in the bill of material for each item, and used to determine at what period an order must be released in order to meet the requirement date. For purchase orders lead times are based on statistical data and suppliers' commitments, for in-house manufactured items lead times are stored in the routing specifications. Lead times are made up of several time elements such as currency remittance, transportation and customs clearance for purchased items, tool set-up and machine time as well as inter-operation time for in-house manufactured items. Whether lead times for item ordering are realistic or not, they affect the requirements planning. If planning lead time is too short, a purchase order or a shop order is released too late and the number of stock outs increases. If planning lead time is too long, a shop order is released too early and the result is increased work-in-process with increased planning problems on the shop floor. Uncertainty, both external and internal, manifests itself as deviations from planning lead times occur. At El-Nasr company, this uncertainty appears in both purchase and in-house production. At the company, disturbances influence all three sources of supply. Figure ( 9-2) explains this situation.

Figure (9-2)

A cause/effect analysis for too early order release at the company




The difficulty in predicting the future at El-Nasr Co. has a tendency to make cause/effect understanding needed, which may assist to reduce uncertainty. In production planning this means that for vital planning parameters such as lead times there is little correlation between the planned and the actual situation. The ideal situation would occur if lead times for material supply, which vary depending on type of material and source of supply, were fixed and known beforehand. Release time for a shop order for in-house production or for a purchase order would then be calculated simply by subtracting the actual lead times from the start of the first assembly operation. However, uncertainty causes varying lead times. This uncertainty can be partly compensated with a temporary storage, used as a planning buffer, before assembly starts. Too much variation, however, causes substantial planning difficulties.

Figure ( 9-3)

Ranking lead times by sources of material supply

| Source of supply | Lead time |
|---|---|
| Local supply | Long |
| Foreign supply | Long |
| In-house manufacturing | Medium to Long |

All the different fabrication lead times are established in relation to due-dates for assembly operations. However, if one lead time fails (also after uncertainty compensation), assembly operations are delayed. An alternative approach is being discussed at El-Nasr Co., where not due date but rather the starting date for the longest lead time determines the planning. In concentrating the planning on those parts which have the longest lead times, less attention is needed for the other parts which are likely to be finished in due time, even ahead of time. However, this situation easily results in too many work orders on the shop floor, with increased planning difficulties as a consequence as indicated in figure ( 9-1) above.

## 9.5 Summary

Analysing the company's current situation in this chapter revealed that the problems faced by this company can be traced to increased uncertainty and complexity in its manufacturing environment. Increased complexity and uncertainty, by its nature, require improved and expanded information flows to support it. The current cost control system tends to be based on the ways of performing existing activities are not reviewed. Global variances, through OMAC system, by functions and work centres can not be relied on to track complex factors which drive costs.

This study highlights the fact that insights that emerge from the strategic cost analysis are different from and better than the insights available from the current cost accounting systems adopted by the Case Company. The company must pay more attention to how does it manage costs than concentration on allocating and controlling costs which are based on non-reviewed existing activities. This requires a broad focus on supply and/or value chain. This focus is external to the company which can be viewed in the context of the overall chain of value-creating activities of which it is only a part, from raw material to en-use customers. In contrast, the company's current system adopts a narrow perspective that is largely internal to the company. This narrow perspective made the company overlooked the bad consequences that its scheduling changes had on its suppliers' costs. Although the company has attempted to develop a sustainable competitive advantage through tight cost control and providing novel product designs, it still suffers from financial difficulties. The current cost accounting systems are responsible for this failure because they did not highlight areas which need to improve. A failure to adopt a value chain perspective doomed this major effort to failure; ignorance of supply chain cost analysis concepts on the part of the company's CAS proved very costly.

Consequently, breaking down the chain into strategically relevant activities will be helpful to understand the major cost drivers and the sources of differentiation. The company is only one part of the larger set of activities in the value delivery system. Suppliers, for example, not only produce and deliver inputs used in the company's value activities, but they importantly influence the company's cost or differentiation position as well.

# Developing the Cost Accounting System,

# Conclusions and Recommendations

## 10.1 Introduction

The proposed developing is based on suggesting some solutions or improvements to overcome the shortcomings in the Company's current cost accounting system. The improvements include both cost control process and strategic cost reduction.

### 10.1.1 Towards Improving Cost Control For Developing Cost Accounting System

Although the current company system has already improved the shop floor control through increasing effectiveness of the information processed, it does not provide great improvements in cost control techniques. Uncertainty resulting from the internal environment could be reduced by improving cost control process. El-Nasr Co. should seriously consider the opportunities for improved budgeting and cost control offered by the current sophisticated production and control system. Such systems as OMAC made possible by high speed data processing, emphasize large volume of data and rapid updating of information that could reduce internal uncertainty. There is commonality of data as computer data files are available to all users at the company. The challenge is how to use this advantage to improve budgeting and cost control functions.

The output of MRP sub-system is a forecast of the physical status of specific products which are planned to be in varying stages of completion plus the forecasted level of raw materials at various points in time. Thus, aggregating the individual product forecasts provides us with the opportunity to forecast standard cost of goods sold, work-in-process, and raw material inventory directly from production schedules where a standard cost system is in use.

Utilizing the MRP sub-system as a budget generating device would not only provide more accurate predictive capability than the current approach, but would also provide the discipline necessary to ensure that continuous review would depend more on computer system prompting than human prompting. An inventory addition (including in-process and finished goods) and cost of goods sold budget could be generated periodically by the MRP system. This budget would be based on the forecasted production schedule with specified completion dates plus standard costs and would provide management with a reliable preview of the investment in inventories and cost of sales at numerous points in the future.

#### 10.1.1.1 Budgetary Process

As explained in Chapter Six, the main objective of budgetary process at El-Nasr Co. is to match the targets or standards and to compare results between years and among companies as well. Budgets are prepared based on past experience rather than trend analysis or percentage of sales. At the company, in the short-term budget - planning process the following sub-budgets are prepared:

1. Production budget
2. Sales budget
3. Parts and materials budget
4. Manpower and wages budget
5. Capital budget
6. Cash budget

These six sub-budgets formulate the current period planning process and become the annual corporate budget. The production and sales budgets or plans are the centre of the current period planning process. The plans determine the planned or estimated profit based on the actual results of the previous year, and the estimated volumes and prices of car models in the coming year. In a formula:

| |
|---|
| Total planned contribution margin = The sum of contribution margin per unit of each car model i of the previous year x estimated sales volume of the car model i |

The actual cost numbers of the previous year are used as a cost base for comparison to the coming year. Planned costs of parts and materials provide the targets to achieve for the purchasing department. The manpower and wages budget provides targets for direct and indirect labour.

What is proposed is to adapt the expected uncertainty that leads to increasing cost by using the high predictable capabilities of production schedule and material requirements planning. As materials and parts constitute a high percentage of total cost as explained in Chapter Six, it should distinguish between variable and fixed costs for control purposes.

The sales forecast for the year turns into budgeted operating profit through the following process, as illustrated in Figure ( 9-4).

Figure (9-4)

Planning the Budgeted Operating Profit

| Budget / Plan | | Budgeted Operating Profit |
|---|---|---|
| Production budget & Sales budget → | | Sales forecast |
| Parts and materials budget<br>MRP budget → | (-)<br><br>(-) | Estimated or standard variable costs<br>Uncertain budgeted contribution margin<br>Expected changes in variable costs |
| Manpower &<br>Wages budget →<br>Capital budget | <br>(-) | Certain budgeted contribution margin<br>Estimated fixed costs |
| | | Budgeted operating profit |

As illustrated above that in the current company system, the actual production cost per car of the previous year serves as the cost base of the current year. Achievement ratio is determined from this base figure. This measure is used to identify what is achieved in the current year not to use as a target achievement ratio. Total cost base of the current period is calculated as follows:

| |
|---|
| Total cost base of the current period = |
| Current cost base per car x Actual production quantity of the period |

The production quantity of the month, which is used in the above formula, represents the converted quantity for a typical car model as illustrated in chapter five. In order to identify the efficiency of the predicted planning capabilities independent from the efficiency of the execution departments, the researcher proposes to distinguish between two classes of variances:

(1) Planning variances

(2) Execution variances

While, planning variances measure the capability of precisely predicting and planning manufacturing requirements including materials, parts, capacity, manpower etc., execution variances measure the actual achievement of different departments at the company.

This separation will be of benefit in reviewing the planning process and reducing uncertainty resulting from the internal environment of the company. It also assists to identify the real achievement of persons on the shop floor and its motivational reflections on their morale. Table (9-1) shows proposed format of the efficiency reports.

Table (9-1)

Proposed format of cost reports

| Department | Variances resulting from Internal Efficiency Factors | | Variances resulting from External Suppliers |
|---|---|---|---|
| | Planning Efficiency | Execution Efficiency | |
| 1. Fabrication<br>2. Assembly<br>3. purchasing<br>4. marketing<br>5. inspection | | | |

The first phase of the suggested model, discussed above, deals with how the company can benefit from the OMAC facilities, particularly MRP system, to overcome internal uncertainty and improve cost control process. The second phase in the proposed improvement pertains to guide the company to change into JIT through which it can develop the current company's system to adapt uncertainty resulting from the external environment aiming to reduce costs strategically.

### 10.1.2 Opportunities of Cost reduction For Developing Cost Accounting System

As mentioned in Chapter Nine, the major source of uncertainty of production for the El-Nasr Co. is its external environment. The external environment comprises three components: Financial market, Product market, and Resource market. Implications of both product and supply markets and potential improvement opportunities in the cost accounting system will be explored below.

Changing the competitive environment of the company forced it to enact a competitive manufacturing strategy to meet its customers' expectations as explained in Chapter Five. Customers' expectations for the quality, reliability and durability of products are continuously changing. This was clearer in passenger cars than in commercial vehicles. The company attempted to develop its capabilities that might enable it to effectively compete in the product market place. For example, the company used such advanced manufacturing technology as CNC machine tools which enabled it to design and produce different models of cars in a flexible manner, and developed information production technology OMAC system in order to respond to customers' expectations as quickly as possible.

Although the company developed some of its capabilities, it could not capture a competitive advantage in the market place. Moreover, it still suffers from problems in quality, delivery and idle capacity as illustrated in Chapter Five. Most of these problems are caused by suppliers and market demand. These problems led to a drop in the company's market share and weakened its competitive position accordingly.

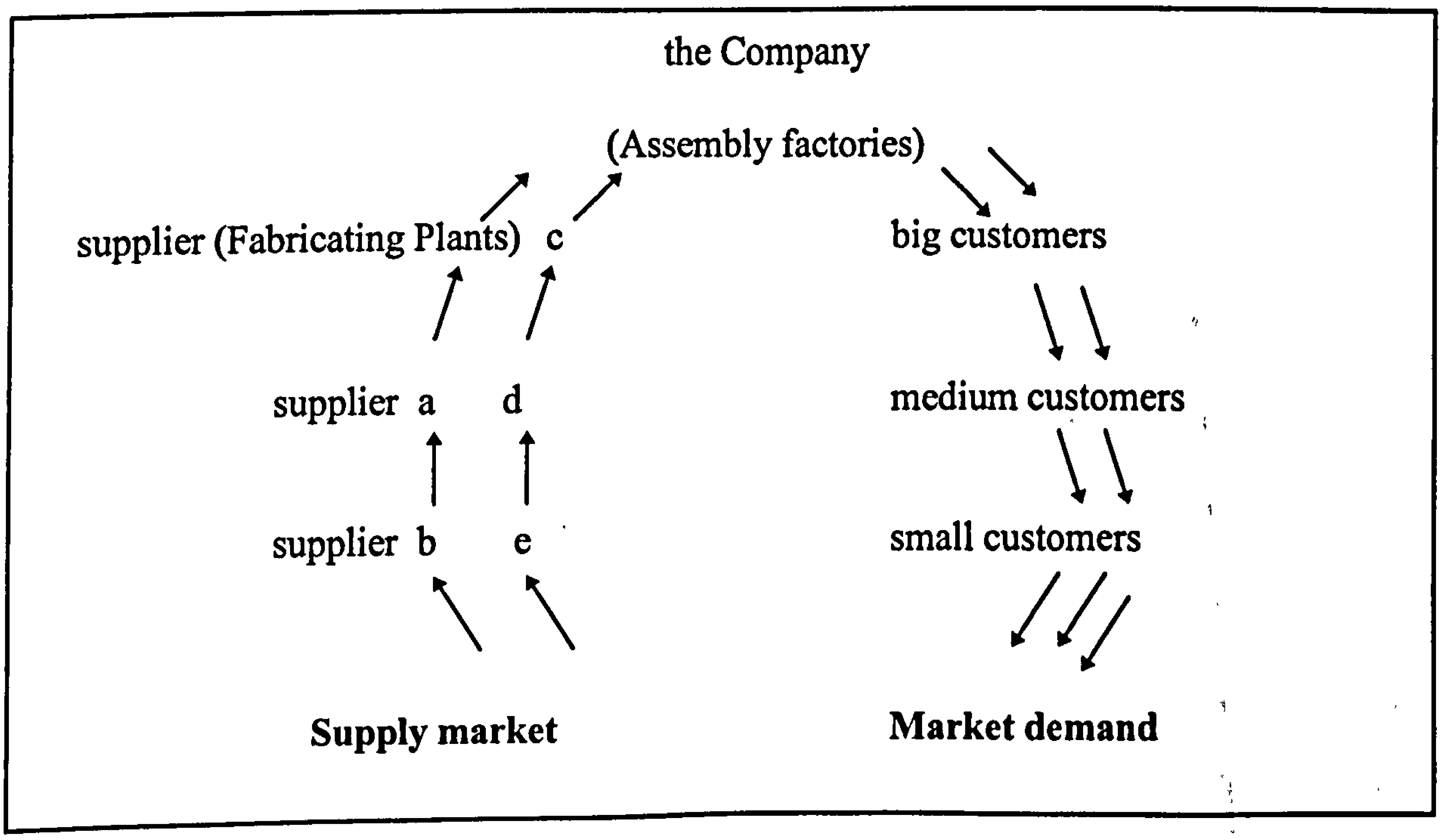
As a cost accounting system is a part of the organisation, it should be consistent with the changes in its environment. The cost accounting system should support the company's strategy to achieve competitive advantage through improving the processes of cost control and cost reduction. A strategic cost control process should highlight the areas which need support under the new concentration in the company's strategy.

Idle production capacity is one of the most serious problems to which management should direct attention. The external environment, both product market and supply market, is the major sources of this problem. The question is how the company adapts to the changes in the external environment. Developing a cost accounting system in this phase is through exploring the potential opportunities for cost reduction as will be explained below. Figure (9-5) explains the parties of the current environment of the company along the supply chain. These parties are:

- the company's fabricating plants are suppliers for its assembly factories;
- different classes of independent suppliers, a, b, c, etc.;
- different classes of final customers.

Figure (9-5)

Supply chain of the company



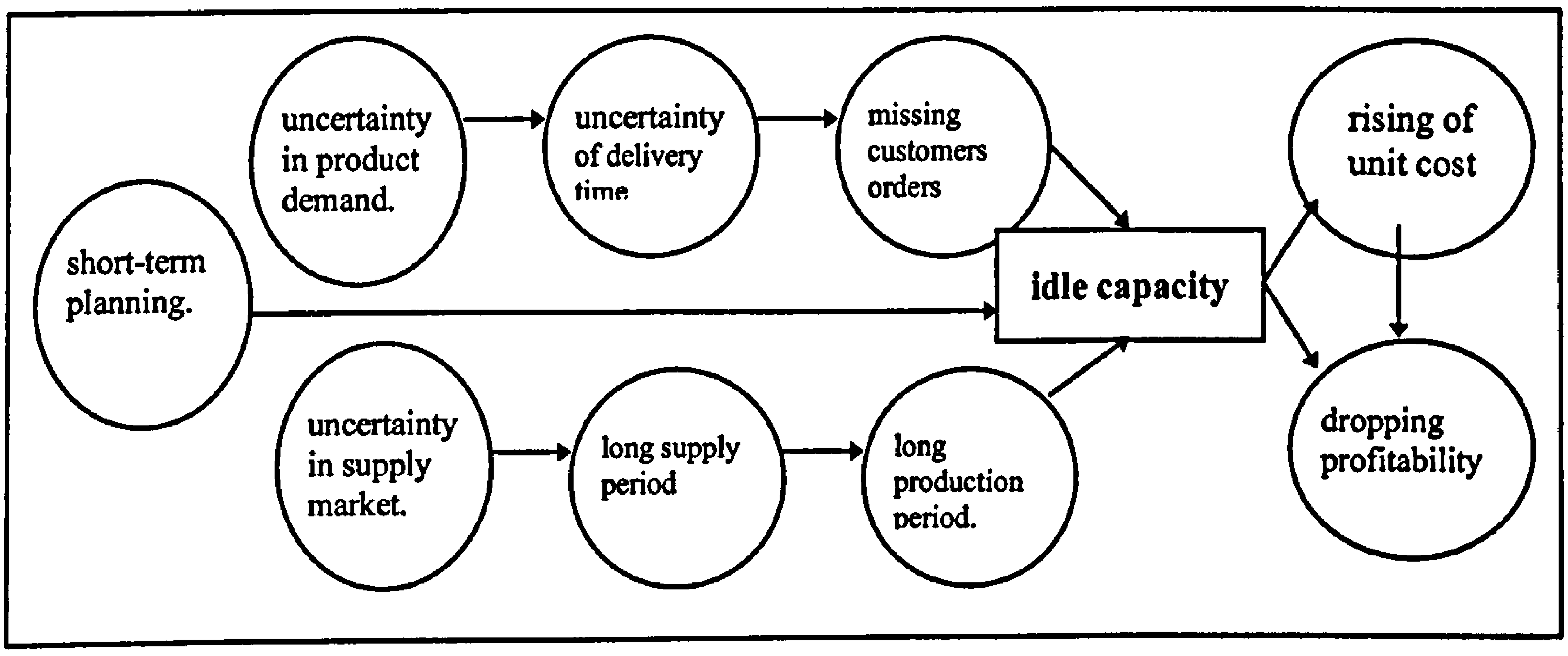

The idle production capacity resulted from uncertainty in the market place. Uncertainty caused by the supply market resulted from long lead time of supply, while uncertainty driven by market demand resulted from shortening the product life cycle and the continuous changing in the customers tests and in designing product models.

Idle production capacity resulted also from short-term planning and inability of the traditional machines to adapt to the quick change in the demand and transferring from one product to another as explained in figure (9-6). The company plans its product portfolio which, in turn, determines the installed capacity for each resource. Providing long-range capacity means making production facilities available. Many capacity resources impose constraints; capacity once installed cannot be increased in the short run, particularly when investments are authorised by a local authority as in this case, which takes a long time. Also, resources such as specialised machines impose capacity constraints. The more capital intensive or even automated the process, the more constraints exist on a facility's ability to be flexible in the range and degree of complexity of products it can make. Capacity levels may temporarily be increased in periods of shortage, but it may be more expensive than acquiring capacity at the time of capacity planning.

Capacity planning plays a significant role to determine the level on which fixed costs are. Long-term capacity planning means higher levels of committed investments and fixed costs. A product's full cost is a measure of its long-run manufacturing cost, because it includes allocations of fixed costs associated with capacity resources. Assigning costs of capacity resources to products can used for capacity planning. Hence, full cost is viewed as an appropriate basis for deciding whether a product should be included in the company's product portfolio, and how much capacity should be installed to manufacture the product. With shorter product life cycle, there is an increasing need to understand the total product cost over its entire life cycle to determine profitability. Reduced product life has significant effects on costs to recover product/process fixed costs.

Figure (9-6)

Cost drivers throughout supply chain at the company

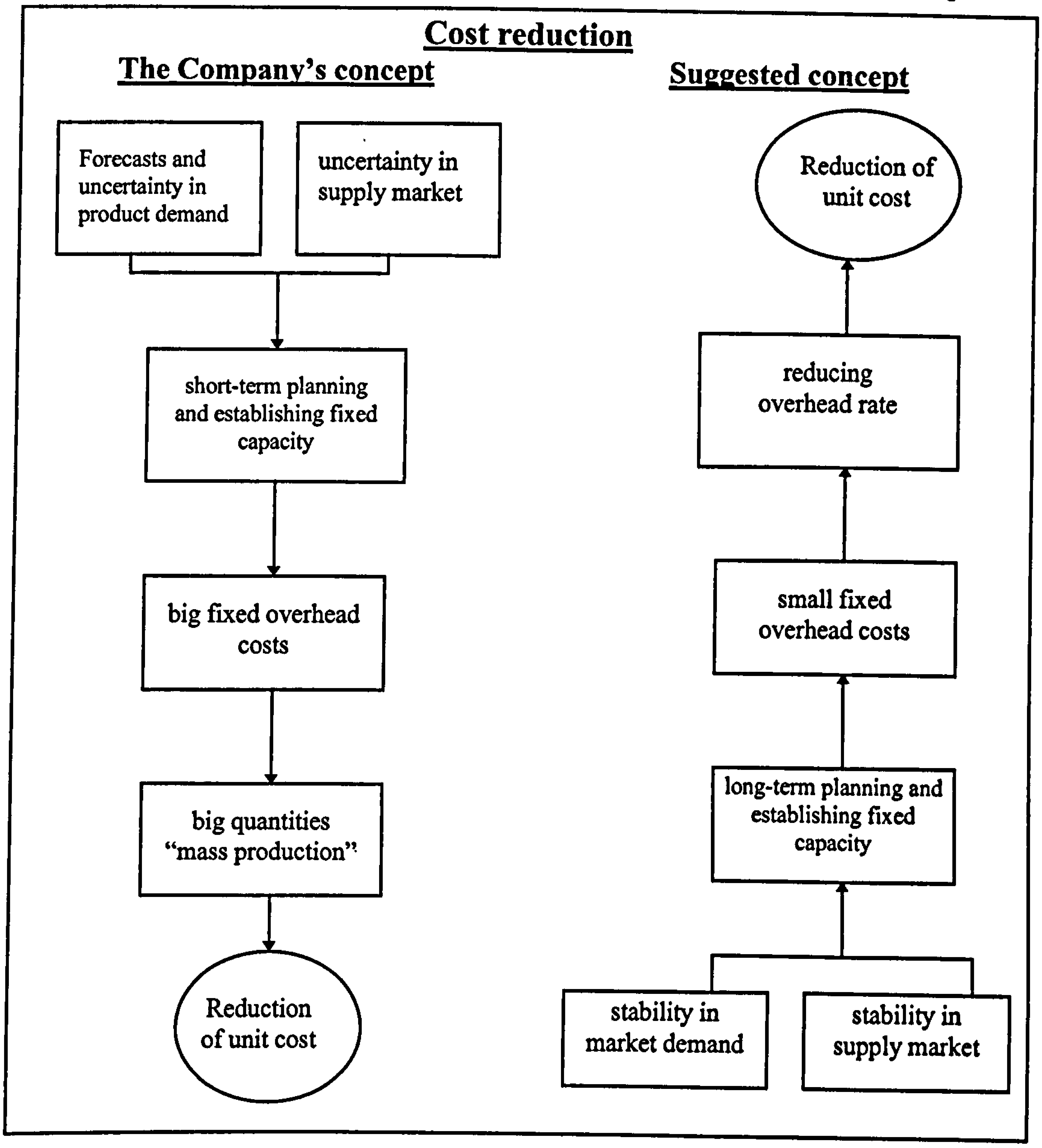



Reducing the idle production capacity will lead to the company avoiding the cost of non-value added activity and to decrease the overhead rate formula because of the potential reduction in the fixed costs in the nominator of the formula and also to decrease the level of capacity on which overhead rate is built in the denominator of the formula.

This suggested concept is in line with the policy of reducing the production volume for the purpose of diversification in the production and transferring from one product to another. In contrast, the traditional concept is based on establishing fixed capacity and cost firstly, then manufacturing mass production to spread the significant fixed costs on the greatest quantity of units produced in order to reduce the unit cost as shown in figure (9-7).

Figure (9-7)

Cost reduction under both the company's concept and suggested concept




The suggested concept is in line with the new manufacturing environment. It is based on the spread of a small amount of overheads on small quantities of units. Therefore, when a product life cycle is short, it could transfer from one product to another easily. Also, the reduction in unit cost is true because it is based on reduction in both total production quantity and total fixed costs. In contrast, the traditional concept led to building up inventories. Under this concept, the reduction in unit cost is not true because it resulted from increase in both total production quantity and fixed costs. Stability in both demand market and supply market is very important to implement the suggested concept for cost reduction. Linkages between the case company and both customers and suppliers are significant to achieve this stability. This mean that the environment will be restricted in three parties only:

- the company
- big superior supplier(s)
- big customer(s)

With this relationship, the company can guarantee stability and reducing costs. In this environment, cost accounting would be based on a car model because every model has its own short life cycle then a new generation of a product starts with a new cost by simple or significant engineering changes. Therefore, each car model has its own cost cycle by agreement or contract between the chain parties (the company, supplier, and customer) on which selling price will be based.

The next section will discuss how interrelationships can reduce uncertainty in the external environment and thus reduce costs as well.

#### 10.1.2.1 Interrelationships With Customers

The company, in this case, faced uncertain product demand at the time of capacity planning; it faced competition in its product market; it cannot use the excess capacity to produce inventory in anticipation of future demand because it has overstocked and it did not face any capacity constraints. Uncertainty in the product market, particularly with shortening the products' life and the continuous changing in a product's models, leads to unstable demand and thus non-constant sales volumes. With non-constant demand, the company faced problems in the coming years following capacity acquisition. This is because manufacturing resource planning is based on the prediction of sales volumes in the long-run. Therefore, capacity planning and fixed costs, associated with establishing this capacity, are affected by these fluctuations in demand. However, idle production capacity emerged at the company leading to rising unit cost as a result of spreading total fixed costs over the lower number of units produced.

In order to avoid the idle production capacity problem at the company, the demand for each product should be constant and identical for each period over the planning horizon i.e. it should be known at the time of capacity planning. In this way, the actual fixed overhead cost per unit of the product's model will not vary, depending on its constant sales volume. Therefore, selling price may cover total fixed costs.

The existing Long-term relationships between the company and its customers should be maintained and new ones should be established, particularly big profitable customers. Consider the market share of the company during five years in Table (9-2) The El-Nasr Co. was established basically to supply the needs of the Government institutions including public sector, agencies, services, companies, which constituted 63.74% of the company's sales in 1991/92. Corporate Organisation of Transport Services (COTS) mainly, the major customer of the company. Also, the company aimed to satisfy the requirements of the rest of the state sectors as well as its concerned companies and individuals. The close link between the El-Nasr Co. (the producer and seller) and COTS (the buyer and rendering the transport service), was created and certainly existed about forty years ago until now. This trend was assured when the state took the necessary precautions to protect the national industry. The Government protected and encouraged the national industry through purchase from El-Nasr Co. all the requirements of vehicles required by the ex-public sector.

Table (9-2)

The market share of the company

| Products | Total demand | The Company 's Sales | The market of the Company |
|---|---|---|---|
| | (unit) | (unit) | % |
| **Buses** | | | |
| 1992/93 | 2117 | 636 | 30 |
| 1993/94 | 2229 | 707 | 31 |
| 1994/95 | 2346 | 719 | 30 |
| 1995/96 | 2470 | 732 | 29 |
| 1996/97 | 2600 | 546 | 21 |
| **Lorries** | | | |
| 1992/93 | 4316 | 1545 | 35 |
| 1993/94 | 4544 | 1047 | 23 |
| 1994/95 | 4783 | 1009 | 21 |
| 1995/96 | 5035 | 642 | 12 |
| 1996/97 | 5300 | 1064 | 20 |
| **Passenger Cars** | | | |
| 1992/93 | 22995 | 4188 | 18 |
| 1993/94 | 26714 | 4521 | 16 |
| 1994/95 | 39343 | 8259 | 20 |
| 1995/96 | 40376 | 11838 | 29 |
| 1996/97 | 31587 | 11375 | 27 |

(Information Centre at the company, June, 1998).

The ex-public sector, particularly, COTS was the main and basic client that absorbed most of the company production of vehicles except for a little ratio absorbed by other state's sectors such as government agencies, companies and the private sector units. This is indicated as in Table (9-3).

Table (9-3)

The company's sales by customers

| Customer | Market share | |
|---|---|---|
| | 1990/91 | 1991/92 |
| | % | % |
| public sector | 13.60 | 17.65 |
| agencies | 07.35 | 13.00 |
| services | 21.90 | 19.54 |
| companies | 18.11 | 13.55 |
| customers abroad | 09.90 | 21.20 |
| individuals | 11.50 | 05.51 |
| private retailers (distributors) | 17.60 | 09.53 |

(Performance Assignment Reports of the company, 1991/92).

Recently, the company's competitive environment has changed compared with the last ten years. New competitors have entered the Egyptian automotive market in addition to the strong international competition. Also change in the customers' tastes and the manufacturers' target is towards gaining their satisfaction. All these pressures forced the company to try development, modernisation, raising quality level, improving performance and increasing productive capacity.

The company plans to expand its sales of these products to the individuals and enterprises by meeting their expected demands. Nowadays, the company's sales of these products are still concentrated in COTS because of the traditional close relationship between the ex-public sector companies. The company's interviewees feel this product's market is dropping, unless they continue advances into full systems capabilities. Also, the company has an extensive investment in test equipment to conform to the strict tests conditions mandated by its main customer, COTS as a representative of the Egyptian government.

Establishing long-term relationships with big customers, like COTS, will be of benefit in reducing not only costs of decreasing the idle capacity but also costs associated with any customer order such as pricing, scheduling delivery, invoicing, and collecting. Also, there are additional costs of ordering materials and scheduling production for this order. Therefore, customer interrelationship is an important component in a strategic cost reduction.

The implication in this point is if the company wishes to obtain a constant in demand and capacity, it should strive to get sales contracts with the larger customers based on long-term relationships. This will reduce the cost of a produced unit and will improve the company situation.

#### 10.1.2.2 Interrelationships With Suppliers

A large part of JIT is the management of inventories by purchasing raw materials just in time for production, reducing buffer stocks of work in process, and minimising the finished goods inventory. In the existing scenario at El-Nasr Co., JIT approach could be adopted by the company. Four reasons for this are: (1) purchasing of raw materials is negotiated and contracted by the decentralised authority, and deliveries are made in response to order releases issued by the company, (2) the company uses such advanced manufacturing technology as CNC machine tools which enable it to design and produce different models of cars in a flexible manner, in order to respond to customers' expectations as quickly as possible. (3) OMAC can support JIT manufacturing and lot treacability, and (4) the raw materials are delivered for the entire plant in frequent small-size lots, but lead times for delivery are longer than the production schedule and the times are not reducible, as shown in Chapter Five. This is due to unreliability in suppliers and the continuous changes in the company's plans.

JIT purchasing requires stable production schedules to help suppliers plan deliveries and close relationships with suppliers to ensure reliable deliveries.

As has been shown in section 9.1 in this chapter, parts and components cost constitute over 89 % of total manufacturing costs. Development linkages with suppliers take priority of place in this study, particularly because it is one of the essential foundations to implement JIT at the company.

Developing the supplier relationships, recognises the merit in pooling the skills of both El-Nasr Co. and supplier to reduce overall cost, rather than simply restricting relationships to hard bargaining over actual prices. There are hidden costs in frequently switching supplier to take advantage of lower prices. Attempts to reduce wastage and inefficiency within the supply chain, perhaps by systems emphasising quality or accelerated material flows, can only be effective with co-ordination and co-operation between the company and its suppliers.

Make or buy decision is a strategic decision as illustrated in Chapter Eight because it affects other strategic decisions at the company such as the decision of planning and establishing fixed capacity. Therefore, before management takes this serious decision, it should determine which suppliers can achieve competitive advantage in making some items which the company cannot produce themselves currently or in the future. Shifts towards 'supplier development' have been encouraged by technological and competitive pressures leading to greater specialisation among suppliers, and by the inability of manufacturers to maintain all expertise in-house. The shift from making to buying also increases the need to involve suppliers in new product development.

#### 10.1.2.2.1 Advantages of Interrelationships With Suppliers

Positive supplier relationships cannot be ignored, but are seen as cost reduction opportunities. Good and strong relationships may lead to achieving benefits for both a supplier and the Case Company. A supplier which has interrelationships with a buyer in a subcontracting relationship can obtain several benefits from this relationship, depending on the form and type of interrelationships; specialisation as well as on its relative size. The benefits can include: an ability to plan for its long-term production by receiving a steady flow of information from the buyer; achieving a higher degree of specialisation and lowering of costs of products; a stable flow of business to this company; the receipt of technical assistance from the lead companies such as El-Nasr Co., and an introduction to new technology and training of staff; and receiving financial assistance. Supplier companies (linked companies) can also receive assistance concerning managerial know-how, raw material procurement, possibilities for exports and opening of new markets for their products.

El-Nasr Co. as a buyer can obtain such advantages as: a cost-cutting effect as costs of production of an item may be reduced by placing orders with a smaller company for different reasons, e.g. specialisation, lower labour costs, more flexibility. Strong linkages may also enable El-Nasr Co. to adjust production to fluctuations of demand, to become more flexible, and to avoid excess capacity. El-Nasr Co. may become more efficient by subcontracting certain work, by benefiting from specialisation of production, economies of scale, securing alternative sources of supply of a product by using several suppliers for one item. Subcontracting can also assist in overcoming certain problems owing to the limitation of facilities and resources of the company, e.g. high transportation or freight costs, , using skilled workers of the subcontractor, lack of space, etc. There are also some financial advantages that may result to El-Nasr Co. by saving on storage costs, by shifting some of the cost of working capital to suppliers, etc.

For example, good relationships require suppliers to inspect their own components and materials, and guarantee their quality, these procedures completely eliminate non-value-adding costs of incoming inspection, storage, inventory, and materials handling. This will reduce overhead costs and reduce the need for arbitrary procedures of cost allocation and thus improve the precision of product costs. This is because manufacturing and cost problems will be transferred from the company's factories into the suppliers' plants.

#### 10.1.2.2.2 Analysis of the Overall Cost Structure of the Suppliers

Analysis of the cost structure of the suppliers is important because price is a major factor in purchase decision as explained in Chapter Eight. A supplier must be cost competitive even though it has superior quality, delivery, and customer responsiveness. The company would analyse costs for several important reasons. First, cost analysis allows the company to evaluate whether a quoted price is fair and reasonable. The company would perform cost analysis even with competitively bid items to ensure the quoted price does not provide excessive profit to a supplier. Second, cost analysis allows the company to identify the most efficient production level of a supplier for a given item. As we illustrated in chapter five, purchase volume should match a supplier's process capability. A mismatch between the company's requirements and a supplier's capability can create higher per-unit cost. Third, detailed cost analysis can help identify higher cost areas that can benefit from co-operative improvement efforts. Cost data is a major area for information sharing in a collaborative relationship between the company and its suppliers.

The ability to perform a cost analysis is a direct function of the quality and availability of information. If the company and a supplier maintain a distant purchase relationship, cost data will be more difficult to identify due to the lack of support from a supplier. The company may have to use internal engineering estimates about what it costs to produce an item, rely on historical experience and adjustment to estimate costs, or review public financial documents to identify key cost data about a supplier.

For the publicly traded small suppliers producing limited product lines, financial documents allow estimation of a supplier's overall cost structure. The drawback is that these documents do not provide much information about a specific breakdown of cost by product or product line. Also, if a supplier is a privately held company, cost data become even more difficult to obtain or estimate.

Another approach that can help in obtaining necessary cost data is to require a detailed production cost breakdown when the company submits a purchase quotation. The company's ability to enforce this requirement relates to the relative size of the purchaser compared to the supplier, the volume of the purchase, and the type of product being purchased. The company must also consider the reliability of self-reported cost data. Again, closer relationships make it easier to obtain cost information. A third option involves the joint sharing of cost information. Joint cost-savings initiatives involve the sharing of cost information between the company and its suppliers. A cross-functional team composed of engineers and manufacturing personnel from both companies may then meet to identify potential areas of the supplier's process (or the company's requirements) that can potentially reduce costs. The team then brainstorms possible solutions for cost reduction. Possibilities may include changing specifications, reducing set-up, providing advance forecasts to reduce inventory, training supplier personnel in quality improvement techniques, and many other possible solutions.

#### 10.1.2.2.3 Types of Interrelationships the El-Nasr Co. With Suppliers

Interrelationships in the definition used here include all purchases made by El-Nasr Co. on the basis of contracts made with local suppliers, where specifications are laid down in advance and which exclude all 'off-the-shelf' purchases. As has been discussed in Chapter Five, El-Nasr Co. encounters with risks and uncertainties in quality, delivery and price that force it to undertake several measures to guarantee that the flow of production is continuous. Interrelationships are thus needed to ensure the company's interests, e.g. to co-ordinate long-term plans; to maintain quality; to protect against any supply/demand disruption to determine prices; and to secure the flow of technical information. In this context of inter-industry interconnections, there are two issues to be discussed. The first is mainly related to the nature and extent of the relationship between the company which is influenced by such factors as, transport costs, technological factors and by problems of writing and enforcing contracts between the company and its suppliers. The other issue is concerned with the advantage to El-Nasr Co. by the decision to buy-out rather than to go for in-house production of some items.

There is no doubt that the less industrialised a country such as Egypt, the less evident is the atmosphere of mutual confidence, which is essential for establishing subcontracting relationships. This is partly because companies, El-Nasr Co. in this case, lack confidence in the capabilities of small industries to produce the items of the accepted quality, at the accurate delivery time, and with the right price.

It is also observed that one of the important reasons for the comparatively limited interrelationships of subcontracting in El-Nasr Co. is the finite information available on the potential suppliers. For these reasons, it is argued that it is not likely for any subcontracting to take place or to have a significant position in the industrial development of a particular company, unless the large companies like El-Nasr Co. or some public enterprises are prepared to take a long-term view and are ready to provide support to subcontractors, e.g. financial assistance, raw material procurement, technical assistance, etc. This is not likely to happen unless the government is prepared to pay more attention to change attitudes at least to overcome the first difficult stages in the development of such relationships.

However, in the long-term, it is only if suppliers are managed to obtain the confidence of the company that subcontracting can play its full role in improving the company's situation.

The important role of the private sector in industrial development has been emphasised by the government in the last few years particularly after privatisation. This fact led to the unexpected concern in subcontracting and the development of small private industries that is still in infancy as opposed to the developed countries. With the strong competition and the desire to reduce costs by saving the foreign exchange, many companies will have to be encouraged to rely more on local suppliers. El-Nasr is one of the very few ex-public sector companies which pay attention to encouraging subcontracting, particularly for the bus and tractor plant compared to the passenger car factory. The establishment of the Supply Industries Department at the company is a clear evidence in this respect. This fact is not only partly due to the significant importance of interconnections in the automotive industry in general, but also it is related to the policies and attitudes of El-Nasr Co.'s leadership, which are different from other ex-public sector companies, particularly those with technical characteristics that permit subcontracting.

#### 10.1.2.2.4 The Role of El-Nasr Co. in Assisting Local Suppliers

Some interviewees argued that the company's quality control methods are very strict with very good inspection procedures and specifications for ensuring the safety standards of the vehicles. With its strict inspection and requirements for adherence to specifications, they have a positive influence on a supplier's technical capabilities. They also claimed it assisted just a few suppliers in exchanging technical information giving them operation sheets, heat treatment, and processing technology. The company also gives some assistance in production techniques and Know-how assistance, e.g. sequence of operation, correct selection of materials, to quite a few companies. Input specifications and material testing are part of the assistance given by the company to its suppliers. The company has got well-equipped laboratories for material testing and inspection which it sometimes, not always, makes available to small local suppliers who do not have these facilities (this service was used more in the past than in the present, however).

The company's trained workers and engineers should make periodic visits to supplier plants for inspection of production on a weekly basis.

Generally, supplier industries are important in the adaptation of JIT philosophy. As shown above, technical interrelationships seem to be the most significant form of assistance found in the study of El-Nasr Co.'s relationship with some local suppliers, particularly so for small private sector companies with related technology. Low technical interrelationships such as quality control methods with the transfer of technical information and specification, are by far the most important and strongest type of interrelationships to be found in Egypt.

Though El-Nasr Co. is one of the few large ex-public sector companies showing some degree of commitment to the development of local supplier industries, its relationship with local suppliers is by and large partial and shallow, while the extent of its technical assistance leaves a lot to be desired. This fact is perhaps due to the under-developed state of both the assemblers and suppliers. Therefore, El-Nasr Co. may find it more convenient to resort to vertically integrating production of certain parts and components to meet local content requirements, especially with the existence of in-house production facilities coupled with the pressures to maintain high employment levels discussed in Chapter Six.

The assistance provided by the 'Supplying Industry Department' to overcome some of these problems is questionable, considering the limited staff and resources available to the company. In trying to overcome such difficulties, interrelationships should be established.

#### 10.1.2.2.5 Procedures of Selecting Suppliers at El-Nasr Co.

Procedures to select domestic suppliers, which are applied by the 'Supplying Industry Department' at the company, are such that after registration of the potential supplier, the potential supplier makes a sample for testing with a bid. If the sample and bid are accepted, there is an experimental order by the company where the supplier makes about ten percent of the total order. These are inspected through the quality Control Department at the company and, if approved, the remainder of the order can be delivered. Delivery conditions are usually mentioned under general conditions printed at the back of the order sheet. Payments are usually made upon delivery, i.e. four weeks after delivery, but there are cases of delays.

There are no specific programmes at the company for recruitment and the selection of potential suppliers which are usually made through advertisements, with no follow-ups, record results of the company's field visits to potential suppliers and with no identification of those suppliers with a more promising future.

#### 10.1.2.2.6 Suggested Types of Interrelationships El-Nasr Co. With Suppliers

Interrelationships with suppliers should include the exchanges of information on demand and investments to facilitate current production planning and future investments. Communications are required on future market conditions. Information on expected consumption should be exchanged. The company should provide its suppliers with any useful information on future production plans. Co-ordination of exchange of necessary information and data and setting programs that regulate the supply process according to required quality levels. Interrelationships with suppliers should also include helping suppliers in purchasing of raw materials to overcome risks connected with quality and availability of materials. Pricing interrelationships also are very important in order to give stable long-term relationships with suppliers. This includes contractual and bargaining procedures, setting up negotiations to determine prices and to distribute revenues.

Technical interrelationships include the giving/reviewing of technical assistance or exchanging of technical information on, e.g. innovations, product design, know-how, quality, training, testing and tooling to ensure the precise matching of needs with suppliers. Adopting specific programs for training to create technical employment in the field of automotive supplier industries and taking care of technical education particularly in the fields of industrialising components and automotive requirements.

Financial interrelationships include the provisions of grants, loans, advance payments, special prices, etc. to ensure that suppliers are able to meet current and future commitments and to prevent such a phenomenon as monopoly in this field.

Diversification is one of the important aspects to close the relationships with suppliers. It includes arrangements regarding sales to other customers or assisting suppliers to export in order to diversify the market for suppliers to raise their financial stability and reduce their dependency. Managerial interrelationships include the help given to management training, accounting, inventory and other organisational procedures to improve the supplier performance. Establishment interrelationships include direct assistance given to a particular supplier to start production. It is worth mentioning that El-Nasr Co. is in joint ventures with some supply companies e.g. Woodsman Co.

Locational interrelationships include inducing suppliers to set-up plants in a given country or location, e.g. near the buyer or in the case of foreign suppliers, to invest in the country. Other distributional Interrelationships include sharing of development costs and the replacement market.

Government policy also could play an important role in the development of linkages, especially by specifying certain parts and components to be procured from local industries. However, in Egypt official policies contributed to the very under-developed state of local suppliers, preventing the establishment of specialised parts and components industries and led to the weak relationship found between the automotive assembler (El-Nasr Co.) and its suppliers.

Urging scientific research centres, institutions and universities to be involved in Research & Development and to produce local technology through which necessary materials for automotive supplier industries can be industrialised.

#### 10.1.2.3 Proposed Improvement in Cost Accounting System for Managing the Change into JIT

The essential step in planning the changes to the JIT cost system is an analysis of the reports required for planning and control in El-Nasr Co. The information needs analysis for El-Nasr Co. should be recognised: (1) the constraints imposed by top management and Government, (2) the constraints imposed by the available applications software, and (3) any future changes to the information needs if any of these constraints are relaxed.

Top management has imposed reporting requirements that include reporting: (1) direct labour efficiencies, and (2) overhead variances. All financial reporting is created by a centralised computer system, using company-wide applications software. Modification of this software is not considered JIT implementation. Consequently, JIT reports will be created using the trial balance from the existing systems as a basis. With consider suppliers as participants in the company in constituting its cost structure.

In this phase, the cost accounting function is concerned with documentation of the existing systems and the simulation of procurement to reflect the modifications identified by interrelationships of suppliers. Cost drivers are identified in conjunction with purchase and production personnel. The primary activity for accounting in this phase is the identification and documentation of information needs and the development of a cost accounting system to satisfy those needs. The using of simulation module 'what if' is the most significant addition to the JIT implementation. It could facilitate: (1) setting standards, (2) identifying cost drivers, (3) evaluating planned modifications, and (4) defining information needs. Standards for procurement and production are critical for evaluation and control in a JIT environment. Standards in a changing situation usually do not reflect the current processes they control because they are not updated for each change. Simulation module 'what-if' provides a convenient method of estimating new standards as each step in the modification process is completed.

At the company, establishing new standards for materials (and also conversion costs) will be simplified with a simulation 'what-if' module. The simulated output without allowance for inefficiency or downtime is used to set standards. This is consistent with the JIT philosophy of continuous improvement towards perfection. An additional impact of JIT is that standard costs are used to prevent costs before they arise.

During the implementation phase JIT cost accounting reports will be created in addition to the traditional reports issued by top management. This redundancy satisfies the top management requirement for specific reports, and for updating the data base. No change is to be made to the application programs during JIT implementation. This rigidity in the cost accounting system will be expected.

A problem in JIT implementation is the apparent inability of producers to change their paperwork systems. For El-Nasr Co. a spreadsheet template is a suitable interim method for converting the traditional trial balance to JIT reports. A micro computer and spreadsheet template will be used to make the required adjustments.

The accounting reports will show two cost categories, materials and finished goods. To satisfy the needs of less adventurous managers, direct labour will be included as supplementary information on the reports. The non- financial information will be reported.

The reporting method for JIT described above has the advantages of leaving all existing systems intact and experiencing low implementation cost. Introduction the JIT reporting in this method will not create a large workload for accounting personnel and if the JIT reports are seen to be inadequate, the traditional reports can be prepared. The cost savings from simplified data capture and recording are deferred until the applications software is modified when the pilot implementation is completed. The applications software will be changed to accept different input data and to accumulate costs under ledger account headings suitable for JIT. The detailed labour and overhead data capture will be simplified, reports will be created from the corporate data base directly, and the use of the spreadsheet template will be discontinued.

This dual reporting phase is part of the education cycle. It is included to satisfy managers that the JIT reports will satisfy their needs--the traditional reports will continue to be available but they will only be distributed on request. The parallel system ensures the corporate data base will be updated in the existing manner, and there are virtually no software costs. This method of reporting will only continue until the pilot implementation has been evaluated. When JIT concepts are accepted for the pilot implementation, the cost accounting software will be modified or replaced.

However, JIT reporting should be implemented in a manner that satisfies specific constraints and allows flexibility to adjust as the required modifications are implemented.

## 10.2 Conclusions

The manufacturing environment of the company has already changed over time. It is affected by the prevalent conditions of competition, the extent of government ownership and control, and changes in customers' tastes. The monopoly position of the company enabled it to enjoy most of the characteristics of scale economies of the automotive industry in Egypt. A higher volume of output was achieved, particularly, in the commercial vehicles rather than in the passenger cars, with a relatively unskilled labour force backed by heavy investment in machine tools and long model run.

In recent years, particularly, as the competition has become very strong, Egyptian markets are more accessible to foreign auto makers; and customers' tastes have changed as well. Achievement of a competitive advantage in the automotive industry in Egypt depends not only on production volume but also on the number of models produced and the length of life of these models. This factor is especially important in the production of passenger cars, due to the continuous change of models. The normal pattern has been for cars to get a major model change every two or three years. In order to satisfy the diverse customers' needs, the company produces different versions of vehicle models. As a result, vehicle models change over time, particularly with technological progress and changes in product characteristics. The company has started to adopt a more flexible production technology, which has dramatically changed the production method. Flexible automation involves the use of numerical control machine tools (NC) and computerised numerical control machine tools (CNC) which can cope with different models in the different processes of motor vehicle production, e.g. stamping, welding, painting and machining operations, and testing.

Although the developments in production technology in the company have increased the flexibility of production facilities in responding to customers' rapidly changing demands, they have also led to even more capital intensive techniques, so that unit fixed costs have become even more responsive to volume and the financial burdens of underutilisation of capital and production capacity have become more severe, as explained in Chapter Eight. For example, underutilisation of capacity in the 1990s resulted in very heavy operating losses because of the increasing competition.

The effect of environment on the cost accounting system is clear. the company had established a cost accounting system which did not aim at operation effectiveness. It was not helpful for controlling manufacturing resources because it was designed, basically to calculate the products costs for inventory valuation. Deficiencies of the system were due to the arbitrary procedures of collected and allocated manufacturing overhead costs to the products through both production and production service centres. The prevalent circumstances at that time precluded seeing these deficiencies. It appears that this market dominance had allowed the company to show a growth in profitability, but only at the expense of its customers. Its monopoly position had allowed it to act as a price setter, and it was thereby able to export the costs of its own internal inefficiencies to its customers. In a sense this market control took the place of effective internal control and there was an accompanying lack of information systems around production and finance, and more significantly little perception of the need for or value of such information.

The new competition and manufacturing environment has made production flexibility increasingly important to El-Nasr Co. attempting to match production to the current customers' needs. The key objective of the improvements in the cost accounting system is made to control the production and costs concurrently.

However, the research hypothesis was judged to be supported that changes were found in the manufacturing environment caused changes in cost accounting systems at the Case Company. In this thesis, the author identifies a number of findings to be drived from this study. Most important among these are: Linking CAS to operational control systems; improving cost control process by providing visibility of non-value added activities such as capacity utilisation, inventory, scrap, set-ups and defects. Planning capabilities played a significant role in the cost reduction process. Also, cost implications of the suppliers' performance were highlighted in this study. This may provide a direction for cost reduction programme. In general, we have shown in this thesis that the use of current cost accounting systems by the Case Company are not fully consistent with the new manufacturing environment because they are not supportive of the manufacturing strategy.

However, the major conclusions from this case study can be briefly summarised below.

- Changing the economic philosophy and ownership structure led to changing the competitive environment of the Egyptian manufacturing companies.
- Changing the manufacturing environment of the company requires seeking other cost drivers than those volume-related ones. The suggestion in this thesis, to improve the cost accounting system, is to adopt a wider cost driver concept which clearly expands the traditional perspective of cost causality. The author expands the view on cost causality in activities by identifying a set of different drivers. He concluded two substantial cost drivers: internal drivers including the technical and production scheduling factors, and external drivers including suppliers and customers systems.
- There are cost consequences as a result of bad scheduling. The lack of good scheduling makes life very difficult for the purchasing department and may increase direct material costs. The worse the schedule the more likely it is that it will be modified. These modifications ripple back into procurement and often result in inconsistent highly variable material ordering patterns. For instance, the lack of a good schedule may force the purchasing department to expedite material and, after a modification, later call the vendor to ask that delivery be delayed. Haphazard ordering costs the company money. When the company expedites its vendors it usually incurs higher costs. If the company has its vendors keep a safety stock of its material they usually charge it a higher price for the material to cover their carrying costs. The good schedule can help reduce excess material costs.
- A lack of good scheduling results in inefficient management of capacity, low direct labour productivity and high costs. Without a good schedule the company often produces work in a sequence that is not advantageous and sometimes it tears down jobs prematurely. This may cause a plant to run behind schedule. When a plant runs behind schedule, the company is often forced into even less advantageous sequencing

and more frequent tear downs and set-ups. In addition, the company may have to deviate from cost-effective routings or procedures. Unnecessary overtime and excess expediting related costs might be the ultimate result. Unanticipated shop floor changes in shop floor activities can influence direct labour productivity.

- The company with the sophisticated integrated computerised 'OMAC' system, could overcome many of these problems. OAMC enabled the company to have good execution on the shop floor through the goods and flexible schedules. It explicitly considered the limited capabilities of the operation to allow people, equipment, and material to come together in the proper amounts at the proper time. Good schedules allowed the company to meet both its manufacturing and business goals. Flexible scheduling allowed the company to investigate alternatives and adapt to changing conditions. The company's manufacturing environment is complex random and dynamic. Flexible scheduling allowed the company to adjust to new orders changed orders, breakdowns, material shortages, absenteeism, and capacity problems.
- Obviously, OMAC is a complex and detailed system to collect, track, and report information which may not be necessary. The detailed tracking of labour and reporting of labour variances is meaningless, expensive, and unnecessary, because the proportion of labour costs to the total manufacturing cost is fast reducing. For El-Nasr Co., it has been reduced from 6% in 1987/88 to nearly 4 % in 1996/97. In the OMAC production control system, keeping track of labour hours was easy because detailed labour information was required by the shop floor control system. In order to keep track of the progress of the planned production schedule, it was necessary to report the completion of each detailed job step with the product routing. The labour costs, machine costs, and set-up costs are entered at that time.

- Cost structure or composition plays a significant role to determine which cost element needs more attention than others. When the company has a high degree of vertical integration, it produces most of its own components and, therefore, has less need to create systems to indirectly influence its suppliers. In this case, precision of product cost is very important because overhead costs fraction is a high percentage relatively. Therefore, management has to seek sophisticated allocation methods (e.g. ABC).
- Undoubtedly, shrinking the direct labour cost (to only around 4 %) makes this kind of detailed shop floor control unnecessary, making it also unnecessary to engage in the wasteful and fruitless activity of tracking and recording all that detailed information. If tracking the production steps and detailed labour hours on the shop floor is unnecessary, then it is further unnecessary to maintain a work order-style of production control. The leaving of labour reporting and work order control goes a long way toward significant reductions in overheads within the production plant. The company spends enormous amounts of time and effort keeping the production systems going. The detailed planning, tracking, recording, correcting, re-routing, rescheduling, and monitoring that goes into a production planning system is not required for the modern manufacturing.
- In spite of the company has exercising control, through OMAC, over its costs on the production line directly, it has little control over many upstream costs. The company has to pay special attention to materials and components which represent just over 89 % of its costs (including inward shipping costs and duty). Overhead costs, including direct and indirect wages constitute only around 11 % of the manufacturing costs. The accounting system has been kept simple on the grounds that, whilst precise

accuracy is desired, overheads only constitute a small percentage of total product cost (around 6 %).

- However, the company requires amendment in its cost system not only in using a more realistic and acceptable basis such as a material basis to allocate overhead cost, but also in adopting a broader strategic viewpoint, even where this might entail some loss of precision in product cost information. Precision of product costs have become of less significance to pricing decisions in recent years. The reason for this is that increasing competition has made the prices of a wider range of products more market-driven than cost driven. Consequently, there is now significant change in the way that products are marketed. The company would be much more concerned about market share. This change in emphasis has led to significant competitive pressures for the company. El-Nasr Co. rather would seek progress through more positive, more sustainable methods of active cost reduction in order to give it a competitive advantage.
- Competitive pressures facing the company require it to look more carefully at non-value added activities and why they occur. How they impact on the final cost structure is of vital importance to the management, every non-value added activity can result in higher costs. Many problems -and the associated higher costs- can often be traced back to supplier relations. Production stoppage can be provoked by suppliers who frequently miss delivery times; under-supply with necessary components; mislabel consignments or individual parts. A growth in the number of suppliers may have a much greater effect on the cost structure. Reducing costs is important no matter which strategy is chosen. Companies involved in product differentiation will want to reduce costs to maximise their profits; cost leaders want to reduce costs to a level below all their competitors. Costs can be reduced by

reducing activities that cause costs without increasing value. They can also be reduced by exploiting linkages in the value chain.

The company has to recognise the positive factors in relation to its suppliers, such as the possible purchasing of parts in local currency, which can help to alleviate foreign exchange constraints facing the company, lower inventory costs, and greater flexibility. Therefore, the company needs to formulate its broad goals, deciding on the order of priority given to supporting suppliers. The company's assistance is very important because, generally, there are no shortages of skills in small and medium companies in Egypt. From the interview, many automotive suppliers offered considerable skills and ingenuity with limited resources.

However, the development of supplier industries will ultimately rely on the support provided not only by the assemblers (which is essential) but also by other organisations and institutions within the framework of government policies. Recently, the government has been attempting to reinforce and encourage the private sector, regularly taking the opportunity to send signals supporting this fact. What is required for the future is for the government to co-ordinate between these organisations and institutions along with assemblers to make a total support system for the growth and development of supplier industries, particularly small-scale companies which lack both technical and financial support from any organisation, e.g. assembler companies, financial as well as non-financial agencies, for obtaining raw materials, new equipment, training, etc.

The role played by supplier industries in general should be concerned and highlighted as an important part in the broader official policy of enhancing assemblers conditions (El-Nasr Co. in this case).

- The development of a cost accounting system suitable for JIT philosophy cannot be undertaken in isolation. The information needs are determined by aggregating the information requirements of all functional areas. The cost accounting system will be integrated with the other functional areas to provide a total control system. The extent the company's interest and knowledge should extend outside the four walls of a factory in order to gain a better understanding of the complexities of the way the factory currently functions and what happens in the real marketplace. A knowledge of how other functions work and their cost behaviour is essential in designing an overall corporate costing system. In other words, the good costing system should reflect the entire enterprise both in the factory and behind. It involves looking more closely at those key factors which influence the company's cost structure and attempts to work out what forces internally and externally, 'drive' costs in the first place.
- A cost reduction process requires careful planning and the solution of, not only the internal problems of the production but also the external problems with suppliers. Planning, quality and the timing of delivery are three important considerations in cost reduction. Consequently, this study offers considerable opportunities for co-operation among assemblers and their suppliers for the manufacture of a certain product.

It is understandable, however, that due to the high risks and increased uncertainties in the developing countries, large enterprises such as El-Nasr Co. tend to depend on their own resources and facilities and buy-out only where there is no other alternative, leading to low relationships with their suppliers. However, the right approach to cost reduction requires not only technical assistance and technology directly transferred from automotive companies to some local suppliers, but also labour training, greater emphasis on quality control as well as other financial and informational assistance which could lead to an overall improvement in efficiency in the supplier industries and is thus reflected on cost reduction throughout the value chain.

In studying the co-operation in the case company, we were searching for the different types of interrelationships e.g. informational, technical, financial, raw material procurement, locational, establishment, material, pricing and bargaining procedures, distributional, diversification, i.e. concerning sales to other customers, exports. Technical co-operation was by far the most important form of the relationships, that is quality control methods with transfer of technical information and input specification as well as material testing.

In general, however, it was found that the co-operation between El-Nasr Co. and its suppliers was weak, partial and inconsistent. This fact had bad consequences on the process of cost reduction and the competitive position of the company. This low level may be due to assemblers in the developing countries not being aware of the importance of such co-operation and its positive effect. Both assemblers and suppliers work independently and try to maximise their earnings in the short-term without any consideration to the benefits in the long-term. The small volume of vehicle production, the lack of export opportunities and the many problems facing ex-public sector automotive assemblers all acted as constraints on the creation of stronger relationships.

However, the case study showed that the role played by the company in assisting suppliers to tackle their problems was very limited and left a lot to be desired.

## 10.3 Recommendations

In light of the above conclusions, the author recommends academic accountants to educate the new paradigm of cost accounting which adopts a wider perspective about cost drivers and cost causality. Changing competition and manufacturing environment is an important factor to review cost accounting systems which were established in light of old-fashion setting. Managers, therefore, have to be aware of the changes in their manufacturing environment and learn such new techniques to determine strategic cost drivers in order to find improvement opportunities for cost reduction. Companies must identify the key factors or activities that increase costs. Factors such as those resulting from poor quality and late delivery are not added value. The key to analysing the company's internal value chain is to understand the activities within the company that create a competitive advantage, and then manage those activities better than other companies in the industry. These activities will probably have different costs and different cost drivers.

Finally, the author recommends the Case Company to develop the current MRPII to achieve an effective strategic control for its resources by adopting Enterprise Resource planning. ERP system may give the company control of its supply chain environment and enables it to obtain solutions on its internal and external problems. Therefore, one expects that the corporate efforts to be leading - edge companies in technological advances and to compete effectively in world markets should be reflected in their cost accounting systems. To achieve world-class manufacturing goals, companies must build and maintain partnerships with those suppliers that offer the best overall value. A strong linkage between companies and their suppliers is a prerequisite for JIT. What is needed for the future is for the company to co-ordinate between the different parties concerned to make a total support system for the efficient cost reductions.

Considering the findings of this study apply only to one organisation, their generalisability is not possible. To support the advancement of the growing body of knowledge, this study should be replicated in companies in both similar as well as in different industries. If similar findings held in other companies producing technologically advanced products, industry specific cost structure could be delineated. Further, replication of this study in dissimilar companies would yield general truths regarding the cost structures of modern manufacturing organisations. For example, this study looked at ex-public sector companies. Application of the subject to private sector ones in similar or different industries and a comparison to information provided by different CASs would be useful.

## 10.4 Summary

The company's environment changed and become more dynamic and uncertain. The company changed its strategy into differentiation leadership. The goal changed accordingly to capture a fair market share by getting customer satisfaction. Thus the company should consider further dimensions that can satisfy customers and reduce costs at the same time. These dimensions include a short production lead time, a short purchasing lead time, a short delivery lead time, a low inventory. This chapter developed a model in order to overcome the uncertainty which faced the company and improve both cost control and cost reduction. The company should adopt a strategic perspective for reducing costs. However, cost reduction process in an automotive industry at El-Nasr Co. needs the co-operation of all parties not only inside the four walls of a factory but also outside to include suppliers and customers. Cost reduction, however, requires careful production planning and control and the solution of many technical and financial problems.

Cost reduction depends not only on the scale of production of vehicles, but also on the extent of interrelationships created by the establishment of an automotive industry, the percentage of domestic content achieved, and the degree of integration of each automotive company. It will also be particularly affected by the existing degree of sophistication and capacity of the company. Reducing costs at source require that the lead enterprises, as El-Nasr Co., will have to do more for their suppliers, to guarantee an accepted level of production in terms of quality, quantity, time of delivery, percentage of rejections, etc. that could affect a process of cost reduction. In fact, the efficiency of the automotive process in any company is clearly heavily dependent on the efficiency of these suppliers.

However, El-Nasr Co. faced difficulties in developing such relationships. There is always a tendency in such companies for each large-scale manufacturing enterprise to be highly vertically integrated. There are a number of serious constraints imposed by the Government on the industrial development as explained in Chapter Four. Large ex-public sector industries for many years managed, or at least tried, to live without a local supply of parts and components, making the choice between imports and in-house production of parts. In fact, where the habit of integrated in-plant production prevails as in Egypt, it is hard for supplier industries to get started to prove their abilities. Another very important problem is quality control. This is because of the unskilled management and low technical levels of many small scale companies in Egypt. However, the subsequent modernisation and expansion of ex-public sector companies and the establishment of new joint venture companies in engineering industries, has created opportunities for development.

As long as the company has decided that a part will be bought-out locally (as compared to in-house production or imports) interrelationships will be established to arrange for this procurement. Strong linkages in the automotive industry in this sense could lead to improving the company's condition. Subcontracting between industries of various types and sizes, especially between large and small companies, has become one of the characteristics of the modern industrial countries e.g. in Japan.

The interrelationships between the automotive supplier industry and the developing automotive industry should be a very strong one. These relationships should be developed from merely supplying parts according to the designs and requirements of automotive producing companies to becoming, recently, a kind of participation and interchanging responsibility for quality and development. It has been observed that El-Nasr Co. played a little role in supporting supplier industries whether by taking part in their capital or sharing in developing and transferring modern technology as happened in Japan, Europe, and US.

> For instance, Toyota invests up to 22% in a company to produce electronic parts, 14% in a company to produce seats and 12% in a company to produce parts of the engine. Fiat contributes also in 'Brilli' companies for tyres, 'Marilli' for electrical parts and other supplier companies. This turns the relation between the automotive producing company and the supplier companies into a partnership relation. Co-ordination between the required parts exists in order to ensure a smooth supply (Hussein El Gammal, El-Nasr's magazine, 1997, P. 1).

Table (9-4)

Comparison between the company's system and the suggested model

| | The Company's System 'OMAC' | Suggested Model 'Total Cost Control' |
|---|---|---|
| | MRP | JIT |
| | Focus on shop floor control 'Internal' | Focus on shop floor control & suppliers 'External' |
| | Operational | Strategical |
| | Cost Allocation & Control | Cost Control & Reduction |
| | Lumped cost | Cost breakdown |
| | Organisational | Competitiveness |

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# APPENDICES

# Appendix (A)

## Formal Permission to Access the Case Company

(See the formal permission on the next page).

قرار رئيس الجهاز المركزى للتعبئه العامه والاحصاء

بالتفويض

رقم ( ٦٢٣ ) لسنه ١٩٩٨

جمهورية مصر العربية
الجهاز المركزي للتعبئة العامة والإحصاء

فى شان قيام السيد / على جابر صالح على محمود — المدرس المساعد بكليه التجارة جامعه طنطا وعضو البعثه الخارجيه بانجلترا باجراء استقصاء ميدانى للحصول على درجه الدكتوراه بعنوان ( محددات نظم محاسبه التكاليف فى البيئه الصناعيه المعاصره ) .

رئيس قطاع الشئون الماليه والاداريه والمتابعـــه :—

— بعد الاطلاع على القرار الجمهورى رقم ٢٩١٥ لسنه ١٩٦٤ فى انشاء وتنظيم الجهاز .
— وعلى قرار رئيس الجهاز رقم ٢٣١ لسنه ١٩٦٨ فى شان اجراء الاحصاءات والتعدادات والاستفتاءات والاستقصاءات .
— وعلى موافقه السيد / رئيس الجهاز بتاريخ ١٩٩٧/٤/٢١ فى شان تفويض السيد / رئيس قطاع الشئون الماليه والاداريه والمتابعه فى اعتماد القرارات الخاصه بالامن المعلومات .
— وعلى قرار رئيس الجهاز رقم (١١٠١) لسنه ١٩٩٧ .
— وعلى كتاب الاداره العامه للبعثات بوزارة التعليم العالى المؤرخ ١٩٩٨/٦/٢٠ .

قــرر

ماده (١) : تجديد العمل بالقرار رقم (١١٠١) لسنه ١٩٩٧ بشان قيام السيد / على جابر صالح على محمود — المدرس المساعد بكليه التجارة جامعه طنطا وعضو البعثه الخارجيه بانجلترا باجراء الاستقصاء الميدانى المشار اليه بعاليه لمدة عام من تاريخ صدور هذا القرار .

ماده (٢) : يجرى هذا الاستقصاء الميدانى على نفس العينه والشركات والتى سبق ان صدر بشانها القرار رقم (١١٠١) لسنه ١٩٩٧ مع اضافه الشركات التاليـــه :—

١— شركه النصر لصناعه السيارات ٢— الشركه المصريه لصناعه وسائل النقل الخفيف .

٣— شركه النصر للاجهزه الكهربائيه فيلبس ٤— شركه النصر للاجهزه الكهربائيه والالكترونيه .

وبشرط موافقه مفردات العينه وكذا موافقه السادة رؤساء مجالس ادارات هذه الشركات وتحت اشراف ادارتها لا من يكل منها مع مراعاه ان البيانات الفرديه سريه بحكم القانون وعدم استخدام البيانات التى يتم جمعها الا لاغراض هذا الاستقصاء الميدانى فقط .

ماده (٣) : تجمع البيانات اللازمه لهذا الاستقصاء الميدانى على نفس الاستمارة المعده لهذا الغرض والمعتمده من الجهاز المركزى للتعبئه العامه والاحصاء وعدد صفحاتها (١٦) سته عشر صفحه والتى سبق ان صدر بشانها القرار رقم (١١٠١) لسنه ١٩٩٧ .

ماده (٤) : لا يتم البدء فى تنفيذ اجراءات هذا الاستقصاء الميدانى الا بعد صدور هذا القرار .

ماده (٥) : يوافى الجهاز المركزى للتعبئه العامه والاحصاء فورا بنسختين من النتائج الاوليه لهذا الاستقصاء الميدانى ثم يوافى بنسختين من النتائج النهائيه للاستقصاء الميدانى كامله فور الانتهاء من اعدادها .

ماده (٦) : ينفـذ هـذا القرار من تاريخ صـدوره .

صـدر فى : ٩ / ٧ / ١٩٩٨ .

حسنى محمود سليمان

# Appendix (B)

Table (B-1)

Some Operating and Financial Indicators

| | | 1991/92 | | | 1996/97 | | | | | | Difference of | Actual ratio of | Actual ratio of |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Actual | Actual | Ratio of | Actual | | Target | | Actual | | | 996/97 to | 1996/97 to |
| | unit | 1991/92 | 1990/91 | 90/91 | 1996/97 | %1 | 96/97 | % | 1995/96 | % | 1995/96 | target | actual 95/96 |
| Operating profit | ,000 LE. | | | | 93,586 | 13 | 98,944 | 12 | 113,462 | 15 | -1987682 | | 82 |
| Percent of exploiting capacity (in average) | % | 75.7 | 55.6 | 136 | | 58 | | 63 | | 66 | | 92 | 87 |
| Local and Foreign | | | | | | | | | | | | | |
| Content: | | | | | | | | | | | | | |
| 1. Local | ,000 LE. | | | | 216,676 | | 172,835 | | 218,178 | | | 125 | 99 |
| 2. Import including custom duties | " | | | | 608,955 | | 631,470 | | 607,887 | | | 96 | 100 |
| 3. the monthly usage of raw | " | | | | 050,205 | | 044,271 | | 049,392 | | | 113 | 102 |
| Inventory | | | | | | | | | | | | | |
| Ratio of material used /total production | | | | | | 77 | | 76 | | 72 | | 101 | 107 |
| Slow raw inventory" | | | | 001,729 | | | | 2,039 | | | | 85 | |
| Slow spares of tools | " | | | | 001,219 | | | | 01,219 | | | | 100 |
| Sufficiency of local raw | month | | | | 3 | | 3 | | 3 | | | 103 | 108 |
| Sufficiency of import raw | " | 4.7 | 4.4 | 107 | 5 | | 4 | | 4 | | | 124 | 105 |
| Average of selling products | day | 111 | 30 | 370 | 121 | | 68 | | 103 | | | 179 | 118 |
| Inventory turnover | times | | | | 1 | | 2 | | 2 | | | 79 | 86 |
| Liquidity | % | 3.3 | 8.6 | 38 | | 14 | | | | 15 | | | 92 |
| Usage average of material monthly. | LE. ,000 | | | | 50,205 | | 44,271 | | 49,392 | | | 113 | 102 |

# Appendix (C) Budgets

## C.1 Production Budget

Table (C-1)

Form (2/1) (.000 LE.)

| Product | Unit | Target production 96/97 | | Actual production 96/97 | | | | Actual production 95/96 | | Percent of achievement targets | | Percent of development | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Qty. | value | Qty. | target price | current price | previous price | Qty. | value | Qty. | value | Qty. | value |
| Buses | No. | 01,300 | 225,250 | 00,636 | 131,933 | 131,418 | 130,637 | 00,681 | 132,474 | 48% | 59% | 91% | 99% |
| Lorries | " | 01,125 | 152,725 | 00,890 | 096,606 | 101,017 | 107,276 | 01,127 | 131,615 | 65% | 63% | 65% | 82% |
| Tractors | " | 00,500 | 012,500 | 00,869 | 025,326 | 026,129 | 023,805 | 00,803 | 022,047 | 174% | 203% | - | - |
| Passenger cars | " | 15,000 | 500,196 | 17,361 | 429,112 | 429,060 | 428,591 | 12,141 | 410,000 | 81% | 86% | 100% | 105% |
| Engines | " | 00,800 | 013,950 | 00,315 | 008,789 | 008,632 | 011,525 | 00,555 | 021,032 | 63% | 63% | 57% | 55% |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

## C.2 Sales Budget

Table (C-2)

| Code No. | Products | Unit | Targeted sales according to budget of 96/97 | | Actual sales of the current year 96/97. | | Actual sales of the previous year 95/96. | | Ratio of achievement the targets. | | Ratio of progress | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Qty. | value | Qty. | value | Qty. | value | Qty. % | value % | Qty. % | value % |
| | | | | | | | | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

* Sales budget prepared in details at the level of product family including different models of each product. It is setting at the aggregated sales level and at the elaborated exports and local sales of the company.

** Data about sales budgets is available.

## C.3 Purchasing Budget

Table (C-3)

Form (8/1)

(.000 LE.)

| Material & Components | Target of 96/97 | | | | Actual of 96/97 | | | | | | | | Previous year | | | Average of purchasing price | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qty. | Local | import | Total | Qty. | Local | FOB | | Duties | Expenses | Total of import | Total of purchases | Qty | Total of purchases | | Current year | | Previous year | |
| | | | | | | | Free | Aggre-ments. | | | | | | Local | Import | Local | Import CIF | Local | Import CIF |
| Main materials | - | - | - | - | - | 0 46,382 | 010,893 | - | 04,970 | 00,830 | 016,692 | 063,074 | - | 050,293 | 013,690 | - | - | - | - |
| Parts | - | - | - | - | - | 156,590 | 298,861 | - | 71,828 | 21,526 | 392,215 | 548,805 | - | 153,556 | 371,609 | - | - | - | - |
| Sub-total | - | 158,335 | 458,635 | 616,970 | - | 202,972 | 309,753 | - | 76,798 | 22,356 | 408,907 | 611,879 | - | 203,849 | 385,299 | - | - | - | - |
| Fuel, Oil, & Power | - | 006,870 | - | 006,870 | - | 006,689 | - | - | - | - | - | 006,870 | - | 006,413 | - | - | - | - | - |
| Tolls and spars | - | 006,100 | - | 006,100 | - | 001,694 | 001,221 | - | 00,389 | 00,104 | 001,714 | 003,408 | - | 001,734 | 001,504 | - | - | - | - |
| Stationary | - | 000,730 | - | 000,730 | - | 000,692 | - | - | - | - | - | 000,692 | - | 000,915 | - | - | - | - | - |
| Water & electricity | - | 000,800 | - | 000,800 | - | 001,224 | - | - | - | - | - | 001,224 | - | 000,477 | - | - | - | - | - |
| Sub-total | - | 014,500 | - | 014,500 | - | 010,299 | 001,221 | - | 00,389 | 000,104 | 001,174 | 012,013 | - | 009,539 | 001,504 | - | - | - | - |
| Total | - | 172,835 | 458,635 | 631,470 | - | 213,271 | 310,974 | - | 77,187 | 022,460 | 410,621 | 623,892 | - | 213,388 | 386,803 | | | | |

## C.4 Labour & Wages Budget

Table (C-4)

Form (10/1)

(.000 LE.)

| | Actual Wages | | | | | | | | | | Target Wages | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average No. of Employees | Cash | | | | | Sub-total | Fringe benefits | Total | Wage average of employee | Average No. of employees | Cash | Fringe benefits | Total | Wage average of employee |
| | | Basic wages | Overtime wages | Incentives | Other | Insurance | | | | | | | | | |
| workers in production centres | 3,697 | 6,854 | 08,449 | 8,572 | 10,374 | 5,110 | 39,359 | 2,118 | 41,476 | - | 4,202 | 41,070 | 1,832 | 42,901 | - |
| Workers in production support centres | 3,391 | 7,548 | 05,181 | 8,658 | 10,553 | 4,911 | 36,851 | 1,969 | 38,820 | - | 3,854 | 38,453 | 1,703 | 40,156 | - |
| Workers in marketing support centres | 0,789 | 1,702 | 00,717 | 1,929 | 02,156 | 1,013 | 07,517 | 0,341 | 07,858 | - | 0,424 | 07,844 | 0,295 | 08,139 | - |
| Workers in administration support centres | 0,920 | 2,282 | 00,948 | 3,806 | 03,088 | 1,202 | 11,325 | 0,457 | 11,783 | - | 0,495 | 11,817 | 0,296 | 12,213 | |
| Sub-total | 8,796 | 18,385 | 15,259 | 22,965 | 26,171 | 12,235 | 95,051 | 4,885 | 99,936 | 11,362 | 8,975 | 99,184 | 4,225 | 103,409 | - |
| **Others:**<br>Training students<br>Foreign experts<br>External temporary work<br>Missions | <br>07<br>14<br>10<br>160 | | | | | | | | | | | | | | |
| Sub-total | 191 | | | | | | | | | | | | | | |
| Total | 8,987 | 18,385 | 15,295 | 22,965 | 26,171 | 12,235 | 95,051 | 4,885 | 99,936 | 11362 | 8,975 | 99,184 | 4,225 | 103,409 | - |
| (-) wages burdened on capital operations | 21 | 235 | | | | | 235 | | 235 | | 7 | 65 | | 65 | |
| Wages of operating activity | 8,987 | 18,150 | 15,295 | 22,965 | 26,171 | 12,235 | 94,816 | 4,885 | 99,701 | 11362 | 8,968 | 99,119 | 4,225 | 103,344 | 11522 |

Continued over

## C.4.1 Labour & Wages Budget

Table (C-5)

(,000 LE.)

| | Average No. of employees | Previous Year | | | |
|---|---|---|---|---|---|
| | | Wages | | | Average wage for employee |
| | | Cash | Fringe Benefits | Total | |
| Production workers | 3,819 | 38,734 | 1,601 | 40,335 | |
| Production support workers | 3,654 | 39,174 | 1,658 | 40,833 | |
| Marketing support workers | 0,789 | 07,298 | 0,243 | 07,541 | |
| Administrative support workers | 1,135 | 12,274 | 0,439 | 12,713 | |
| Capital support workers | - | - | - | - | |
| sub-total | 9,397 | 97,480 | 3,942 | 101,422 | 10,793 |
| **Others:** | | | | | |
| Kids | 16 | | | | |
| Solders | 01 | | | | |
| Foreign experts | 06 | | | | |
| External temporary work | 10 | | | | |
| missions | 193 | | | | |
| sub-total | 226 | | | | |
| Total | 9,623 | 97,480 | 3,942 | 101,422 | 10,793 |
| (-) wages burdened on capital operations | 14 | 146 | | 146 | |
| Wages of operating activity | 9,383 | 97334 | 3,942 | 101,276 | 10,793 |

## C.4.2. Reasons of Absence

Table (C-6)

| | Current year | | Previous year | | Progress |
|---|---|---|---|---|---|
| | Sub-total | Total | Sub-total | Total | % |
| Total No. of working days | | 5,029,836 | | 5,453,731 | 92 |
| Normal reasons of Absence: | | | | | |
| Missions | 057,371 | | 078,834 | | |
| Formal holidays and vacations | 465,162 | | 118,722 | | |
| Fridays and weekly rests | 088,875 | | 514,568 | | |
| Annual holidays | 273,135 | | 284,283 | | |
| Total | | 0,884,543 | | 0,996,407 | 89 |
| Net of available working days | | 4,145,293 | | 4,457,324 | 93 |
| Abnormal reasons of Absence: | | | | | |
| Illness holidays | 78,350 | | 68,470 | | |
| | 22,973 | | 25,065 | | |
| Absence by permission | 08,255 | | 08,882 | | |
| Absence without permission | 05,456 | | 05,671 | | |
| Total | | 0,115,034 | | 0,108,088 | 106 |
| Net of actual working days | | 4,030,259 | | 4,349,236 | 93 |

## C.5 Cash Budget

Table (C-7)

(,000 LE.)

| | Local | | | Foreign | Total |
|---|---|---|---|---|---|
| | Services | Business | Private | Free | |
| Total of cash payments | 199,920,261 | 113,185,203 | 178,063,597 | 259,795,373 | 750,964,434 |
| Total of cash sources | 019,998,744 | 249,555,965 | 476,914437 | 009,487,960 | 755,957,106 |
| Surplus | -179,921,517 | 136,370,762 | 298,850,840 | -250,307,413 | 004,992,673 |
| (-) Beginning balance | -760,610,260 | | | | |
| (+) Surplus | 004,992,673 | | | | |
| Balance | -755,617,587 | | | | |

# Appendix (D)

# Production Capacity

## D.1 Volume of Production Capacity

Form (3/1)

Table (D-1)

| Product | unit | Maximum capacity | | Available capacity | | production program capacity | Production of current year | | | | | | production of previous year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | current year | previous year | current year | previous year | | begin-ning. balance | actual produ-ction. | according to ratios of capacity | internal usage | sold | Closing balance | | |
| | | | | | | | | | | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

## D.2 Production Capacity by Production Processes and Cost Centres

Form (4/1)

Table (D-2)

| production processes and cost centre | type of machines | capacity in the beginning period | | | | Added capacity | | | | Excluded capacity | | | | Net of capacity | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of machines | No. of working hours a day | No. of working days in a period | No. of working hours of machines in a period | No. of machines | No. of working hours a day | No. of working days in a period | No. of working hours of machines in a period | No. of machines | No. of working hours a day | No. of working days in a period | No. of working hours of machines in a period | No. of machines | Net No. of working hours |
| | | | | | | | | | | | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

## D.3 Production Capacity by Time

Form (5/1)

Table (D-3)

| Production processes | Net No. working machines hours in a period | Total No. of operating hours production program | | Total No. of estimated operating hours of actual production | | Total No. of actual operating hours of actual production | | Un-exploited capacity | | | | | | Efficiency variance of capacity usage | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Un-planned | | | | | | |
| | | No. of hours | Operating level | No. of hours | Operating level | No. of hours | Operating level | Planned | Maintenance | Un-available material | Un-available orders | etc. | Total | No. of hours | Reason |
| | | | | | | | | | | | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

## Materials Variances

### D.4. Efficiency variances in materials usage

Form (7/1)

Table (D-4)

| Materials | Unit | Standard Qty. | Actual Qty. | Variance | Variance ratio % |
|---|---|---|---|---|---|
| | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

(the report includes a notice that it is difficult to fill this report in automotive industry because of there is a lot of components of a product. One product maintain thousands of parts.)

## D.5. Price Variances of Direct Materials

Form (14/1)

Table (D-5)

| | Unit | Usage quantity | | Average cost of usage per unit | | Actual cost of materials | Target cost of materials | Difference | |
|---|---|---|---|---|---|---|---|---|---|
| | | Local | Import | Actual | Targeted | | | Value | % |
| | | | | | | | | | |

(General Administration of Costing & Budgeting, Performance assessment reports, 1997).

(the report includes a notice that it is difficult to fill this report in automotive industry because of there is a lot of components of a product. One product maintain thousands of parts.)

## D.6 Production Surplus Variances

Form (2/3)

Table (D-6)

(,000 LE.)

| | Price variance | Cost variance | Mix variance | Total | Remarks |
|---|---|---|---|---|---|
| Variance of production surplus | | | | | |
| Surplus variance of business for others & sold services | | | | | |
| Total variance | | | | | |

## D.7 Assembly Lead Time for some Buses Products

This appendix indicates to assembly lead times of the buses: (i) heavy bus, model 871, code BF7; (ii) modified bus, model 965/924, code BF4; and (iii) Mini-bus, model 921, code MF3. Tables (D-7), (D-8), (D-9) show assembly lines for the above products and number of work centres in each line. Also, it illustrates lead time for each line based on Work Study Division at the company. Lead time indicates to the time spend from starting entering a product till out of the end of assembly line.

Table (D-7)

lead time for assembly lines of heavy bus

Model 871, Code BF7

| Assembly line | No. of W.C. | Lead time in minutes | Lead time in hours | Time of sequence the product | Remarks |
|---|---|---|---|---|---|
| 1. Assembly of skeleton components | 11 | 1122.8 | 18.40 | 119 Minutes | |
| 2. Construction of wood floor | 1 | 105 | 1.45 | 105 | |
| 3. Sheet metal line | 10 | 1042 | 17.20 | 116 | |
| 4. Prime painting line | 20 | 1778 | 29.40 | 114 | |
| 5. Preparing bus line | 12 | 1316 | 22.00 | 119 | |
| 6. Finishing & chairs | 4 | 418 | 7 | 115 | finished product (prime painting) |
| 7. Second painting | 10 | 898 | 15 | 108 | Finished product (various painting) |
| Total | 68 | 6679.8 | 111.25 | | |

Assembly lead time from starting point in skeleton assembly till finishing the product is approximately 16 days. (111.25 hours / 7 lines = 15.9 days).

Table (D-8)

lead time for assembly lines of modified bus

Model 965/924, Code BF4

| Assembly line | No. of W.C. | Lead time in minutes | Lead time in hours | Time of sequence the product | Remarks |
|---|---|---|---|---|---|
| 1. Assembly of skeleton components | 11 | 1037 | 17.15 | 110 Minutes | |
| 2. Sheet metal line | 10 | 1064 | 17.45 | 112 | |
| 3. Construction of wood floor | 1 | 96 | 1.35 | 96 | |
| 4. Prime painting line | 20 | 1776 | 29.35 | 114 | |
| 5. Preparing bus line | 12 | 1316 | 22 | 119 | |
| 6. Finishing & chairs | 4 | 412 | 6.5 | 106 | finished product (prime painting) |
| 7. Second painting | 10 | 899 | 15 | 108 | Finished product (various painting) |
| Total | 68 | 6600 | 110 | | |

Assembly lead time from starting point in skeleton assembly till finishing the product is approximately 15.5 days. (110 hours / 7 lines = 15.71 days).

Table (D-9)

lead time for assembly lines of Mini-bus,

Model 921, Code MF3

| Assembly line | No. of W.C. | Lead time | | Time of sequence the product | Remarks |
|---|---|---|---|---|---|
| | | in minutes | in hours | | |
| 1. Assembly of skeleton components | 11 | 640 | 10.40 | 60 Minutes | |
| 2. Sheet metal line | 10 | 574 | 9.35 | 60 | |
| 3. Construction of wood floor | 1 | 55 | .09 | 60 | |
| 4. Prime painting line | 20 | 1172 | 19.30 | 60 | |
| 5. Preparing bus line | 12 | 700 | 11.40 | 60 | |
| 6. Finishing & chairs | 4 | 226 | 3.35 | 56 | finished product (prime painting) |
| 7. Second painting | 10 | 583 | 9.45 | 60 | Finished product (various painting) |
| Total | 68 | 3950 | 65.83 | | |

Assembly lead time from starting point in skeleton assembly till finishing the product is approximately 9.5 days. (65.83 hours / 7 lines = 9.4 days).

Table (D-10) shows planned labour and standard production in a shift for each product at the line level.

Table (D-10)

planned labour and standard production of the three products

| | W.C. | Heavy bus | | Modified bus | | Mini-bus | |
|---|---|---|---|---|---|---|---|
| | | labour | Qty/ a shift | labour | Qty/ a shift | labour | Qty../ a shift |
| 1. Preparing a skeleton | 111 → 212 | 41 | 3.5 | 32 | 3.5 | 37 | 6.1 |
| 2. Assembly a skeleton | 220 → 237 | 42 | 3.5 | 47 | 3.5 | 36 | 6.1 |
| 3. Construction of wood floor till automatic doors | 310 → 380 | 27 | 3.5 | 19 | 3.3 | 14 | 6.1 |
| 4. Sheet metal line | 410 → 419 | 47 | 3.5 | 43 | 3.3 | 36 | 6.2 |
| 5. Prime painting line | 501 → 520 | 37 | 3.3 | 37 | | 39 | 6.1 |
| 6. Second painting | 551 → 560 | 20 | 3.3 | 20 | | 21 | 6.1 |
| 7. Preparing bus line | 601 → 712 | 97 | 3.3 | 94 | 3.6 | 78 | 6.2 |
| 8. Finishing & chairs | 810 → 860 | 15 | 3.4 | 15 | 3.5 | 15 | 6.2 |
| Total | | 326 | | 37 | | 276 | |

As we notice above tables, there is seven lines to assemble each product and different work centres are established in each line. Table (D-11) explains a pattern of lead time for each work centre in Skeleton Assembly Line.

Table (D-11)

lead time for each work centre in skeleton assembly line.

| | |
|---|---|
| PAGE | |
| PROCESS SH. NO. | T 6590 |
| STORE | 300 |

El-Nasr Automotive Manufacturing Company

Operations Planning

Hangar (3)

BF7 871

**OPERATION LIST SUMMARY**

| | | | |
|---|---|---|---|
| PART SERIAL | 2997227 | PART NO. | SET. T |
| PART DRAWING NO. | 5708 00 00 30 / 2 | PART NAME | a product of skeleton assembly |

| OP. SEQ. | WORK CENTRE | | | | | | M/C ing TIME | | OPERATION | | LABOUR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H. NO. | CODE | W. S. | L. C. | ST. | M/C. NO. | SET-UP | OP | Code | TITLE | Code | NO. |
| 010 | 03 | 220 | L. | 01 | A | | | 114 | | Rear & front stairs. | | 4 |
| 020 | | 221 | | | B | | | 103.4 | | Honing the welding. | | 3 |
| 030 | | 222 | | | C | | | 108.4 | | Readjustment | | 5 |
| 040 | | 223 | | | D | | | 99 | | Readjustment | | 6 |
| 050 | | 224 | | | E | | | 85 | | Cleaning. | | 3 |
| 060 | | 225 | | | F | | | 118 | | Painting. | | 3 |
| 070 | | 226 | | | G | | | 57 | | Drying-up. | | - |
| 080 | | 227 | | | H | | | 109.5 | | Ass. the internal parts. | | 4 |
| 090 | | 228 | | | J | | | 119 | | Sheet metal of sides & floor. | | 4 |
| 100 | | 229 | | | K | | | 95 | | Inspection. | | 4 |
| 110 | | 230 | | | L | | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| PREPARED | | CHECKED | | DATE | |

(Operations Planning Administration in the Company, 1998).

* It should be noticed that the lead time to complete a product and out from this line is 1122.8 minutes i.e. 18.40 hours. Number of labour required is 42 workers.

** Data is available for all production lines of the three products.

Table (D-12)

Deviation of lead time in compared to a product 871 and finished product in store and on order (WIP)

| Product | Code | Model | on order | in store | Difference of time | Remarks |
|---|---|---|---|---|---|---|
| Heavy bus | BF7 | 871 | 40 | 6 | 0 | |
| H.D heavy bus | BF8 | 935 | - | 20 | +5% | |
| Carriage heavy bus | B61 | 966/1 | 58 | 67 | +5% | |
| Heavy bus | B21 | 977 | - | 109 | +5% | |
| MAN heavy bus | B23 | 982/1 | 33 | 67 | +10% | |
| Heavy | B22 | 976 | 33 | 65 | +10% | |
| Renow heavy bus | B62 | 978 | - | 158 | +15% | |
| Renow heavy bus | B63 | 985 | 57 | 55 | +15% | |
| Public carriage heavy bus | B04 | 966/1 | 41 | 55 | +20% | |
| Modified | B01 | 965/1 | 51 | - | -5% | |
| Between cities | BF9 | 964 | 147 | 249 | -5% | |
| Mini-bus 'issozo' | M81 | 984 | 55 | 89 | +20% | Model 921 in above |
| Mini-bus | MF8 | 941/5 | - | 30 | +20% | " |
| Mini-bus | MF9 | 9/2 | 96 | 124 | +25% | " |

* Quantities shoed 'on order' indicate to work in progress.

# Appendix (E)

# Inventory

## E.1 Materials and parts inventory

Table (E-1)

(,000)

| Store | Book value as in 30-06-97 |
|---|---|
| Production open air | 03,676 |
| Standard parts | 12,571 |
| Weels of trucks | 02,877 |
| Air engines | 07,300 |
| Chassises | 22,638 |
| Bus skeleton | 07,339 |
| Tractors | 01,502 |
| Water engines | 00,734 |
| Batteries of trucks | 00,293 |
| Paints of trucks | 01,592 |
| Tools case | 00,403 |
| Samples | 00,001 |
| Finished engines | 00,272 |
| Sluggish inventory | 01,693 |
| Thunderflash | 00,003 |
| Passenger cars | 09,107 |
| Engines 1500 | 00,655 |
| Case of tractor tools | 00,324 |
| Total parts on assembly lines | 08,118 |
| Lots of trucks | 02,566 |
| Lots of passenger cars | 02,237 |
| Sluggish isolation committee | 02,309 |
| Fabricating stores | 45,272 |
| Parts on fabricating lines | 05,447 |
| Total | 138,929 |

(Information centre at the company, leaflet about company achievements, 1997).

## E.2 Semi-finished production inventory

Table (E-2)

| Type | Quantity "unit" | Value LE |
|---|---|---|
| Different models of engines | 17 | 00,362,554 |
| Different models of buses | 122 | 20,381,135 |
| Different models of lorries | 9 | 2,082,259 |
| Passenger cars (1400 shahein) | 500 | 12,514,000 |
| Gearbox and Compressors | 3 | 00,109,933 |
| Air conditions | 2 | 00,025,144 |
| Different parts in design | | 00,010,282 |
| Engines in process (business for others) | | 00,188,666 |
| | | 35,673,973 |

(Information centre at the company, leaflet about company achievements, 1997).

## E.3 Finished production inventory

Table (E-3)

| Product | Qty. | Unit cost | Total cost | Selling price | Sales value "unit" |
|---|---|---|---|---|---|
| **Lorries:** | | | | | |
| -Military Nasr Lorry 4*4 | 171 | 086,46 | 14,785 | 127,50 | 21,803 |
| -Saturn Nasr Lorry | 185 | 071,73 | 13,271 | 093,00 | 17,205 |
| -Modification Nasr Lorry 190 | 084 | 134,27 | 11,278 | 155,00 | 13,020 |
| -Daily Nasr Lorry | 451 | 062,29 | 28,091 | 068,00 | 30,668 |
| -Heavy Nasr Lorry 2*4 | 003 | 244,68 | 00,734 | 275,00 | 00,825 |
| Heavy Nasr Lorry 4*6 | 002 | 250,53 | 00,501 | 292,00 | 00,584 |
| **Buses** | | | | | |
| -Bien El Mudun Nasr/ 923 | 004 | 186,1 | 00,744 | 235,00 | 00,940 |
| -Modification Nasr Bus/ 924 | 067 | 148,48 | 09,948 | 175,50 | 11,725 |
| -Heavy Nasr Bus 871 | 089 | 334,92 | 29,807 | 465,00 | 41,385 |
| -Tourist Coach Nasr 966 | 023 | 312,97 | 07,198 | 450,00 | 10,350 |
| -Renow bus | 006 | 308,45 | 18,510 | 308,45 | 01,851 |
| -Nasr Mini Bus 941 | 027 | 096,10 | 02,595 | 095,00 | 02,565 |
| -Micro-bus (Comby) | 080 | 000,88 | 07,040 | 090,00 | 07,200 |
| **Passenger Cars** | | | | | |
| -Nasr Dogan | 636 | 035,54 | 22,604 | 046,76 | 29,742 |
| -Tempra car | 089 | 048,04 | 04,276 | 069,60 | 06,221 |
| -Nasr Sahin 1300 | 003 | 024,91 | 00,075 | 032,39 | 00,097 |
| -Nasr Sahin 1400 | 324 | 024,64 | 07,983 | 033,00 | 10,692 |
| -Nova 128 | 001 | 019,92 | 00,020 | 025,00 | 00,025 |
| **Tractors** | | | | | |
| Yugoslav Tractor | 046 | 026,91 | 01,238 | 028,50 | 01,311 |
| **Engines** | | | | | |
| Engine 614 B | 515 | 020,34 | 10,475 | 029,20 | 15,038 |
| Engine 614 L | 123 | 018,96 | 02,332 | 028,80 | 03,542 |
| Engine 614 O | 011 | 015,55 | 00,171 | 028,80 | 00,317 |
| Engine 190 | 042 | 032,40 | 01,361 | 059,00 | 02,478 |
| Tractor engine 4 M | 029 | 007,11 | 00,206 | 010,42 | 00,302 |
| Engine 1500/1600 | 002 | 000,53 | 00,001 | 003,50 | 00,007 |
| **Boxes** | **083** | **003,25** | **00,270** | **003,25** | **00,270** |
| Total | | | 178,855 | | 230,163 |

## E.4. Progress of inventory

Table (E-4)

(,000 LE.)

| Code No. 13 | Inventory | 1991 | % | 1992 | % | 1996 | % | 1997 | % | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1311 | Raw materials & parts | 128,349 | 47.68 | 148,731 | 38.61 | 128,231 | 29.70 | 140,200 | 28.63 | |
| 1312 | Fuel | 000,307 | .10 | 000,359 | .09 | 000,281 | .07 | 000,314 | .06 | |
| 1313 | Spares | 004,475 | 1.70 | 005,008 | 1.30 | 004,665 | 1.08 | 004,271 | .87 | |
| 1315 | Scrap (or remains) | 000,193 | .07 | 000,614 | .16 | 000,082 | .02 | 000,052 | .01 | |
| 132 | Semi-finished production | 025,267 | 9.40 | 088,436 | 22.96 | 137,615 | 31.88 | 169,455 | 34.36 | |
| 133 | Finished products | 043,224 | 16.00 | 049,560 | 12.87 | 054,962 | 12.73 | 054,033 | 10.96 | |
| 134 | Consignment | 059,929 | 22.30 | 082,446 | 21.41 | 086,415 | 20.02 | 088,604 | 17.97 | |
| 135 | Goods for sale | 000,408 | .15 | 000,457 | .12 | 000,642 | .15 | 000,374 | .08 | |
| 136 | Credence for foreign suppliers | 007,166 | 2.70 | 009,550 | 2.48 | 018,800 | 4.35 | 035,828 | 7.26 | |
| | Total | 269,318 | | 385,161 | | 431,693 | | 493,131 | | |

# Appendix (F)

## Production Costs

### F.1 Analysis of Production Cost Average per Unit

Table (F-1)

| Products | 1996/97 | | | | 1995/96 | | | |
|---|---|---|---|---|---|---|---|---|
| | Raw materials & Components | Direct labour cost | Manufacturing overhead costs | Total | Raw materials & Components | Direct labour cost | Manufacturing overhead costs | Total |
| Buses | 166,018 | 13,647 | 19,237 | 198,902 | 140,193 | 8,840 | 17,905 | 166,938 |
| Lorries | 102,973 | 03,594 | 05,254 | 111,821 | 86,266 | 2,572 | 05,911 | 94,749 |
| Tractors | 027,153 | 02,273 | 02,757 | 32,183 | 32,289 | 5,851 | 01,533 | 30,673 |
| Passenger cars | 026,051 | 00,876 | 01,493 | 28,420 | 24,396 | ,766 | 01,093 | 26,255 |
| Engines | 019,304 | 01,600 | 02,358 | 23,262 | 18,952 | ,576 | ,915 | 20,443 |

(General administrative of costing & budgeting at the company, Annual performance assessment report, 1997).

## F.2 Comparison between total costs an selling price

Table (F-2)

Comparative the Products Costs and Selling Prices

| Products | 1996/97 | | | | 1995/96 | | | |
|---|---|---|---|---|---|---|---|---|
| | Production cost of unit | Marketing, Administrative cost & Interest | Total cost | Average of net selling price | Production cost of unit | Marketing, Administrative cost & Interest | Total cost | Average of net selling price |
| Buses | 198,902 | 31,118 | 230,020 | 176,918 | 166,938 | 47,932 | 214,869 | 194,425 |
| Lorries | 111,821 | 13,836 | 125,657 | 118,332 | 94,749 | 39,746 | 134,495 | 146,562 |
| Tractors | 32,183 | 03,473 | 35,657 | 29,927 | 30,673 | 5,498 | 36,171 | 27,368 |
| Passenger cars | 28,420 | 06,033 | 34,453 | 34,689 | 26,255 | 5,492 | 31,747 | 33,808 |
| Engines | 23,262 | 04,298 | 27,560 | 28,417 | 20,443 | 5,545 | 25,987 | 38,705 |

(General administrative of costing & budgeting at the company, Annual performance assessment report, 1997).

# Appendix (G)

## Semi-structure Interview Questions

Department Name: —————————— Date: ——————

Person Interviewed: ——————————

**Section One: General Information**

1. What are the substantial characteristics of your company (i.e. size; age; organisational structure; etc.)?
2. What is the scale of your company in the industry ?

**Section Two: Data About Changing the Economic policy; Competition; and Ownership Structure**

1. What are the objectives, goals and strategies of your company?
2. What is the effect of national manufacturing strategy on operating policies in your company?
3. Does your company operate independent from governmental intervention?
4. To what extent Government intervened and controlled your company's activities?
5. To what extent your company gets flexibility to developing its activities?
6. What has the nature of competition faced by your company?
7. How your company's activities changed or plan to change in response to changing the competition? What are the old and new management philosophies adopting?
8. What is the type of marketing strategy applied?.

9. Have your major markets been adversely affected by threats from new competitors or improved products from existing ones?

**Section Three: Data about the Current Manufacturing Environment:**

**A. Manufacturing Techniques:**

1. What is the type of manufacturing process in your company i.e. assembly, fabricating or both?

2. What is the kind of manufacturing techniques applied in your company ?

3. Do your entity implement or plan to implement advanced manufacturing technology in the last or the future periods?

4. Has your company replaced the traditional machines with more advanced ones? What is the effect of the machines' modernisation on the workforce's structure in your company?

5. Has your company organise programmes to induce shop floor operators to become involved in quality improvement?

6. Which type of manufacturing layout applies in your company?

7. Has your entity changed the layout in the last period? Will your company plan to change the layout in the next five years to improve the efficiency of the manufacturing process?

8. What is the extent of the support service's decentralisation of the manufacturing processes in your company?

9. How many manufacturing operations in your company?

10. How could a shop order to be release? How is observe equipment and individual are available for a shop order or operation?

11. How could control an operator on the shop floor? Are there standard times used for each operation? What is the average lead time of a shop order?

12. Do actual lead production time including operating time, waiting time, other are reported for each operation? If not, how could you know the reasons of delay?

13. What is the reason of disruption the production i.e. lost of materials, parts, worker, rush orders machine breakdown and to whom a worker report? How do you know about missing worker, material, tools?

14. Does a worker report finishing a job and any machine problems?

**B. Production Setting:**

1. What is the kind product setting, multi-product or single-product in your company?

2. What are the existing and new products which produce in your company ?
Has your company promotion in the existing products or made continuous innovations of new products?

3. What is the nature of production in your company (mass or lean) ?

4. How would you characterise the production standardisation of your entity?

5. What is the type of the demand for your entity's products?

6. The capacity will affect if the entity produces numerous products in different volumes in light of changed demand. How are your entity's capacity and the bottleneck machinery change with the product mix?

7. What are the quality control systems applying?

8. What are the most important problems and obstacles that may arise during the production and has your company tried to find solutions? For instance, availability and quality of raw materials, production facilities, inventory control, or quality control?

**Production Planning and Control**

1. What is the nature of production planning in your company. For what the time-scale of plans and what are the techniques and the information used to prepare plans? How much the changes in the production plans?

2. What are the other departments that participate to put the plan? Does your company is independent in drawing its plans or affected by external pressures?

3. Do you consider the life cycle product when determining your production plans?

4. When preparing the production plans, What is the market information used to estimate the demand upon which the production plans are built? For instance, market research, historical data.

5. What are the external threats facing the company? Does the company consider them when preparing the production plans?

6. What is the importance of inventory to managing the manufacturing processes in your company?

7. How and to whom is actual inventory level reported?

8. How is the production scheduled and inventory controlled ?

9. What is the type of production planning and control system (i.e. EOQ, OPT, MRPI, MRPII, TQC, etc.) applied ? What are the developments occurred in it? What are the reasons of the change?

10- What is the most significant cost elements other than raw materials are included in manufacturing costs when preparing the production plan?

11. What the average lead time from a part leaves store till used in the first operation i.e. transportation and wail time)

12. What and How often do engineering modifications occur in parts design, structures etc. which result in changes in shop order documents?

13. What is the average lead time for changes? i.e. time among started change and production.

14. What is the extent of the required change receiving from the licenser and making in in-house production?

15- Do you operate information system/ data base in your company. What the extent of automation of this system? What is the development which the company introduced in the field of information technology?

16. How is change reflected in the data base, in the product structure?

17. What is the relation between maintenance planning and production planning department? Is the maintenance of machinery carried out regularly? What difficulties you have in carrying out this task, for instance, shortage of skilled engineers, inefficient planning system, poorly motivated operators?

18. Equipment suppliers are a basic source of information. Please, describe to what extent is updated maintenance information obtained from suppliers?

**C. Materials and Parts Supply**

1. What are the main raw materials and parts used in the production facilities? Are they imported from abroad or available locally whether by make them in-house or by buy them from domestic suppliers?

2. Do you have independent department in your company which is responsible for inspecting the purchased raw materials, parts operations and output?

3. Where and by whom is a purchase order issued?

4. Where is decision made and What are the factors which govern your company's decision to import some parts and components of the vehicle or procure them locally. For example, Government policy, company strategy, costs of production, availability of technology etc.?

5. What is the extent of the local manufacturing of the vehicles produced?

6. Given local content requirements, in your viewpoint, what are the factors governing your company's make or buy decision. For instance, non-availability of local *suppliers,* availability of investment fund?

7. What is the base for deciding purchase *from a specific supp*lier?

8. Is there follow-up from your department to the suppliers? What is the reaction *if* a supplier does not adherent to deliver on time?

9. What is usual lead time during the period from issuing purchase order to supplier and actual coming of purchased material?

10. What is the effect of rush orders on lead time in items coming?

11. What is the degree of co-operation between your company and the local suppliers?. Do you provide any technical assistance to your suppliers in order to raise product quality. For example, quality control, material testing, training, know-how?

12. Do you encounter any difficulties in your relations with your local suppliers. For example, selection main suppliers, high prices as compared to imports, services offered by suppliers, quality or high rates of rejection, availability of raw materials and parts or time of delivery?

13. Is information about confirmed purchase orders e.g. delivery time, quantity, etc. enter to the computer?

## Section Four: Data about The Cost Accounting System

### A. The Old-established Cost Accounting

1. How did old CAS design?
2. What is cost information needs of management in your company?
3. How did old CAS satisfy these required information?
4. Are cost information needs of your company differ in the contemporary environment from the old environment?
5. What is the change in management's requirements from cost information?
6. Does the old-established cost accounting system still able to provide the required information?
7. Has management changed or plan to change all or some old CAS in your company?
8. How and Why has the old-established cost accounting system change?
9. What are the factors leading to raising the production cost. For example, suppliers, production methods, labour, overhead etc.?

### B. Design Considerations

1. What were objectives designing the old-established cost accounting system: Government and financial reporting 's objectives or management and manufacturing's objectives? In other words, Do old-established CAS still play a significant role in satisfying Governmental purposes and preparing financial statements?
2. What is the best way to create an accounting system for your company compulsory or voluntary? and why?
3. In light of the new environment, do you think that the old-established CAS still could satisfy different needs of companies with different economic conditions? In other

words, Does old-established CAS still satisfy management's needs in the new dynamic environment?

4. What kind of cost accounting system do you need in your company?

5. Does your cost accounting system establish in relate to the other systems in your company? What is the degree of co-operation between cost information system and the other ones in your company, e.g. product design, production planning and control?

6. What is the biggest managerial problems in your company?

7. What is the major problems in cost accounting in your company?

## Section Five: Evaluating the Effectiveness of Cost Accounting System to Achieve Its Functions:

### A. Product Cost System

1. What is the type of the product cost system currently being used in your company (e.g. Full or Variable costing; Job or process costing)? How does it work?

2. Have you heard about the new cost accounting systems, e.g. ABC, TA, Target costing etc.? Do you believe that one of these is more suitable to your company to develop your current cost accounting system?

3. Has your company changed it because of changing the manufacturing and competitive environment?

4. What is the base used to design CAS in your company (actual or standard)?

5. What is the extent of computerised an accounting system in your entity?

6. What is the method used to evaluate the issue material pricing?

7. What is the method applied to account the employees wages?

8. What is currently the burden rate used to allocate overhead costs in your

company? Which allocation base uses? Have they changed resulting from applying advanced manufacturing technology?

9. What is the type of the cost drivers that are your company use?

10. What is the purposes of using cost allocations for your company? In other words, What is the purpose of using product costing-inventory valuation for external reporting or determine the accurate cost of the products?

11. How many cost centres in your facility and how did they design? Do they restructure because of changing the layout?

**B. Cost Control Process:**

1. Did the old-established CAS use to achieving cost control purposes in your company? If not, Has your entity installed costing system for cost control purposes?

2. Has your company applied a standard costing system or has changed to use it? Who is responsible for setting standards?

3. How standards (cost, quantity, time etc.) are established? What is its relation to the production planning and control? Are they updated in the computerised system?

4. Are operators work in light of these standards?

5. Has your company used budgets for operating control? What are the kinds of them?

6. What the role of cost accounting system in preparing the operating budgets?

7. How does setting budget link to planning the requirements?

8. Do cost variances use as feedback to prepare the operating budgets? How?

9. How control information is produced and used? To whom is it feedback? What is the time spent to make corrective decision?

10. What is the sources of cost variances in your company?

11. What is the methods used to determined control for the non-value added activities?

12. What are the types of cost reports in your company? How is the frequency to receive these reports? How long to prepare them?

13. What is the extent of detail included in control reports?

14. What are the other controls existed?

**C. The Process of Cost Reduction**

1. What is the strategy that your company adopted. e.g. cost-leadership or product-differentiation?

2. Does your company consider cost reduction as a subsequent phase to cost control. How?

3. If your company uses a product volume as a basis to allocate overhead, Does your company interest in consider other non-related volume cost drivers that cause increasing costs. What are these?

4. Does your company success to eliminate cost drivers, How?

5. What are the methods that your company adopted in order to reducing costs?

6. Does your company interested in reducing costs for current products only or the potential products either. Why?

7. What is the stage to be cost reduction considered. e.i. production stage only or pre-production stage either. e.g. design, planning?

**D. Decision Making Process:**

1. What are the kinds of decisions to be made in your company i.e. pricing, make or buy, etc.?

2. What is the role of cost data analysis play for decision making in your company?

3. What is the cost theory applying for pricing decisions?.

Does still optimal for your entity to use full costing as the correct basis for deciding whether a product should be included in the entity's product portfolio?.

4. What are the concepts of production capacity used in your company?
5. How do your company planning and measure production capacity?
6. Does your company make cost analysis of production capacity for decision making? How?
7. The predictability of sales volumes plays important role to determine the usefulness of the cost information (or allocations) to selecting product pricing policy. Which product pricing policy uses for pricing your company's products in relation to product sales volumes(low or high)?
8. Has management changed or plans to change its cost accounting system for support decision making?. What and How this change is?