UTILISATION OF MIS IN MANUFACTURING INDUSTRIES

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by

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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any technikon or university for a degree.

Signature:_____ Date:_____

The promotor, Professor P J S Bruwer, has accepted this final version of the thesis.

Signature:_____ Date:_____

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ABSTRACT

Management information systems can be defined as information systems using formalised procedures to provide managers at all levels, in all functions, with appropriate information from all relevant sources, to enable them to make timely and effective decisions for which they are responsible. There is, and continues to be, an awareness in society that accurate and timely information is a vital resource of any organisation, and that an effective management information system is a means of providing the needed information. Many top management people are finding that information is a source of competitive power. It gives them the ability to out-manoeuvre their rivals at critical times, especially when introducing new products. Effective management information systems allow the decision-maker (i.e.. the manager) to combine his or her subjective experience with computerised objective output to produce meaningful information for decision making (Thierauf, 1984:22).

Managers must also learn how to state their wishes with precision. Management information systems (MIS) produce only what is asked, which may not be at all what is required. For effective use of information technology, managers must be able to define their information requirements as well as understand computer capabilities and limitations (Hussain and Hussain, 1995:8).

The primary objective of this research was to establish the impact of utilising management information systems (MIS) and applying information technology on the success of manufacturing industries. The other aim of the study was to investigate the extent of utilising management information systems and applying information technology in these industries. The study focused on medium- and large-scale chemical manufacturing companies in the Cape Metropole area that have operated for at least the past five years.

A questionnaire was developed to collect the empirical data. Copies of the questionnaire were distributed to the full population of 30 chemical manufacturing companies in the specified area. Six people from each company were asked to complete the questionnaire, i.e. two people from each management level, namely, top, middle and supervisory

management level. A total of 132 completed questionnaires were collected for the empirical research, giving a response rate of 73%.

The computer software application that was used to do the data analysis was BMDP (Dickson, 1981). Frequency analysis and multiple regression analysis were done to analyse the data.

The results of the analysis indicate that most of the managers of the manufacturing companies appear to be aware of the capabilities and use of MIS for their business success. However, there are still some managers who are unaware of MIS.

It was also found that utilisation of MIS and applying information technology in manufacturing companies have a positive impact on their success. The results of the study also determined that there are some manufacturing companies that do not apply management information systems. The managers in these companies need to learn the advantages and capabilities of MIS to be competitive in the business world.

To Kib with love

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CHAPTER 1: INTRODUCTION AND PROBLEM DEFINITION

1.1 Introduction

It is widely acknowledged that information technology has revolutionised procedures within organisations. Yet if one looks at some organisations, one will find that the pace of change has been slow and there is not much evidence of a revolution. In many organisations the availability of expensive equipment does not seem to be making much contribution to the goals of the enterprise. It often seems that researchers and suppliers are in the midst of exciting new technological breakthroughs whilst potential user organisations are still trying to assimilate yesterday's technology. The pace at which technological developments are taking place today means that organisations are perpetually having to decide what is worth using and how it should be used.

An organisation succeeds by bringing together and managing certain resources in a productive way. The traditional list of resources comprises labour (manpower), money, material, managers, machines and facilities. Only over the past two decades has information come to be recognised as another resource, one that is crucial to the management of others and one, which under certain circumstances, may be substituted for them cost-effectively.

Information shares many properties with other resources: it has value and lends itself to the process of management. Information is a valuable resource and hence must be managed in a well-designed system so that managers are able to obtain relevant information timeously for their decision-making processes.

The difference between successful organisations that reach their goals and unsuccessful organisations that do not is manifested by full utilisation of resources. One of the resources available to organisations is the availability of useful information that enables managers to make decisions for directing the organisations. The availability of such information, as and when it is needed, is a great asset and may very well determine the success of the

company. Conversely, the lack of sufficient information when it is needed may be one of the factors that have a negative impact on these businesses.

According to Lauden and Lauden (1995:xi), now and in the foreseeable future, the success of a business, whether it becomes the market leader in design and quality, the low-cost producer, or the successful innovator, will increasingly depend on the quality of its information systems and technology.

Information, the logical output of a system, is of vital importance to the managers of an organisation in order to achieve short-, intermediate-, and long-range goals. Management needs a fairly accurate measurement of its sales and cost factors for various time periods. It must maximise its income through optimum selling prices and inventory turnover while it minimises the costs of products and services. In short, management wants a combination of selling prices, turnover, costs, and profit per unit that will provide the highest return on invested capital. Given adequate information on these essential facts, management can rely more on deductive and analytical methods than on guesses and intuitive judgement, which it is forced to employ when many of the relevant facts are missing. Many wrong decisions are the result of insufficient or inadequately processed information.

There is, and continues to be, an awareness in society that accurate and timely information is a vital resource of any organisation, and that an effective management information system is a means of providing the needed information. Many top management people are finding that information is a source of competitive power. It gives them the ability to out-manoeuvre their rivals at critical times, especially when introducing new products. If the management information system does not produce the information necessary for management to handle its operations effectively, an " out- of- control" condition may result from which the organisation may never recover. An examination of business organisations that have experienced difficult times over the years will verify this fact.

Effective management information systems allow the decision-maker (i.e., the manager) to combine his or her subjective experience with computerised objective output to produce meaningful information for decision making (Thierauf,1984:22).

Information technology places a burden on managers, however. To take full advantage of information systems, managers must understand what computers can and cannot do, and must actively participate in the development of computer systems for their own special needs. The latter requires not only the ability to define problems, objectives and constraints in operational terms, but also a knowledge of problems that may be encountered in design, testing and conversion of new systems.

Managers must also learn how to state their wishes with precision. A management information system (MIS) produces only what is asked, which may not be at all what is required. For effective use of information technology, managers must be able to define their information requirements as well as understand computer capabilities and limitations (Hussain and Hussain, 1995:8).

In this information age, manufacturing industries need to be beneficiaries of information technology in order to be competitive in business. It is clear that manufacturing industries will have to organise global markets, international corporations and multinational work forces in order to maintain and expand existing business conditions.

Could the suitable application of effective management information systems in manufacturing industries determine their success in the business world?

1.2 Problem statement

As described in the previous section, the major problem that causes organisations to fail may be insufficient utilisation of the major resource of the organisation, viz. information. Managers have to be aware of utilising management information systems effectively to be competitive in the business world.

Many managers in the manufacturing industries in South Africa may be unaware of the capabilities and use of an effective MIS.

1.3 Background to the research problem

Why do some manufacturing industries in South Africa lose their market share while others are successful in the market? It could be because of an insufficient raw material supply chain, inefficient management, and a shortage of skilled manpower, or even something that has not yet received sufficient attention from manufacturing industry managers. This study intends to establish whether the answer to the above questions may lie in the assumption that using effective management information systems could play a substantial role in the success of manufacturing industries.

Most manufacturing industries are possibly already using products of information technology. However, their awareness level of applying information technology to designing effective management information systems to overcome their specific problems needs to be investigated and determined.

Most manufacturing companies are seldom able to meet their objectives using manual controls of inventory. Frequently customers are inconvenienced by out-of-stock notices because of their manual control of inventories. If a computer system is installed to monitor warehouse contents and re-order when stock levels fall below predetermined levels, customer satisfaction can be achieved by the prompt fulfilment of orders.

To be effective in today's dynamic and competitive business environment, a manager, and indeed, an organisation, must think in the system mode. Technological innovation has simplified the collection of data into sophisticated information systems. With appropriate management information systems in place, managers can focus their attention on the creative elements of management such as developing strategy, searching for new opportunities and competitive advantages, and optimising the use of the organisation's resources. Without such systems, the outcome of events will be determined by forces beyond the manager's control. As a result, no matter how "hard" people work, the future of the organisation remains at risk (Godfredsen and Deveau, 1991:38).

As Rossetti and DeZoort (1989:30) affirm, a modern business organisation must either adapt to changes in management information systems or face a decline.

This research will concentrate on determining the extent of the role of management information systems on the success of manufacturing industries. Can most of the problems that cause manufacturing industries to fail be solved by utilising effective management information systems? If it can be established that management information systems play a major role in the success of manufacturing industries, then those industries that do not apply management information systems may be persuaded to apply effective management information systems to reach their goals.

1.4 Main objective of the study

The primary objective of the research is to establish the impact of utilising management information systems and applying information technology for the success of manufacturing industries.

1.4.1 Sub-objectives

- To investigate the extent of utilising management information systems and applying information technology in the manufacturing industries in the Cape Metropole area.
- To investigate the extent of using information technology and applying management information systems in the manufacturing industries to solve their problems and facilitate decision making.

1.5 Research questions

- What is the impact of using management information systems in manufacturing industries for the success of their business?
- What is the extent of using management information systems in manufacturing industries in the Cape Metropole area?

1.6 Delineation of the study

- The study refers only to chemical and chemical products manufacturing industries in the Cape Metropole area.
- Those manufacturing industries that have been operating for less than five years will not be included in the study.
- The study focuses on medium and large size (number of employees greater than 50) chemical and chemical products manufacturing industries.
- Chemical and chemical products manufacturing industries whose manufacturing plants are not in the Cape Metropole are not included in this study.

1.7 Overview of the structure of the thesis

This thesis has three sections. The first section, Chapter 2, contains an overview of the general aspects of terminology and main concepts of the research study. In this section a broad definition of the term MIS and an overview of the chemical industry in South Africa are given. The second section contains:

Chapter 3: MIS structure and management.
Chapter 4: Planning, development and implementation of MIS.
Chapter 5: MIS of the major functions of manufacturing companies.

In this section the structure of MIS within different aspects of an organisation and the development, design and application of MIS in different functional areas of manufacturing companies are discussed and an intensive literature review is presented.

The last section, Chapters 6 and 7, contains the empirical research presentation, interpretation of results and conclusions. In this section all the methods of analysis which have been used are presented, and final conclusions, with reference to the objectives of the study, are reached.

CHAPTER 2: GENERAL CONCEPTS

2.1 Introduction

In a fast changing world, there is a great need for timely and accurate business information. In the past, it has been generally undervalued, underestimated, and underused. After the human element, business information is a manager's most important resource. A major problem facing today's managers is the volume of information crossing their desks. It is so voluminous as to be almost unmanageable; yet, good planning and control over operations via effective decisions must be based on a steady flow of quality and up-to-date information.

Given the explosive transformation from an industrial to an information society and the accelerating pace of business, a definite need has arisen for the manager to change his or her working habits to accommodate a new member of the information management team, the computer. A dialogue between the manager and the computer is essential if the manager is to be productive and effective. The computer should not interface with a manager's thought processes; instead, it should augment the individual's capabilities and become an extension of his or her mind. It is from this perspective that a need for the knowledge of management information systems arises.

For managers it is difficult, if not impossible, to manage an organisation without at least some knowledge of information systems: what information systems are, how they affect the organisation and its employees, and how they can make businesses more competitive and efficient.

This chapter first discusses the general concept of information, a system and information systems so that the reader may get a better understanding of the concept of management information system once its basic components are explained. After the need for information and information systems for organisations has been discussed, management information systems are defined. Next, definitions of the terms "manager" and "types of information" are given. The types of information needed by top, middle, and lower

management for effective decision making are also discussed, followed by a broad explanation of manufacturing industries in the Cape Metropole.

2.2 Information

Information is data that have been shaped into a form that is meaningful and useful to human beings (Lauden and Lauden, 1998:8). In its being meaningful and self-explanatory, its concept differs from ordinary data. Information is knowledge that can contribute to the general framework of concepts and facts that we know (Zwass,1992:14). Data should pass through certain processes in order to be changed to information. An information processing view of MIS is shown in Figure 2.1. In the figure, MIS is described as a nexus of a general set of capabilities: capture of data, various forms of processing to transform data into information, long-term storage of data, and provision of access to information.

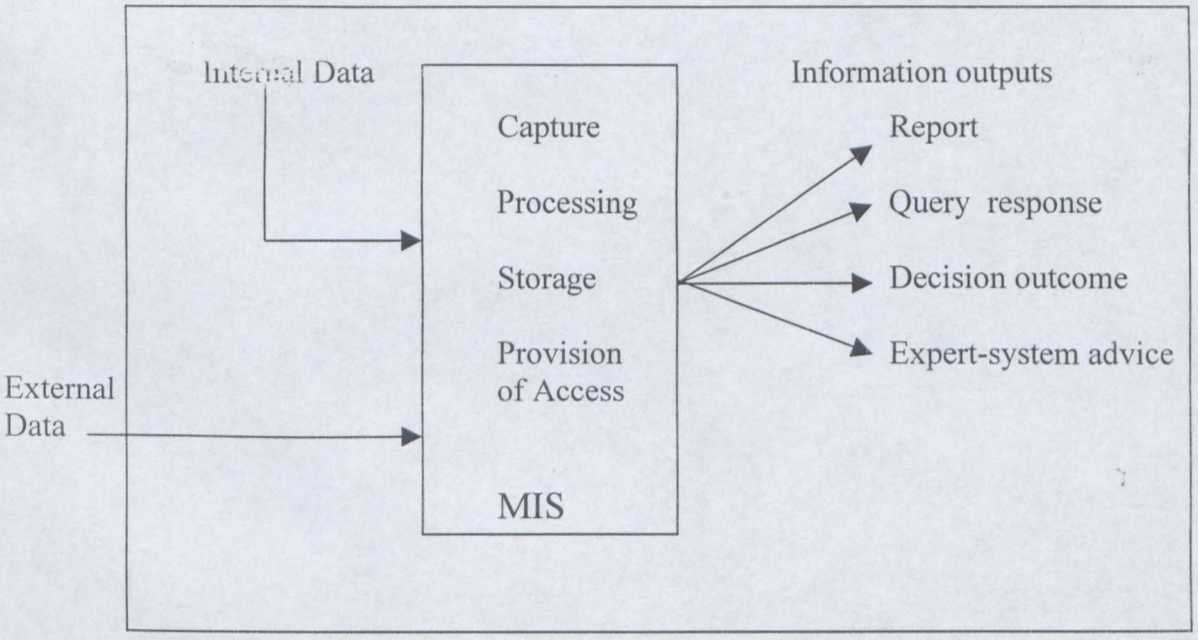

Figure 2.1 An information processing view of MIS (Adapted from Zwass, 1992:14)

Information can be obtained from either formal or informal sources. Formal sources provide information in a relatively organised and predictable fashion, for example: business forms; electronic monitoring equipment such as digital thermometers; and machine-readable purchased data such as an encyclopaedia on a computer disk. Informal

sources provide information in a less structured way and include conversation with customers, suppliers, and other employees, as well as general observation of personal and organisational activities. Indeed, any formalised information system operates within the context of informal information channels - interpersonal "networking", water-cooler gossip, or conversations with the supplier's truckers at the loading dock.

Information is what results from the thoughtful analysis, manipulation, and presentation of data in a form that will enhance the decision-making process (Long, 1989:10). The quality of information can be described in terms of its accuracy, verifiability, completeness, relevance, and timeliness. Many wrong decisions have been the result of insufficient or inadequately processed information. There is and continues to be an awareness in society that accurate and timely information is a vital resource of any organisation, and that an effective management information system is a means of providing the needed information.

2.2.1 Information as a sixth major corporate resource

Recently information has been added to the five major corporate resources, namely: money, material, machines and facility, manpower, and management. It has been recognised as a sixth corporate resource (Long, 1989:12). If information is recognised as a sixth major corporate resource, it assumes a similar value to any of the five major corporate resources. Seen from this perspective, information provided by the management information system can assist managers at all levels in performing their managerial functions of planning, organising, directing, and controlling available corporate resources.

In terms of an economic perspective that recognises information as a valuable resource, the processing of data into information costs money. As such, information may be judged by the value-added concept. Value is added to a product as it moves from the raw material state up to the point of consumption by the consumer; the same can be said for the conversion of data to information as a resource. Information has a specific monetary value associated with it just as if it were purchased from an outside vendor. The loss of a company's competitive edge occurs when critical information is not produced or is lost (i.e. an opportunity loss). Information can thus be regarded as a value-added asset that is

useful to managerial and operating personnel in a typical company for planning, organising, directing, and controlling organisational activities.

2.3 Management

Management is the process of achieving organisational goals by planning, organising, leading, and controlling organisational resources. What does a typical manager's job look like, and what information does he or she need to perform that job? The list of responsibilities and type of information needed for each manager depend on his or her level of management. The type of information and different levels of management are explained in Chapter 3, Section 3.2. Managers face a variety of challenges in performing their work in a global environment. They must deal with increasing competition, decreasing resources and rapidly changing technology. They must understand and respond to dramatic cultural differences, the imposition of legal constraints, and dynamic customer requirements.

2.4 System

A system is any group of components (functions, people, activities, events, and so on) that interface with and complement one another to achieve one or more predefined goals (Long, 1989: 33). Typically, a system accepts input. Various sub-systems work in concert to produce some kind of output. Depending on the system, the input could be like aluminium, temperature, data, information, and so on.

Systems exist in all fields of endeavour. There are social systems, fuel monitoring systems, political systems, biological systems, electrical systems, economical systems, and information systems.

A system exists within a defined boundary. The conceptual boundary includes:

- All components of the system.
- That which provides input to the system.

- That which is influenced by output from the system.

Everything is external to the system. However, just about every system is a sub-system to another system. In this study, the word "system" is always used within the context of an information system. It is easy to relate these general system concepts to information systems. The next section defines an information system.

2.5 Information system

An information system (IS) is a formalised computer information system that can collect, store, process, and report data from various sources to provide the information necessary for management decision-making (Hicks, 1993:2). In addition to supporting decision-making, co-ordination, and control, information systems may also help managers and workers analyse problems, visualise complex subjects, and create new products. Lauden and Lauden (1995:5) define an information system (IS) as a set of interrelated components working together to collect, retrieve, process, store, and disseminate information for the purpose of facilitating planning, control, co-ordination, analysis and decision-making in business and other organisations. Planning, control, co-ordination, analysis and decision-making are some of the major functions of the management of a company. The application of information systems for the purpose of management functions in the company employs the term "management information systems", which is defined in the next section.

2.6 Management information systems (MIS)

Many literature resources indicate that there hasn't been common agreement on the definition of management information systems (MIS) to date. Terms such as information systems, information services, or information processing systems, often used as synonyms for MIS, refer to an information system that supports transaction processing and management decision-making functions.

MIS has been called a method, a function, an approach, a process, an organisation, a system, and a sub-system. Here are some of the definitions of MIS given by different authors and practitioners.

A management information system is an organised portfolio of formal systems for obtaining, processing, and delivering information in support of the business operations and management of an organisation (Zwass, 1992:6).

Gupta (1996:6) defines MIS as a broad class of systems that provide decision-makers with the information necessary to make effective decisions in a world that has almost overnight become an "electronic show room". Such systems are competitive tools that allow organisations to create new, innovative products and services quickly, efficiently, and effectively.

Management information systems (MIS) deal with the planning for, and development, management and use of information technology tools to help people perform all tasks related to information processing and management (Haag, Cummings and Dawkins, 1998:4).

MIS is an information system at the management level of an organisation that serves the functions of planning, controlling, and decision making by providing routine summary and exceptional reports (Lauden and Lauden, 1998:43).

Management information systems are the most common forms of management support systems. They provide managerial end users with information products that support much of their day-to-day decision-making needs (O' Brien, 1999:6).

Optimally, every MIS professional and user should share a common working definition of a management information system. That being unlikely, the next best thing is for decision-makers in a given organisation to reach a common understanding of the purpose, scope and objectives of an MIS.

For the purpose of this study, summarising all the above definitions given by different MIS professionals, MIS can be defined as an information system using formalised procedures to provide managers at all levels, in all functions, with appropriate information from all relevant sources (both internal and external to the industry), to enable them to make timely and effective decisions for which they are responsible.

Since the late 1960s, MIS, a field of over a quarter century's standing in practice and a subject of research, has been defined as an integrated, computer-based, user-machine system that provides information for supporting operations and decision-making functions. Its key elements are:

- Integrated system to serve many users.
- Computer-based system that integrates a number of applications through a database.
- User-machine interface that gives instant response to ad hoc inquiries.
- Providing information to all managerial levels.
- Support of operations and decision-making functions.

These elements tell us that MIS can be an important organising medium. Developing MIS means creating a new environment in which to manage a business (Awad, 1988: 5).

2.6.1 Historical overview of MIS

The intellectual roots of management information systems go back to the study of management as a process in which the crucial aspect is decision making. The most prominent work, laying the foundations for this approach, was *Administrative Behaviour* by Hebert Simon, an influential book that appeared in 1974. The late 1940s and early 1950s saw the development of Norbert Wiener's idea of cybernetics and Ludwig Von Bertalanffy's general system theory - both searching for a general theory of control and communication in human and mechanical systems. A classical paper by Clude Shannon, in 1948, led to the technical conceptualisation of the idea of information. The fundamental notions of decision making, information, systems, and their control have their own lives in

the reference disciplines. These notions have also influenced thinking on the role of information in organisations; that is, the focus of the field of MIS (Zwass, 1992:20).

Management information systems are unthinkable (well, perhaps only "thinkable") without computers. Technological developments related to computers and digital communications have continually driven the field in both practice and research. Many areas of research in MIS overlap with the work done by computer scientists.

The first general-purpose electronic computer, ENIAC, was completed in 1946 at the University of Pennsylvania (Zwass, 1992:24). Developed in response to problems encountered by the military during World War II, computers were thought of at that time as devices for solving their problems precisely. Today, the predominant tasks of computers are storing, accessing organised information, and processing symbols. Calculation is just one of the several functions computers perform.

Mass production of computers started in 1951 when UNIVAC I was delivered commercially as the first such machine built on an assembly line. UNIVAC I was also the first computer model used for business data processing when it was installed by General Electric in 1954. However, MIS as an area of practice had a rather slow start, with only some 4000 computers installed by the end of the 1950s (Dickson, 1981:2).

The organisational computing landscape was revolutionised by the emergence of personal computers in the late 1970s. When appropriate software become available, the personal computer facilitated end-user computing, furnishing an accessible means for users to develop their own applications and become true partners of MIS professionals in the use of technology for organisational benefit.

The last decade has seen an unprecedented rate of development of computer hardware and software, which has created the opportunity for sophisticated data collection, its conversion to meaningful information, and the retrieval and communication of that information. During this period the concept of MIS has evolved from earlier uses of computers for data processing. It is now defined to include everything that deals with the computer-assisted

flow and presentation of information, and can be considered not only to support the data-processing function of data transmission, data handling and record keeping, but to provide much more. For example, the use of database, artificial intelligence and graphics concepts in MIS has created the potential for large-scale, coherent and secure connectivity of information across all management levels.

However, apart from overall cost-benefit analysis, little attention has been paid to assessing the inherent contribution of MIS to an organisation. There is a growing concern about whether the true capability of MIS is being realised. Most MIS can be shown to improve the quantity, accuracy and timeliness of information in organisations, but the extent to which this improves the performance of the organisation is not so clear (Wolstenholme, Henderson, and Gavine, 1993:2). The work on this thesis centres on the issue of utilisation of MIS and its impact on the organisation.

2.6.1.1 Technological change in MIS

MIS, developed in the early 1970s , is now a full-fledged business support system. In this section, the major stages of technological change in MIS development and how they evolved are highlighted (Awad, 1988:10).

- Isolated computing: - the first stage, isolated computing, began in the early 1960s when computers were housed in their own rooms and run by youthful "supermen". The major activities were cost reducing, data processing applications such as payroll and accounts receivable. The computer, viewed as a tool for reducing operating costs, became a saviour for many firms. Data processing managers were promoted and rewarded by their organisations.

  Despite these feats, the computer was not utilised to its full potential. Management was lax. Controls were lacking.

- Consolidated computing: - Consolidated computing represents the mid-to late 1960s, when computer functions were merged into a computer centre facility. There was a

surge of applications in all functional areas. General ledger, forecasting, and inventory control were typical applications. The rush to complete projects resulted in poor documentation and high maintenance costs caused by program errors. The programming staff grew and costs escalated. In most computer installations, no one knows exactly how much was spent on computer operations.

At the end of the 1960s, organisations began to realise that technological feasibility was not enough to justify further expansion; with no additional funds allocated for data processing, management put a freeze on new applications. This set the tone for stage 3- management controls and restraints.

- Management controls and restraints: - The third stage, management controls and restraints, started in the early 1970s. It was a period of belt tightening; computer centres began to charge users for computer services. Efficiency in computer operations and services became a paramount objective.

- Embedded computing:- The fourth stage unfolded in the mid-to late 1970s. The pent-up demand for implementing computer technology and the appearance of application software packages signalled a greater demand for the computer professional. Of significance was the rising role of the user who, by then, was computer literate and could become a partner in the computer processing function. This meant the MIS manager had to evolve from a technician into a manager with interpersonal and administrative skills.

The proliferation of minicomputers, database and distributed computing during this stage laid the foundation for MIS. In distributed computing, computer power is provided at the user's level and linked to the mainframe for higher-level processing and reporting.

Embedded computing allows the end user to access files via a terminal linked to a remote computer. During this stage in MIS development, heavy emphasis was placed on single, ad hoc inquiry into databases for decision making.

- The user-machine interface: - In the early to mid-1980s, emphasis switched to the user-machine interface and MIS was transformed from a formerly program-oriented transaction support system and from "single-thread" applications such as payroll to user-oriented decision support systems (DSS) that handled multiple applications and enquiries. MIS was now a user-oriented, user-friendly, user-driven environment with emphasis on structured programming, ad hoc inquiries, and real-time information access.

2.6.1.2 Where is MIS going?

The goal of MIS is to provide an adequate environment for the support of various organisational and managerial decisions. MIS has been viewed as a "federation of subsystems … conforming to an overall plan" (Davis and Olson, 1984:10). The primary extensions of the MIS concept in shaping information systems are decision support systems (DSS), expert systems (ESS), office support systems, and end-user computing systems.

- **Decision support and expert systems**

  DSS, or the managerial use of computers, is a type of MIS - a computational aid to help managers integrate judgement, experience, and insight for improving their performance as managers. It examines alternatives in semi-structured, decision-making situations. Using simulation and decision models, the interactive dialogue allows trial and error search for feasible solutions.

  DSS represents a step away from the traditional toward the personal computer (PC) linked to the mainframe. Such an environment encourages users to interface with a computer for addressing "what if" situations in business.

  An expert system is one type of artificial intelligence that allows a novice user to achieve results comparable to those of an "expert" in a specific decision-making area. An expert system transforms computers that have always been "dumb" calculators into machines that draw conclusions from a massive database. An intelligent terminal is a

system with memory, processing capability, and the ability to accept input and produce output. The personal computer is an example of an intelligent terminal.

Expert systems (arbitrarily called expert support systems as ESS) can also be viewed as one aspect of DSS. Their knowledge base and decision rules represent "expert" thought processes.

An expert system "learns" from each episode and uses it to ask fewer or different questions for a final decision.

- **Office support system**

  An office support system covers the day-to-day functions of office personnel managers and professional personnel, including secretaries. Until recently, the term was restricted to word-processing. Today it includes administrative functions such as electronic mail, electronic filing, and processing of images, voice, data and text.

- **End-user computing**

  End-user computing has been called different names, including DSS. As the term implies, the objective of this system is to help end users, managers, and professionals to make timely decisions by interacting directly with the computer. To implement this environment, the system must incorporate tools such as query and report generators, electronic spreadsheets, financial models, statistical analysis programs, and graphic display routines.

  End-user systems tend to overlap with office support systems. The data generated by a data processing system are presented in graphic or tabular form in reports prepared on the word-processor. The reports may also be transmitted to other managers via electronic mail or filed in an electronic filing system for later retrieval.

  The trend in MIS is to get closer to the user and expand the information system network to allow transactions to be collected closer to their source.

This goal is being achieved by the greater availability of intelligent terminals and personal computers. Networking cuts paperwork and minimises reaction time.

DSS appears to be a step towards supporting the entire process of decision making. The current trend is to adopt expert systems that help us extend MIS by adopting the system to the cognitive styles of the end user. The goal is to establish a mutual relationship between the individual manager as a decision-maker and the information system.

2.6.1.3 The role of the personal computer in MIS

A major change has taken place in the way managers in the office and factory do their work. Wherever a visitor to a Fortune 1000 firm turns, the personal computer is performing as an aid to personal productivity, as a data processing machine, a mainframe and network link, and more. These chores are permanently changing the user's work habits (Awad, 1988:17).

The uses and applications of the personal computer are too numerous to list. The important point is that the personal computer has introduced a new way of doing business. In terms of personal productivity, lap-based or curling portable PCs help get writing, calculating, or other simple work done. These machines are used for word-processing, running spreadsheets, time management, and the like.

In the early 1980s, the personal computer was used mainly for stand-alone processing without links to the main frame. This situation is rapidly changing. As microcomputers became more powerful, end users began to inquire about accessing the wealth of information stored on the host computer to improve their decision making. With the growing sophistication of end users and their increasing demand for mainframe data, programmers and end users are co-operating in developing applications by jointly building a prototype that the user then tests. In this way, applications are built more quickly and with better results.

The PC has had a mixed impact on the MIS function in general and MIS managers in particular. Since the PC handles various applications at the user's level, the responsibility for application development is now the user's. On the one hand, this has eased the computer centre's application backlog. Yet user-originated applications have caused problems for the MIS manager who must maintain compatibility between PCs and the mainframe. Additional problems resulting from recent attempts at linking the PC to the mainframe have not all been solved or are even solvable. There are technical, organisational, and security issues that will take time to revolve.

2.7 Overview of the chemical industry in South Africa

The chemical industry in South Africa has a relatively long history, having been founded in 1896 to meet the demand for explosives (nitroglycerine) for the mining industry. During the next 50 years diversification into the manufacture of inorganic acids, fertilisers and mining chemicals occurred. Other than nitroglycerine, the main interests in organic chemicals were ethanol, from the fermentation of molasses, and petrol, from the distillation of turbinate shales (South Africa: chemical industry, 2001).

As South Africa has no oil reserves and little natural gas, the organic chemical industry has developed primarily around the gasification of coal. The establishment of a petrochemical industry can be traced to the early 1950s when the first oil-from-coal plant was built at Sasolburg. It was, however, only in the Sixties when the possibility of an organic chemical industry based on local raw materials rather than imported feedstock became possible. This development was given further impetus with the establishment of two large oil-from-coal plants at Secunda during the early 1980s, to provide strategic self-sufficiency in fuels. The synfuel sector, while serving the local petroleum industry as a source of fuels, is now also the major source of feedstocks and intermediates (South Africa: chemical industry, 2001).

The chemical industry has also been shaped by the political and regulatory environment which prevailed from 1948 to 1994. This created a philosophy of isolationism and tended to foster an inward approach, with a focus on import replacement in the local market. It also encouraged the building of small-scale plants with capacities geared to local demand.

Through isolation from international competition and high raw material prices, due to import tariffs, locally processed goods have generally been less than competitive in export markets. Now that South Africa is once more fully part of the global community, local chemical companies are focusing on the need to be internationally competitive and the industry is re-shaping itself accordingly.

Another consequence of the focus on import replacement was the building of chemical plants at inland locations close to the coal-based synthetic fuel plants, which provide feedstocks. This strategy was attractive at the time owing to the additional benefit of being sited close to the heavily populated Gauteng area which is the largest domestic market. These plants are generally smaller than world scale and their cost structures are not highly competitive in export markets, partly because of the high transport costs to coastal ports. They are, nevertheless, well placed for exports to neighbouring African countries such as Zimbabwe, Namibia and Botswana (South Africa: chemical industry, 2001).

There is evidence that there is currently a concerted effort to make the chemical industry more competitive. The South African Department of Trade and Industry has convened a number of Petrochemicals, Plastics and Synthetic Fibres workshops to analyse the problems and opportunities of a sector of the South African economy which is considered to have great potential for the future, and to develop a way forward. The Chemical and Allied Industries' Association (CAIA), a South African association which forms part of a world-wide network of chemical industry associations, seeks to promote competitiveness, and health, safety and environmental awareness in the chemical and allied industries in South Africa.

Managers of chemical industries play a great role on the competitiveness of the company. Business success results from the effective use of resources of the industry. Money, material, manpower, machines and managers have been considered as major resources of an organisation. Since the 1990s information has been added as a major resource. Chemical industries in South Africa should be encouraged to use the latest information technology in order to automate their activities and to be more productive and competitive.

Managers of chemical industries need to be aware of how to use companies' information that helps them in planning, managing, controlling and decision making.

2.7.1 Industry structure

South Africa's chemical industry is of substantial economic significance to the country, contributing around 5% to GDP and approximately 22% of its manufacturing sales (South Africa: chemical industry, 2001). This industry is the largest of its kind in Africa. It is highly complex and widely diversified, with end products often being composed of a number of chemicals which have been combined in various ways to provide the required properties and characteristics. MBendi Information Services Pty Ltd describes it by dividing it into three broad sectors:

- Primary products (feedstocks and commodity chemicals).
- Secondary products (intermediate chemicals).
- Tertiary products (speciality chemicals and processed goods).

The primary and secondary sectors are dominated by Sasol (through Sasol Chemical Industries and Polifin), AECI and Dow Sentrachem. These companies have recently diversified and expanded their interests in tertiary products, especially those with export potential. Chemical Services, in which AECI has a major stake, has been and still is a highly successful company concentrating on niche markets for a wide range of speciality chemicals.

2.7.2 Players

MBendi Information Services (Pty) lists the local players in the chemical industry as Afchem, Indian Ocean Fertilizers, National Starch and Chemicals, Next Chimica, Prochem, Somchem and Suprachem. Many multi-nationals are involved in manufacture and/or distribution; they include:

- BASF SA
- Bayer
- Ciba Speciality Chemicals
- Degussa-Hueis
- Henkel
- Hoechst
- Huntsman Tioxide
- ICI
- Röhm and Haas
- Shell SA Chemical
- Thor Chemicals SA.

2.7.3 Other participants

Chemicals and chemical feedstocks are transported in South Africa by road, rail and in some instances by pipeline. A substantial proportion is stored and moved in bulk form including marine bulk tankage, road tankers, iso-tank containers and smaller bulk tanks holding 1,000 to 2,000 litres of product. Packaged chemicals are moved in steel and plastic drums of various sizes and in various baled, bagged and palletised forms. Tanker Services, Cargo Carriers and Unitrans are major road transporters of chemicals, having large fleets. Transnet, the road arm of the South African Transport Services, is also active in this sector. Rail transport is handled by Spoornet. In the case of chemical tank containers, South Africa is one of the world's leading tank suppliers with production of over 4,000 tanks in 1995. South African tank builders account for about 30% of world production with major suppliers including Consani and Welfit Oddy. Chemical bulk storage is done by the major producers and users. There are, in addition, several storage companies which handle chemicals. These include Island View Storage which has chemicals and oil storage facilities in Richards Bay, Durban and Gauteng; and van Ommeren which has chemical storage facilities in Durban (South Africa: chemical industry, 2001).

2.7.4 Chemical markets

Markets for chemicals in South Africa are dominated by plastics and rubber, agricultural chemicals, fertilisers, paints, explosives and mining chemicals. Smaller, but nevertheless significant market sectors include fibres, adhesives and sealants, cleaning chemicals, pulp and paper chemicals, additives and catalysts.

In this study, the way in which computer technology has changed manufacturing in recent years is examined. Then the impact of these changes on management is discussed, including such questions as : Are corporations revising traditional manufacturing strategies because of the computer revolution? Can information systems contribute to competitive supremacy in manufacturing? How close have we come to computer-integrated manufacturing? Are managers embracing or resisting the concept?

CHAPTER 3: MIS STRUCTURE AND MANAGEMENT

3.1 Introduction

This chapter discuses the MIS structure, the relationship between MIS and organisational management, MIS in the manufacturing company, the competitive advantage of MIS and organisational performance. The MIS structure can be described in terms of 1) physical components (hardware, software, personnel or supporting staff); 2) managerial functions (strategic, planning, management control, and operational control); and 3) management support for decision making (unstructured, semi-structured and structured). This orientation suggests that MIS is a multi-level information system that incorporates transaction processing, decision support, and expert systems.

The application of MIS in different functional areas of the manufacturing industry to facilitate its business activities is also presented in this chapter. Information systems have become essential for creating competitive firms, managing global corporations, and providing useful products and services to customers.

Different companies may use different ways to measure the performance of their business. For several years managers have treated only financial figures as a measurement of the success of their businesses. A revolution has begun and has made managers rethink their performance measurement. They have started to consider productivity, customer services and market share as their measurement of performance.

3.2 The manager and types of information

Because the output of MIS is directed towards management, one needs to identify the type of information needed by different levels of management. They are:

- Strategic information for top management.
- Tactical information for middle management.
- Operational information for lower management.

The type of information supplied is based on the relative position of the manager in the organisation's hierarchy and the activities which the information describes - the internal environment of the organisation or the external environment in which it operates. Internal information would be increasingly summarised as the level of management for which it is prepared rises in the hierarchical structure. Higher levels of management require summary reports of internal information. The rationale is that internal data are control-oriented, and the lower and middle echelons of management are the most control-oriented; top management, on the other hand, is more planning- and strategic-oriented.

Information concerning the external environment of the organisation should be summarised exactly opposite to that describing the internal environment. Because the upper levels of management are more planning-oriented, and because planning requires more information about the organisation's external environment, information concerning the external environment should be increasingly summarised and selective as the position of the receiver decreases in the managerial hierarchy. Thus, periods of time spent on planning and controlling for lower, middle, and top management complements one another in a management information system, as illustrated in Figure 3.1 (Thierauf, 1987:13).

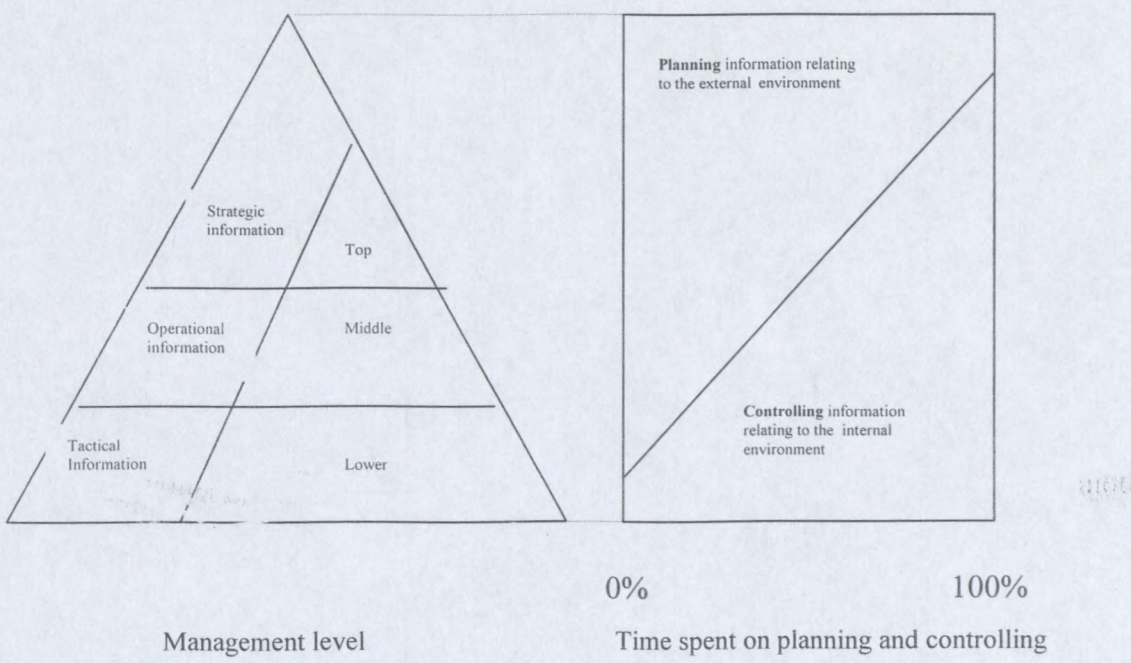

Figure 3.1 The relationship of managerial levels to time spent planning and controlling, and to the summarising of information (Adapted from Thierauf, 1987:13)

3.2.1 Strategic information for top management

Strategic information is used primarily by top management and their staff for long-term planning - generally one to five years. This type of information is used for planning and to discover the underlying reasons for specific problems or situations. In many cases, the objective of using strategic information is to answer "why" rather than "what" or "where".

Strategic planning concerns itself with the establishment of organisation objectives and policies that will govern the acquisition of resources needed to achieve those objectives. It is normally conducted at the highest level of management. Primarily, it requires large amounts of information derived from or relating to areas of knowledge outside the organisation. Finally, strategic planning is original and covers the entire spectrum of the organisation's activities.

To translate this task into the information systems area, top management must be directly involved in:

- setting directions for computer use to accomplish organisation objectives;
- setting priorities so that the limited computer resources can serve the whole organisation;
- setting criteria for selecting MIS alternatives;
- insisting that computer-use planning be as thorough as other tactical and operational planning;
- following through to ensure that broad plans are being achieved and objectives realised.

3.2.2 Tactical information for middle management

Tactical information covers relatively short time periods (not greater than twelve months); it is used by middle management to implement strategic plans at functional levels. It centres on the delineation of subordinate plans necessary for implementing a particular strategy, and then maintaining and controlling the actual performance against the defined

plans. For middle management, the concerns and decisions revolve mostly around specific funding, responsibility delegation, and follow-through. As with operational information, tactical operational data are used by a large number of people. Examples are a functional budget report comparing actual to estimated amounts, a production report evaluating assembly operations, and a vendor performance evaluation report that rates overall vendor performance.

At the middle management level, inspiring management commitment in support of system development is important. A well thought-out application can significantly affect the company's profits. Hence, management must participate in the project prioritisation process, select the best alternatives based upon cost-benefit trade-off relationships, and approve the relevant expenditure of the resources required to make things happen. They must also participate in the co-ordination between various organisational entities to resolve conflicts that may arise between the different user groups contending for limited information systems resources.

3.2.3 Operational information for lower management

Operational information, being at the lowest level, is concerned with structured and repetitive activities that are measurable in achieving specific results. It allows line managers, such as plant foremen and department heads, to measure performance against predetermined goals, including standards and budgeted figures. Similarly, operational information allows lower management to evaluate operating standards and policies and how they can be improved to assist day-by-day operations. The feedback of essential information from this low level keeps higher levels of management aware of any significant changes or results.

To the information systems department, the information user is most important, because the user triggers the development of systems and ultimately determines the success or failure of the system. But for systems to be successful, managers at the operational level who are system users must discharge certain responsibilities. They must re-examine the patterns of the past and creatively conceive new systems to increase corporate profitability,

to better control and manage the function, and to improve the efficiency of the operation. Before going forward with new systems, they should ensure that the development project is sound - that it is both economically justified and operationally feasible. Also, they should be creative, and yet not automate for the sake of automation.

3.3 Structure of MIS

3.3.1 MIS structure based on physical components

Enquiries about an organisation's management information systems are likely to produce descriptions of a physical system - hardware, software, user or operations manuals, and support staff. These are important resources of an MIS of course; however information is now recognised as one of the most important resources of a business.

3.3.1.1 The hardware

The hardware represents "what you see"- the equipment and devices that play the following four roles in the function of management information systems:

- Data input and entry: - Data must be accessible to the computer before processing. The role of the data entry staff is to enter data either through a keyboard or electronically via a scanning device using a mouse, touch, voice, or electronic sensing. Quality and accuracy of data entry are crucial.

- Processing: - Processing a transaction means acting on the data (inputting, entering, updating a file, handling enquiries, or producing a report). Systems analysts and programmers play a major role in determine how efficiently the computer processes data.

- Output: - The end-user's primary objective is to secure information (output) to meet the demands of his or her business. Output may be in the form of a screen display, a

hardcopy, voice, direct action (e.g., dispensing money at an automated teller machine), and the like.

Predefined reports are the traditional "formatted" reports (e.g. sales reports) that describe historical data, summarise transaction activities, or list performance data. In contrast, ad hoc reports have their print format and content specified by the user. Also, screen display makes it convenient for the user to view information, edit it, or react to it as needed. The role of an information system is to be responsive to user enquiries in time for the output to be useful.

- Storage: This includes main computer memory and secondary storage such as disk and tape. The role of storage is to store the programs and data for computer processing.

3.3.1.2 The software

Software is a set of instructions to the computer to perform a task. Software is classified as system software for performing internal computer functions, and applications software for problem solving. Some of the examples of system software for the personal computer are MSDOS (disk operating system), Windows and Macintosh. These groups of programs provide a way to organise and use the information placed on disks. The system software programs also control the way the PC uses application programs: how to return or write information that the programs supply to the user, and similar functions. Moreover, system software allows the user to make use of devices such as printers and disk drives with the computer. In contrast, applications software is a program the user writes to perform a specific work. Examples are payroll, student grade processing, accounts payable, and the like.

Under applications software, the database management system (DBMS) is included that controls the data to be processed by applications software. A DBMS is the software that co-ordinates files and determines how quickly the user accesses, retrieves, or updates information in the database. A decade ago, DBMS was unique to large corporations with mainframes. Today it is a common MIS component available for virtually every size of

computer. Word-processing, spreadsheet and all database software are part of application software.

3.3.1.3 Personnel or support staff

Computer operators, programmers, analysts, database administrators, technical writers, and managers who develop, operate, and maintain the information system make up the support staff.

- Computer operators do the actual loading and running of the system. This category includes data entry operators and tape librarians who control the use of various applications programs.

- Programmers write step-by-step instructions for the computer to execute. In small organisations, programmer/analysts have dual involvement in programming and systems analysis.

- Analysts are persons who start methods with a complex problem, break it down for evaluation, and design a better system.

- Database administrators are specialists whose main tasks are to design, monitor, and manage the database; resolve user conflict; and maintain the system.

- Technical writers write procedures manuals, describe technical specifications, and prepare user manuals.

3.3.2 MIS structure based on managerial and decision-making levels

Another way of classifying MIS is in terms of managerial level: lower level, middle level and top level. The structure of an information system may be described in terms of three categories of information and three levels of decision making: strategic, managerial, and operational.

- **Strategic information**

  Strategic information is future oriented, involving a lot of uncertainty. It deals with long-range policy planning, which is the task of upper management. For example, trends in financial investment, location of a plant, and how technology affects human resources would be the responsibility of senior management, from vice-presidents to the president of the firm. The time horizon is measured in months or years, depending on the nature of the decision.

- **Tactical or managerial information**

  Managerial information is useful to middle management or department heads, who focus on tactical planning and policy implementation. For example, sales analysis, production scheduling, and budget allocation involve a time horizon measured in weeks or months rather than years.

- **Operational information**

  Operational information is the short-term, day-to-day information used in operating the business. It is usually structured and well defined in advance. Examples are employee absence sheets, a decision on a customer's credit rating, and job assignment to an employee.

The nature of the information and managerial levels are also related to three categories of decision making. They are structured, semi-structured and unstructured. Lower management dealing with operational information generally makes structured or routine decisions. For example, completing a sales order is a straightforward procedure not subject to change. In contrast, upper management dealing with strategic information cannot follow a structured approach for policy planning. The nature of the decisions is judgemental and thus unstructured, not routine. For example, industry forecasts rely on a combination of experience, foresight, and judgement to determine how possible trends may affect the company's future. There is no formula or procedure that routinely predicts the outcome.

Finally, one can expect a relationship between managerial levels and the level of information detail. Lower management expects detailed operational information for

dealing with day-to-day structured decisions. Upper management, for whom long-range objectives are a major concern, requires summarised information from a variety of sources. Each managerial level may tap the information provided for lower levels, but the level of summary increases as we move up the managerial level.

MIS is a user-machine system, providing management with a comprehensive picture of specific operations. In reality, MIS is a combination of sub-information systems. In developing MIS, the designer needs to remember the objectives of the organisation, determine the type of information needed, at what level it will be used (operational, tactical, or strategic) and how it must be structured (Awad, 1988:35).

Awad notes that experience in MIS installation has shown greater success with systems that provide information for operational and managerial decisions than strategic decisions. Decision support and expert systems are now making strides in filling the gap at the managerial and strategic levels.

3.4 MIS in manufacturing industries

Manufacturing industries are companies which produce goods from raw materials. In recent years, increasing attention has been given to the role of manufacturing firms because rapidly shifting consumer tastes and heightened global pressures have necessitated shorter product design cycles and responsive manufacturing facilities (Parker, 1989:555). Manufacturing is an information-intensive activity. For example, the engineering design of a product must be communicated to manufacturing before the raw materials and parts can be ordered for making the product. Purchase orders must be sent to suppliers. The availability of raw materials in inventory must be known before production can start. Scheduling of materials and labour must be performed. Costs must be accumulated. Often, the same pieces of information flow throughout the production process from engineering to the shipment of the final product to customers.

In manufacturing firms there is also a great deal of information flow between managers in office work for decision-making processes. It includes information such as payroll details, customer orders, sales invoices, debtor statements, purchase orders, computerised stock

reports and profit and loss account reports. This type of information is used by operating personnel and various levels of management to assist them in making decisions on a daily basis. From this data they can examine overspends and adverse labour variances, collect overdue accounts from customers, and so on.

These decisions are, however, made on the assumption that this information is accurate. Naturally, the correctness of the data is dependent on the quality of the staff who prepare it, either manually or using a computer.

Similarly, the timing of decision making is equally important. A production line will grind to a halt if the chemical for a particular paint in a paint factory has not been ordered in time, or the specific chemical of a particular glue in an adhesive factory is delivered late.

In the management area, the one who makes the most successful decisions is often the one who has access to quality information as rapidly as possible, and is flexible to the changing needs of the competitive business environment in which he or she operates.

A Management information system (MIS) is a base of information used by executives, managers and decision-makers within an organisation. Often it is a highly sophisticated, computer-based system that is accurate, up-to-date and readily accessible to various users who may extract data on plans, activities or the operational situation in the business.

If the data is computerised, the manager can manipulate the information to create a series of "what if" scenarios in order to assess the consequences, prospects and risks of any particular plan, both quickly and accurately.

There are, however, major problems in the manufacturing environment. A typical case may be where an energetic entrepreneur launches into his own business to manufacture and distribute a particular product. Soon, an administrative department, responsible for purchasing, sales, invoicing and administrative work is set up, and shortly after, the production facilities are put into operation.

As the business grows, the infrastructure in the various departments increases in size, each attempting to cope with the increasing volume of paper and data. The odd personal computer is introduced to speed up month-end preparation of debtors' statements and financial accounts.

Then, the production department acquires a PC with Lotus 1-2-3 to assist in the allocation of workloads to the various production lines to plan the utilisation of its resources as effectively as possible. The computer may, for example, be used to track the product in the factory as it passes through the various cost centres. More PCs are introduced as managers realise the power of relatively cheap computers and quickly develop their own literacy in the computer field. In the process, various stand-alone software packages are installed. Regrettably, these various systems' procedures are not documented, with the result that when a staff member leaves, the company loses a vital link in its information system.

A new staff member tries desperately to understand what his/her predecessor did and in the process introduces his/her own variations to the system.

In the meantime, managers or indeed the MDs themselves, require accurate information daily to monitor the performance of the company in all its departments. This may include daily invoicing, unit price and value, production outputs, rejects, inventory levels etc. Inevitably, the information is often not readily available because of its fragmented preparation in various departments and its accuracy is therefore questionable.

The information in each department can be organised in a database system. One big database can accumulate the daily transactions of different departments and be accessed by the responsible individuals for viewing and inputting data. This integrated database can give a limited access to each department for security purposes. This is generally the idea of accessing the same centralised database to get the required information for different activities of the company. It facilitates the working atmosphere, saves time and is easily secured.

Manufacturing is an information-intensive activity. Thus, manufacturing firms are viewing the manufacturing process as an information-intensive process that can be managed with

an integrated database. The database is used in the entire manufacturing process, from engineering, to scheduling, to cost accounting, to marketing of the product, with all the intermediate steps being driven by the same database. This approach is called computer-integrated manufacturing (CIM) (Hicks, 1993: 123).

3.5 MIS as a competitive strategy

A highly competitive world market is pressuring corporate executives in a desperate search for solutions. Those with a genuine desire to survive and flourish are doing everything they can to improve profitability. Companies are adopting no-smoking policies to lower the cost of insurance premiums. Unions are accepting wage concessions. Executives are flying economy rather than first class. At least one layer of management has been eliminated in most companies during the last decade. These are examples of a few of the thousands of approaches being taken by executives to improve profitability. Ironically, only recently have organisations began to realise that computers and information systems can improve profitability and provide the all-important competitive advantage (Long, 1989:94).

The days are gone when good management and hard work would invariably result in success and profits. Now that these corporate qualities have become prerequisites for survival, managers are seeking strategies that can give their companies the competitive advantage, especially those strategies that involve computer and information technology.

In this highly competitive era, the judicious use of computers and information systems can make the difference between profitability and failure in just about every kind of industry. New and innovative uses of computers and information systems are being implemented every day. Even so, the business community is still in the early stages of automation. Each company has a seemingly endless number of opportunities to use computer and information technologies to achieve a competitive edge.

All manufacturing companies, large or small, must perform transaction processing. They perform it either manually or with computers and other machines such as calculators and

adding machines. Even the smallest manufacturing companies must perform data processing to keep records for income tax purposes.

Often, though, small manufacturing company managers depend less on a formal information system and more on informal information sources for decisions. A small manufacturing company manager is intimately familiar with all aspects of the business. Therefore, the manager has less need for a formal information system. Small manufacturing company managers do not seem to apply integrated information systems for their decision-making process. The need for the application of MIS greatly increases in areas of medium and large manufacturing companies (Hicks, 1993:7). That is why this study focuses only on medium and large scale companies.

However, as a business grows larger, managers depend much more on formal information systems for their information. Imagine the managers of South African Nylon Spinners depending on informal sources for information about the operations of the company. Such an approach would be impractical since the higher level managers are not close enough to day-to-day operations to have the information necessary to make decisions.

The attitudes of top management toward business automation have changed dramatically since the 1980s. At the start of the 1980s, more often than not, top management viewed computers and data processing as a support capability that would forever be relegated to routine data processing tasks, such as printing invoices and payroll cheques. In many companies, management exhausted all other avenues for improving profitability before turning to MIS for solutions. On the other hand, the management of aggressive companies recognised early on that MIS is much more than an expense; it is a strategic weapon that can be very effective in the business battlefield (Long, 1989:94).

The obvious question becomes: "If MIS is so clearly the solution to establishing a competitive advantage, why isn't every company implementing it?" Long (1989:95) lists three primary reasons for this question, i.e. cost, risk and change.

- MIS solutions are often expensive and time consuming.

  The implementation of information systems to achieve a competitive advantage is a perfect example of a situation in which one has to spend money to make money. Companies with the best performance records spend twice as much on computers and information systems as do companies with the worst performance records.

- There is usually an element of risk in the implementation of information systems. Traditionalist managers would opt to maintain the status quo rather than subject themselves to the risk of failure, even at the expense of losing market share.

- The implementation of information systems inevitably means change. People inherently resist change.

Companies are improving their MIS to achieve a competitive advantage that ultimately increases the company's performance. The performance of a manufacturing company can be measured in many ways, depending on the priority goal of the company. Different measurements of performance of manufacturing companies are discussed in the next section.

3.5.1 Organisational performance measurement

What do companies measure when they measure performance? Some of the leading corporations are rethinking the way they measure the performance of their sub-units. Traditionally, performance measurement has been done with financial figures such as profitability or return on investment. These measures are still the bedrock of management control today.

However, as corporate strategies become based on the drive for enhanced customer service and for positioning in global markets, financial performance measures are becoming insufficient to reflect how well the firm will be in the longer term.

Revolutions begin long before they are officially declared. For several years, senior executives in a broad range of industries have been rethinking how to measure the

performance of their businesses. They have recognised that new strategies and competitive realities demand new measurement systems. Now they are deeply engaged in defining and developing those systems for their companies (Eccles, 1991: 131).

At the heart of this revolution lies a radical decision: to shift from treating financial figures as the foundation for performance measurement to treating them as one among a broader set of measures. Put like this, it hardly sounds revolutionary. Many managers can honestly claim that they - and their companies - have tracked quality, market share, and other non - financial measures for years. Tracking these measures is one thing. But giving them equal (or even greater) status in determining strategy promotions, bonuses, and other rewards is another.

Eccles (1991:131) describes the result of comparison of measurements of performance between two manufacturing companies. Senior managers at one large, high-tech manufacturer recently took direct responsibility for adding customer satisfaction, quality, market share, and human resources to their formal measurement system. The impetus was their realisation that the company's existing system, which was largely financial, undercut its strategy, which focused on customer service. At a smaller manufacturer, the catalyst was a leveraged re-capitalisation that formally gave the CEO the opportunity to reorder the company's priorities. On the new list, earnings per share dropped to last place, preceded by customer satisfaction, cash flow, manufacturing effectiveness, and innovation (in that order). On the old list, earnings per share stood first and almost alone. In both companies, the CEOs believe they have initiated a sea change in how their managers think about business performance and in the decisions they make.

For the purpose of this study the term "success of a company" is used in place of the phrase "performance of a company" and it can be measured in terms of profitability, customer service, productivity and market share. The application of MIS in companies to improve the above-mentioned measurements of success will be discussed in the following sections.

It is expected that this broader understanding of success measurement will lead to an expanded role for MIS in companies.

"However, apart from overall cost benefit analysis, little attention has been paid to assessing the inherent contribution of MIS to an organisation. There is a growing concern about whether the true capability of MIS is being realised. Most MIS can be shown to improve the quantity, accuracy and timeliness of information in organisations, but the extent to which this improves the performance of the organisation is not so clear" (Wolstenholme, Henderson and Gavine, 1993: 2). The work described in this study centres on the issue of MIS evaluation and its impact on the success of manufacturing companies.

3.5.1.1 MIS to improve profitability

The major goal of any company is to make a profit. Once this is done, the company starts to design different techniques to improve its profitability. There are different ways of improving profitability. In this section improving profit by applying MIS is discussed. Increasing sales can enhance profitability. The most important activities that could contribute great advantages for increasing sales are increasing market research, creating new business, and research and development. In this context, market share expresses the extent to which the product of a company covers the national market.

In manufacturing companies, products are distributed to retailers or shops in different places. Most of the time these shops or retailers have no on-line communication with each other and / or with the manufacturing plant. With the advantage of high technology and an efficient information system, a product can be delivered to a customer with no time and distance limitations.

All retailers or shops of the manufacturing company where the product is distributed to the customers can be banded together in a computer network system to create a national market for their product. If one shop does not have what the customer needs, the salesperson of the shop could call another shop at the other end of town or in a nearby city

and receive at least one positive response and a price. The net effect of this system increases the sales of the product.

Market research is a very important activity to increase the sales of a product. The most prominent system in the retail sales industry is the point-of-sales (POS) system. However, not all POS systems are the same in the most basic systems. The cash register-like POS workstation simply records the transaction of the sale and perhaps associates the sale with a particular department. Also, not all POS workstations are linked directly to a centralised computer. In these situations, data are collected off-line and periodically dumped to a centralised mainframe computer system.

The more sophisticated POS systems provide companies with a clear competitive advantage. The POS systems of retailers that use an information system as a strategic weapon are on-line to a centralised computer system. This direct link gives salespersons greater capability to serve the customer and gives market researchers the information they need to develop strategies to maximise sales. These POS systems permit on-line enquiries by salespersons, such as customer credit limit checks, and the inventory status of the item sold is updated immediately. This immediate feedback is valuable input to market research and analysis. For example, a department store chain relies on its on-line POS system to identify fast-selling items so that these items can be reordered before the stock is depleted. This system also identifies slow-moving items so that management can reduce the price accordingly. Retailers with limited POS capabilities are at a distinct disadvantage. Companies with more sophisticated POS capabilities will be able to restock fast-selling items before their competitors realise that they are out of stock.

A manufacturer can develop a system to provide better service to distributors of its products. One of the side benefits of the system is that it can be employed to encourage customer loyalty, or in other words, " lock the customer in". A manufacturer can create a computer-based system that would permit distributors to place orders and make enquiries regarding pricing, availability of parts, and delivery dates directly to the manufacturer's computer system. In this system, distributors are essentially in direct contact with their supplier when talking with one of their customers while the system distributors can give

their customers a delivery date within minutes. The same information may take a week or more to obtain from other suppliers.

The distributors not only enjoy the convenience of the services available through the system, but they have become comfortable with its use. The net effect of the system is increased sales for the manufacturer and very loyal distributors of its products. Eventually other competing suppliers will follow suit with similar technological capabilities, but this may be too little, too late.

3.5.1.2 MIS to improve productivity

Productivity is a measure of the amount of outputs that can be produced with a given amount of inputs, outputs being products and inputs being human labour, material, and so on. In manufacturing, computers have produced very significant increases in output through the use of machines. In the area of engineering, accounting, marketing, and finance, computers have certainly increased the productivity of individuals engaged in these professions (Hicks, 1993:9). One only has to look at electronic spreadsheets to see the impact of the computer on the productivity of accountants.

The use of computers has also reduced the need for clerical workers in business. In the past, these workers were the individuals who did the information processing with a manual system. However, as the demand for clerical workers has decreased, demand has increased for people who are technically trained in the use of the computer, such as systems analysts and programmers. Demand has also increased for other information workers, such as accountants, whose disciplines are closely linked with information processing.

Computers can process information at a much lower cost than humans can. However, the cost of processing information in relation to the amount of output generated from the information system has declined drastically.

Computers and information technologies are the vehicles by which manufacturing companies are streamlining operations. The integration of computers and manufacturing is

called computer-integrated manufacturing (CIM). In computer-integrated manufacturing, the computer is used at every stage of the manufacturing process, from the time a part is conceived until it is shipped. The various computer systems are linked together via data communications and feed data to one another. An engineer uses a computer-aided design (CAD) system to design the part. The design specifications are produced and stored on magnetic disk. The specifications, now in an electronic database, become input to another computer system that generates programs to control the robots and machine tools that handle and make the part. These computer-driven tools are even linked to the company's MIS computers to provide data for order processing, inventory management, shop floor scheduling, and general accounting. Some CIM systems go one step further and provide a link between the manufacturer and the customer.

Several companies in each industry are working feverishly towards the implementation of total CIM (Long, 1989:105). Few, if any, have achieved total CIM, but many have achieved at least a degree of CIM. CIM is the classic situation that calls for tremendous changes in management attitudes. To create the efficiency in design required of a CIM environment, management in all phases of the company must co-operate. The degree to which CIM can be implemented depends on the level of management co-operation that can be achieved and the company's level of technological sophistication. Each increment of implementation of CIM means substantial improvements in productivity and reduces cost. Companies have been able to reduce inventory levels, reduce the elapsed time between design and production, improve quality control, and eliminate much of the manual data entry that takes place in a typical manufacturing environment. These savings give CIM companies the competitive advantage.

3.5.1.3 MIS to improve customer service

Manufacturing companies sell their products to retailers or end users or any other companies that use the product as a raw material for their manufacturing process. For the purpose of this study a company or a person to whom the manufacturing company sells its products is a customer of the company. Customer services include all those activities and facilities which enhance the environment in which the customer makes purchases.

There are several ways of improving customer service in the business world but this study is interested in applying MIS to improve customer service. In order to facilitate the purchasing process and satisfy customers' needs, there should be an effective and efficient exchange of information between the producer and the customer.

Electronic Data Interchange (EDI) involves using computers and data communications to transmit data electronically between companies (Long, 1989: 108). For example, invoices, orders, and many other inter-company transactions, including the dissemination of information, can be transmitted from the computer of one company to the computer of another. Figure 3.2 illustrates the contrast between the traditional interaction between a customer and supplier company and interactions via EDI.

EDI enables managers to get correct and timely activity reports for decision-making processes and furthermore highly improves the customer service of the company, which is one of the major factors of a company's success.

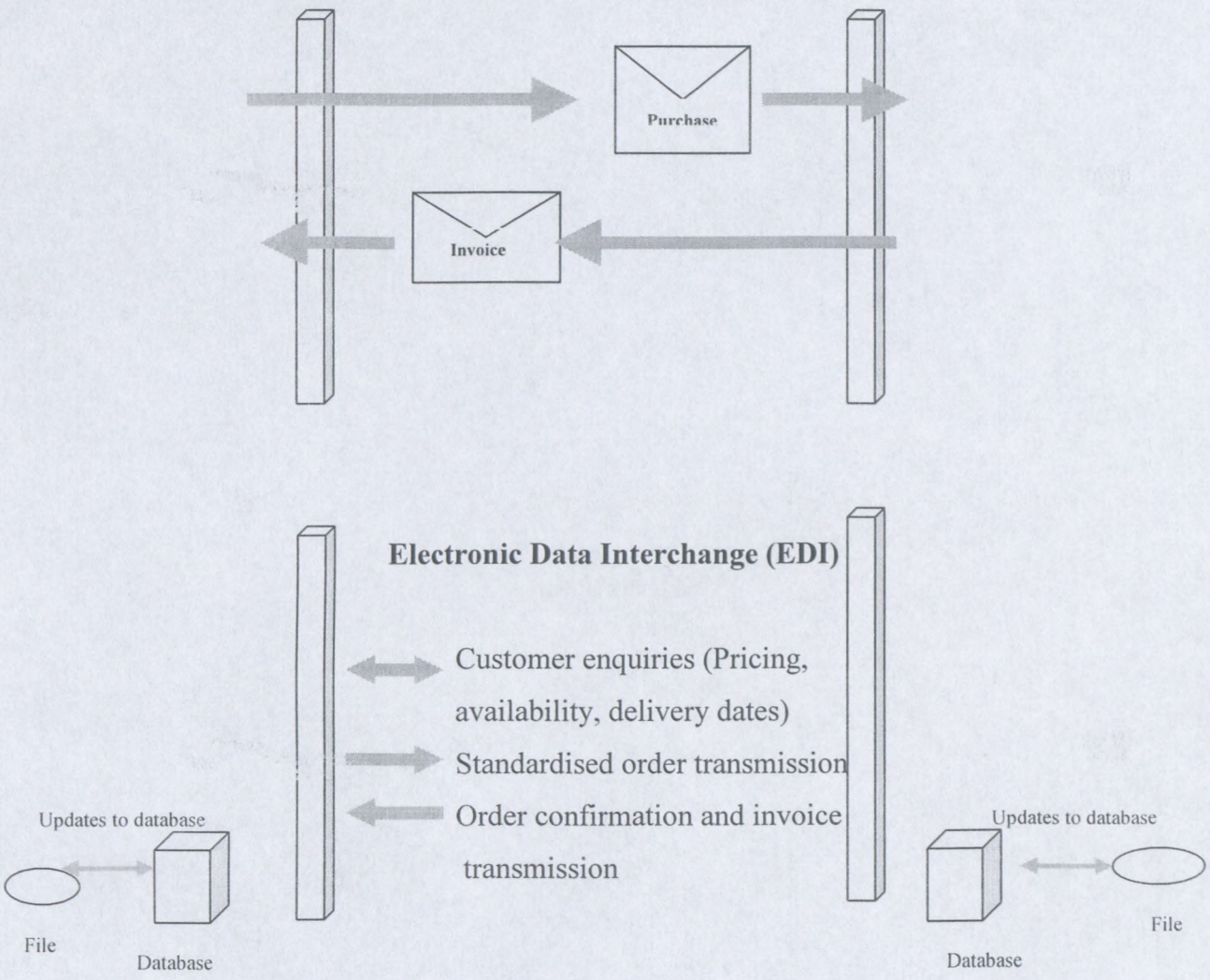

Figure 3.2 Interactions between customer company and manufacturer (supplier) company (Adapted from Long,1989:109)

CHAPTER 4: PLANNING, DEVELOPMENT AND IMPLEMENTATION OF MIS

4.1 Introduction

Planning is one of the major five management functions, but often, it is given a lower priority than are the more immediate management functions of staffing, organising, directing, and controlling. Top management, specifically, plays a significant role in the MIS planning process. According to Doll (1985:16), top management is responsible for providing general guidance for the information systems activity. This chapter deals with MIS planning, development and implementation processes, which are the most important activities of MIS that involve managers, MIS professionals and users.

Management information systems are built and installed in a process known as the system development process. There are different approaches to the MIS development process. In this chapter, one of the principal approaches, the system development life-cycle (SDLC), is presented. The SDLC method has a series of phases to follow. The different phases of SDLC comprise system analysis, system design, programming or construction, installation, implementation and maintenance. An SDLC-oriented methodology aims to produce reliable systems that are thoroughly documented and that lend themselves relatively easily maintenance during the extensive period of system operation. Each phase has its own life span and specific work. Each phase is divided into different sub-phases that consist of various tasks. This chapter explains the objectives and activities that should be performed at each stage.

SDLS-based development methodologies are increasingly being either supported or entirely supplanted by prototyping. Prototyping is the development of an initial pilot system that can be tested by end users to establish their requirements and to secure their commitment to the new system. The prototype of a system may be either refined into a final product or discarded in an evolutionary development process. In evolutionary development, it is possible to turn an initial version of a system over to its users quite early.

Furthermore, the process of preparing an organisation for a new system and establishing the system within the organisation, which is known as implementation, is discussed in this chapter.

4.2 MIS planning

Many professionals in the field of information systems agree that the system development life cycle includes planning, analysis and design, implementation, and operation. In the stage of planning, which is the first stage of system development, activities like designing a specific development methodology and organising staff meetings in order to specify system requirements take place. The success of these activities has a critical impact on the success of the entire development of MIS. The objectives MIS directors pursue as they plan for the development of new or the maintenance of the existing information systems may influence the success of overall MIS development efforts (Doll, 1985:23).

Typically, MIS and user managers deal with the routine crises of day-to-day activities before they turn to long-range planning, and, sometimes, there is no time left for planning. Although the importance of planning has become a time-honoured business maxim, planning is often deferred until executives realise that no planning will have an adverse impact on the bottom line. For those companies involved in competitive struggle, planning can no longer be deferred. Now that progressive companies are actively pursuing the competitive advantage via automation, the bottom line has come into play and MIS planning has become a priority activity. Now executives in progressive companies are beginning to focus their energies on information resource management (IRM); until the mid-1980s, most MIS-related planning emphasised hardware, with little attention being given to information systems and other areas of MIS. MIS planning has evolved as a critical activity in recent years because (Long, 1989:274):

- Companies have found that MIS can be used to achieve a competitive advantage.
- Companies can use MIS to increase productivity.
- Corporate executives have become more acutely aware of the strategic importance of integrating their databases and information dissemination.

Companies have been facing problems and obstacles to improve their performance and these problems have most likely resulted from lack of MIS planning. If one tries to identify the common threads among today's successful companies, one of the threads would surely be a commitment to a comprehensive MIS planning effort. Management personnel who neglect the MIS planning function may be doomed to a short–term crisis-oriented environment (Long, 1989:276).

According to Thierauf (1987:13), managers are classified into levels of strategic planning, management control and operational control. Managers at these levels are, respectively, involved in long-range, medium-range and short-range planning. A key to the success of the information system function in organisations is a comprehensive, effective planning system (Bruwer, 1987:44).

4.2.1 MIS strategic planning

Strategic planning is long-term organisational planning that is normally done by top-level management. The purpose of strategic planning is to develop long-term objectives for the entire organisation and for its major business units, and to specify general strategies for the acquisition of the resources needed to accomplish these objectives.

A company will have several operational information systems and other information systems in various stages of planning and development. For example, a manufacturing company might be conceptualising a system to permit electronic data interchange (EDI) between customer computer systems, developing an on-line skills inventory system for the personnel department, running any number of operational information systems from inventory management to accounting, and determining whether or not to scrap their outdated order processing system. All information systems, whether proposed or currently operational, are within the scope of the MIS planning process.

MIS planning involves more than just information systems. It encompasses all facets of the information service environment that directly or indirectly have an impact on the application of computer and information technology.

Of course, information systems continue to be the driving force behind MIS strategic planning. This is because everything else, including hardware, facilities and personnel, is considered support. Any MIS environment revolves around the applications supported by its information systems.

The result of the MIS strategic plan identifies general strategies for meeting the company's MIS objectives. For example, a company's MIS objective might be to make EDI capabilities available to customers. A supporting strategy might be to develop an information system that accepts customer orders via EDI.

Managers play a large role in MIS planning. They are responsible for relating their individual and collective visions to planners and for co-operating with planners and other managers throughout the planning process. Who are the planners?

Commonly the persons or groups who should participate in the MIS planning process are:

- The chief information officer (CIO).
- Functional area managers (accounting, purchasing, marketing, and so on).
- Corporate executives.
- User committee.

A high-level user-based committee which encompasses the above-mentioned persons is organised for the aim of accomplishing the MIS planning process. MIS strategic planning is an iterative process that requires a formal, ongoing feedback mechanism and well-defined authority for both intermediate and final approval.

There are many different approaches for strategic MIS planning. The most popular techniques, critical success factors (CSFs), business systems planning and Ends/Means (E/M) analysis are covered in this thesis.

4.2.1.1 Critical success factors (CSFs)

Critical success factors are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation. They are the few key areas where "things must go right" for the individual department or the firm to succeed (Rockart, 1979:85). The critical success factor (CSF) method created by Rockart of the Massachusetts Institute of Technology is a procedure that helps planners to define an organisation's information processing requirements.

Figure 4.1 illustrates the major steps that must be completed to develop a list of critical success factors. Once CSFs are identified and listed, they become valuable input into the MIS planning process. Planners use CSFs to give them added insight into the identification of MIS objectives and, in MIS operational planning, the prioritisation of projects. For example, if both the vice-president of sales and the vice-president of accounting identify electronic data interchange as their number one critical success factor, then the implementation of EDI would surely be given a very high priority in the MIS plan.

Critical success factors differ from organisation to organisation. The nature of the industry, the competitive strategy of a business and the goals of the organisation determine critical success factors. Critical success factors support the attainment of organisational goals and objectives. Goals represent the target points that an organisation hopes to reach, while critical success factors are the areas in which good performance is strictly necessary to ensure attainment of these goals. Representative goals and CSFs of a typical manufacturing company are presented in Figure 4.2.

CSFs change over time as circumstances change, and they must be periodically revised. Eventually, updated CSFs provide programmers and systems analysts with insight into the design of information systems.

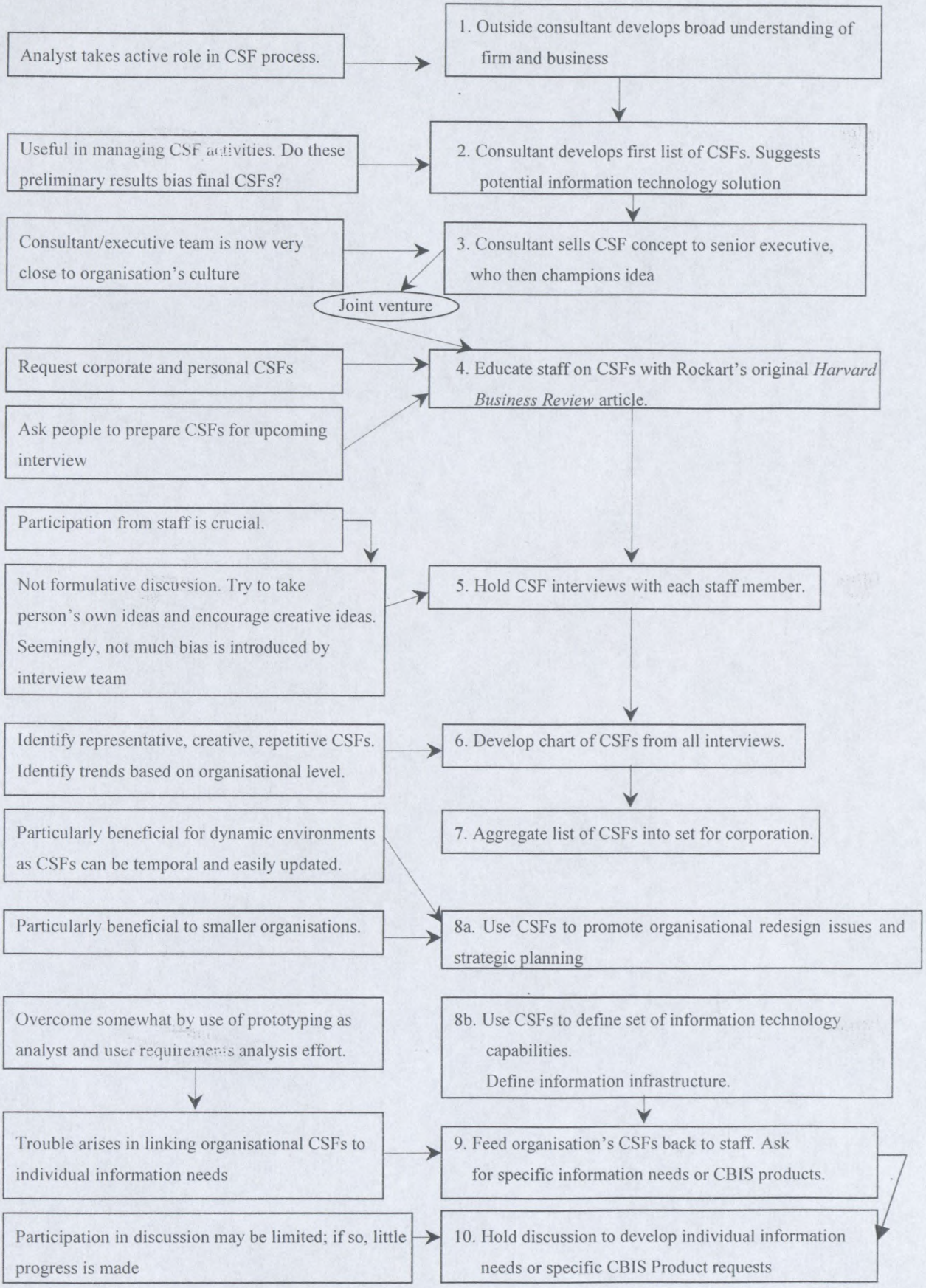

Figure 4.1 Steps in developing critical success factors (Adapted from Hicks, 1993:410)

Desired Corporate Goals		Critical Success Factors
New product success	⟶	Timing of market entry
Increase market share		Quality dealer system
High return on investment		Fast inventory turnover
Increase earnings per share		Effective cost control

Figure 4.2 How the attainment of desired corporate goals is supported by critical success factors of a typical manufacturing company (Adapted from Thierauf, 1987:409)

4.2.1.2 Business systems planning (BSP)

Business systems planning, developed by IBM Corporation, is a structured process that many companies use to establish a foundation for the MIS planning process (IBM, 1984). BSP is rooted in the information resource management (IRM) approach, which considers data to be a fundamental corporate resource.

One of the underlying objectives of BSP is to develop a data architecture that supports information systems development activities. Most organisations build the information systems one piece at a time. As each system is built, a new database is structured to store data elements needed to generate reports. After dozens of systems are built, the organisation has to grapple with the problem of maintaining dozens of databases. Many of these databases store the same data elements, contributing problems of data redundancy and data inconsistency.

For example, customer-related data elements may be used in 33 different regions and stored in 18 different databases. When a customer's address changes, the respective data elements have to be changed 18 times. The BSP approach attempts to overcome this problem by analysing data requirements for major business processes by proposing a data architecture that supports multiple applications.

Business systems planning is a team business study. According to Schultheis and Sumner (1998:124), the major activities that are involved in a BSP study are:

- Make a commitment.
- Prepare for the study.
- Hold a kick-off meeting.
- Define business processes.
- Define data classes.
- Determine executive perspective.
- Assess business problems.
- Define information architecture.
- Determine priorities.
- Review information systems management.
- Develop recommendations and action plans.
- Report results.

The nodal components of BSP, defining business processes, defining business data and defining information architecture, are explained in the next sections.

- **Defining business processes**

  The BSP study team identifies groups of related activities and decisions required to manage the business. Such a group, called in this methodology a "business process", is the principal entity to be equipped with needed information. A business process is identified independently of the organisational unit or units that perform it. This ensures that a future organisational change will not affect the premises of this requirement analysis.

  An example of a business process in MIS for a manufacturing firm is "Control Raw Material Inventory", which includes the receipt, inspection, storage, and accounting of this inventory.

- **Defining business data**

  Classes of data about each business entity are identified. Business entities include persons (for example, customers or employees), places, things (such as plants or equipment), concepts, and events.

  Next, the planners determine data usage and creation by each business process. They thus identify what data classes each process creates and what data classes it uses.

  For example, the data class "Inventory Record" might include stock-keeping number, name, location, quantity in stock, lead time for restocking, and average inventory prices.

- **Defining information architecture**

  The relationship between business processes and data classes is established. Each data class ought to have a single creating process that is responsible for keeping it up to date and may also have a number of using processes.

  Business processes become the basis for understanding information system needs and for identifying key data requirements. The BSP methodology uses a number of matrices to establish relationships within the organisation, its processes, and data requirements. The process versus organisation matrix, shown in Figure 4.3, relates the activities of the organisation to people responsible for these activities.

  One of the major objectives of BSP is to identify the data classes that support business processes. These relationships are graphically depicted in the data-class versus process matrix as shown in Figure 4.4. This matrix enables management to determine which data classes support multiple business processes. Identification of shared data creates a basis for developing data architecture to support multiple applications. Borders enclose clusters of shared data that support multiple business processes. In Figure 4.4, the C in certain cells of the matrix indicates that a process creates certain data. The U in some cells indicates that a process uses certain data. One can see that the business planning process uses financial data.

PROCESS / ORGANISATION	Plan administration	Plan review	Receipt	Edit	Entry	Processing	Tracking	Territory management	Selling	Administration
	Business plan		Order servicing					Sales		
General manager	+	+					+	+	+	+
Sales manager		+	+				+	+	+	+
Marketing manager		+		+	+		+	+	+	+
Controller	+	+		+						
Purchasing manager		+								
Service manager		+								
Manufacturing operations manager		+		+	+	+	+			

Figure 4.3 Process/Organisation (Adapted from Schultheis and Sumner, 1998:124)

4.2.1.3 Ends/means (E/M) analysis

The third technique, ends/means (E/M) analysis, was developed by Wetherbe and Davis at the University of Minnesota (Wetherbe, 1991:51). The purpose of E/M analysis is to determine effectiveness criteria for outputs and to specify efficiency criteria for processes used to generate outputs.

The first question in E/M analysis is: What is the end or good or service provided by the business process? The next question is: What makes these goods or services effective to the recipients or customers? The effectiveness criterion is that these orders be delivered when expected, and, if possible, as soon as or sooner than those of the competition. The final question is: What information is needed to evaluate that effectiveness?

Data class / Process	Planning	Financial	Product	Parts master	Bill-of-material	Vendor	Raw material inventory	Fin.goods inventory	Facilities	Work in process	Machine load	Open requirement	Routings	Customer	Sales territory	Order	Cost	Employee
Business planning	C	U															U	
Organisation analysis	U																	
Review and control	U	U																
Financial planning	C	U								U								U
Capital acquisition		C																
Research			U												U			
Forecasting	U		U											U	U			
Design and development			C	C	U									U				
Product specification maintenance			U	C	C	U												
Purchasing						C											U	
Receiving						U	U											
Inventory control							C	C		U								
Work flow layout			U						C				U					
Scheduling			U			U			U	C	U							
Capacity planning						U			U		C	U	U					
Material requirements			U			U						C						
Operations										U	U	U	C					
Territory management			U											C		U		
Selling			U											U	C	U		
Sales administration															U	U		
Order servicing			U											U		C		
Shipping			U					U								U		
General accounting		U				U								U				U
Cost planning						U										U	C	
Budget accounting	U	U								U							U	U
Personnel planning		U																C
Recruiting/ Development																		U
Compensation		U																U

Figure 4.4 Data-class/process matrix (Adapted from Schultheis and Sumner,1998:124)

In the other part of E/M analysis, the manager needs to specify efficiency criteria for processes used to generate outputs. This analysis asks three questions. First: What are the key means or processes used to generate or provide goods or services? Second: What constitutes efficiency in providing these goods or services? Third: What information is needed to evaluate that efficiency?

4.3 Development and implementation of MIS

Management information systems are built and installed in a process known as systems development. There are two principal approaches to this development: the life-cycle approach and prototyping. System development life cycle (SDLC) organises the team effort into a series of stages, with each stage terminating in a demonstrable event - a milestone - during which well-defined deliverables are indeed demonstrated. Every stage is defined in terms of the activities and responsibilities of the development team members.

For the purpose of this research, an SDLC is defined as a systematic and orderly approach to solving business problems, and developing and supporting resulting information systems (Whitten, *et al.*1994:11). The term "problem" in systems development can be regarded as any one of the following (Terblanche, 1996:20):

- An undesirable situation that prevents the organisation from fully achieving its purpose, goals and objectives.
- An opportunity to improve the organisation even in the absence of a specific problem.
- A directive, which is a new requirement, imposed by management or some external influence.

Whitten *et al.* (1994:92) describe the seven steps of the classical approach to solving problems as follows:

- Identify the problem.
- Understand the problem's environment and the problem's causes and effects.
- Define the requirements of a suitable solution.

- Identify alternative solutions.
- Select the "best" solution.
- Design and implement the solution.
- Observe and evaluate the solution's impact. Refine the solution accordingly.

It was therefore necessary to establish a process by which systems could be developed based on a proper problem-solving approach. Although there are major differences in the SDLCs found in the literature, all of them basically satisfy the requirements of the above problem-solving approach. Some of the various life cycles that are based on SDLCs are:

- Classic life cycle as described by Whitten *et al.* (1989).
- Modern life cycle as described by Whitten *et al.* (1994).
- Software Process Models such as the Waterfall Model, the Rapid Prototyping Model, the Incremental Model and the Spiral Model as described by Schach (1992).

Although the above SDLSs sometimes have completely different names for the various phases and tasks, most of them agree on the tasks that should be performed during the systems development process. The major differences, however, are in the grouping of these tasks into phases.

The major phases and tasks of systems development life cycle, systems investigation, systems analysis, systems design and systems implementation are described in the next consecutive sections. These phases of SDLSs are more or less common for most different types of SDLSs found in literature even though activities and work classifications are different.

Factors like user involvement in the development of a computer-based MIS, personal factors and the attitude of the user towards computerisation (managers included) are directly related to the success of a computer-based MIS (Bruwer, 1983:172). Managers and users, in order to be involved in the activity of the development of MIS to solve their business problems, need to be aware of the procedures and all the activities that need to be done in the process. Doll (1985:17) emphasises the importance of managers' involvement

in the development of MIS as it may be the critical factor in determining the success of MIS development efforts.

4.3.1 Systems investigation

Under this first stage of SDLS questions such as: Does the company have a business problem or opportunity? What is causing the problem? Would a new or improved information system help solve the problem? What would be a feasible information system solution to these problems? have to be answered. Systems investigation may involve the consideration of proposals generated by an information system planning process, which is discussed in Section 4.2.1.

The systems investigation stage includes the preliminary study of proposed information systems solutions to end users' business problems. This preliminary study of proposed information systems is called a feasibility study. The goal of feasibility studies is to evaluate alternative systems and to propose the most feasible and desirable system for development. A feasibility study can be evaluated in terms of four major categories (O'Brien, 1999:93).

- **Organisational feasibility**: - is on how well a proposed information system supports the objectives of the organisation and its strategic plan for information systems.

- **Technical feasibility:-** can be demonstrated if reliable hardware and software capable of meeting the needs of a proposed system can be acquired or developed by the business in the required time.

- **Economical feasibility:-** is concerned with whether expected cost saving, increased revenue, increased profits, reductions in required investment, and other types of benefits will exceed the cost of developing and operating a proposed system.

- **Operational feasibility:-** is the willingness and ability of the management, employees, customers, supporters, and others to operate, use and support a proposed system.

4.3.2 Systems analysis

Most of the activities under the systems analysis stage are an extension of those used in conducting a feasibility study. Systems analysis is an in-depth study of end-user information needs that produce functional requirements that are used as the basis for the design of a new information system. The basic activities under this stage are:

- **Organisational analysis**

  A team which is responsible for developing a new system needs to know a great deal about the organisational environment in which that system is located. The organisation's management structure, people, business activities, environmental systems the system must deal with, and the current information system should be well known by at least some of the development group members.

- **Analysis of the present system**

  If there is any present system that needs to be improved or replaced by a new system, it is important to study the system before designing a new system. How the present system uses hardware, software, networks, and people resources to convert data resources, such as transaction data, into information products such as reports and displays, needs to be analysed.

- **Functional requirement analysis**

  Under this stage the managers' and end users' information needs should be determined and that makes user involvement very important at this stage. On the basis of business information need, the information processing capabilities required for each system activity (input, processing, output, storage and control) must be determined.

  Finally, functional requirements should be developed. Functional requirements are end-user information requirements not tied up the hardware, software, network, data and people resources that end users presently use or might use in the new system. That is left to the design stage to determine.

4.3.3 Systems design

As systems analysis describes what a system should do to meet the information needs of users, systems design specifies how the system will accomplish these objectives. Systems design consists of design activities that produce system specifications satisfying the functional requirements developed in the systems analysis stage. The systems design stage can be explained as the design of user interfaces, data, and processes (O'Brien, 1999:99).

- **User interface design**

  The user interface design activity focuses on supporting the interactions between end users and their computer-based applications. Designers concentrate on the design of attractive and efficient forms of user input and output. They also may design methods of converting human-readable documents to machine-readable input, such as optical scanning of business forms.

- **Data design**

  The data design activity focuses on the design of the structure of databases and files to be used by a proposed information system.

- **Process design**

  This type of design focuses on the design of software resources: that is, the programs and procedures needed by the proposed information system. Designers concentrate on developing detailed specifications for the software that will have to be purchased or developed by custom programming to meet user interface and data design specifications and the functional requirements developed in the analysis stage.

4.3.4 Systems implementation

The implementation of an information system is the process of preparing people in an organisation for a new system and introducing the system into the organisation. In other words, it is an ongoing process, which should start early during system development

(or even precede actual development) and culminate in the institutionalisation of the new system.

The systems implementation stage involves hardware and software acquisition, software development, testing of programs and procedures, development of documentation, and a variety of installation activities. It also involves the education and training of end users and specialists who will operate a new system.

Finally, implementation involves a conversion process from the use of a present system to the operation of a new or improved application. Conversion methods can soften the impact of introducing new technology into an organisation. Thus conversion may involve operating both new and old systems in parallel for a trial period, or operation of a pilot system on a trial basis at one location.

The success of an information system is not at all assured by its technical qualities alone. It also depends to a large degree on a variety of organisational measures and processes, which are collectively called systems implementation (Zwass, 1992:744).

4.3.5 Systems maintenance

Systems maintenance is the final stage of the systems development cycle. It involves the monitoring, evaluation, and modifying of a system to make desirable or necessary improvements. This may include a post-implementation review process to ensure that the newly implemented system is meeting the functional business requirements that were established for it when it was designed.

Errors in the development of a system are corrected by the maintenance activity. Systems maintenance also includes modifying a system owing to internal changes in a business or external changes in the business environment.

CHAPTER 5: MIS IN THE MAJOR FUNCTIONS OF MANUFACTURING COMPANIES

5.1 Introduction

In this, the last chapter of the literature review, focus is on the application of MIS in the various activities of a manufacturing organisation. To function, organisations need to be structured into subdivisions that take responsibility for their own results and together contribute to corporate objectives. A typical set of functions in a manufacturing organisation includes corporate planning, marketing and sales, manufacturing, accounting and finance, and personnel (Godfredsen and Deveau, 1991: 40). These functional areas can change, of course, with time and with different organisations. In turn, each of the functional areas can be divided into a number of functional units. This division by function is particularly important because it forms the basis for the development of an effective management information system (Godfredsen and Deveau, 1991: 41). Each of these functions has unique information needs and each requires information system support designed for it. A management information system is essentially a federation of information systems that are designed to support the functional sub-systems of the organisation (Davis and Olson, 1985:41).

The design and implementation of management information systems in the major functions of a manufacturing organisation, namely, the corporate planning function, marketing and sales function, manufacturing function, accounting and finance function and personnel function are discussed in this chapter. The need for the integration of systems of these functions to achieve their business goals is also discussed.

5.2 Corporate planning function

Corporate planning is the focal point of an effective MIS (Thierauf, 1984:407). The purpose of corporate planning is to decide what to do in terms of short-, medium-, and long-range plans; how to implement these plans in terms of corporate resources; and when to execute them in order to accomplish an organisation's goals and objectives. Important

relationships and feedback interact among these three planning stages, and often complicate one another. This complexity, along with revenue and cost factors, makes it extremely important that management establish a systematic and analytic approach to corporate planning. Managers in corporate management of manufacturing companies are charged with setting objectives, developing long-range plans, and setting marketing, manufacturing, financial, and personnel strategies as well as programmes and policies. They are also charged with inter-plant resource allocations and analysis of these plans for consistency and credibility.

5.2.1 Types of corporate planning

- **Long-range corporate planning**

  Long-range corporate planning usually involves looking at a plan of three to five years (or more) into the future. However, many organisations have a planning process that reviews and modifies their long-range plans on a regular basis, such as six months to a year (O'Brien, 1996:540). Long-range corporate planning focuses on extrapolating data gathered from external and internal sources for projecting information on marketing and distribution, technical facilities, financing, manpower, and so forth for five or more years.

- **Medium-range corporate planning**

  Medium-range corporate planning addresses the same areas as long-range planning but within a time frame of two to four years. However, the pro forma financial statements in this time span are more detailed than those for long-range corporate planning.

- **Short-range corporate planning**

  Short-range corporate planning is an extension of medium-range corporate planning with great emphasis on flexible budget forecasts related to specific production levels for the coming year. It can range from daily, weekly or monthly planning to a one-year plan.

5.2.2 MIS of the corporate planning function

The main activity in the corporate planning function is to make plans in different time ranges to achieve business goals and make important decisions for the success of the organisation. The corporate planning staff needs valuable and timely information to perform these activities effectively. Table 5.1 shows the types of information that are needed for a corporate planning function as stated by Godfredson and Deveau (1991:42).

Information needed	**Source**
Company product market size, by product type, for the past five years	Database management system
Company sales, by product type, for the past five years	DBMS
Projected company product market, for next five years	Market research
Projected company sales, by product , for the next five years	Forecasting and projections
Current equipment and facilities status	Maintenance and engineering
Projected capital expenditures, for the next five years	Capital budgeting
Personnel requirements for the next five years	Production
Projected new product development, for the next five years	New product development, market research

Table 5.1 List of information requirements for corporate planning function of manufacturing companies

To obtain the necessary information, corporate planning function sub-systems may need to be linked directly with other internal functional sub-systems and external environmental factors as shown in Figure 5.1.

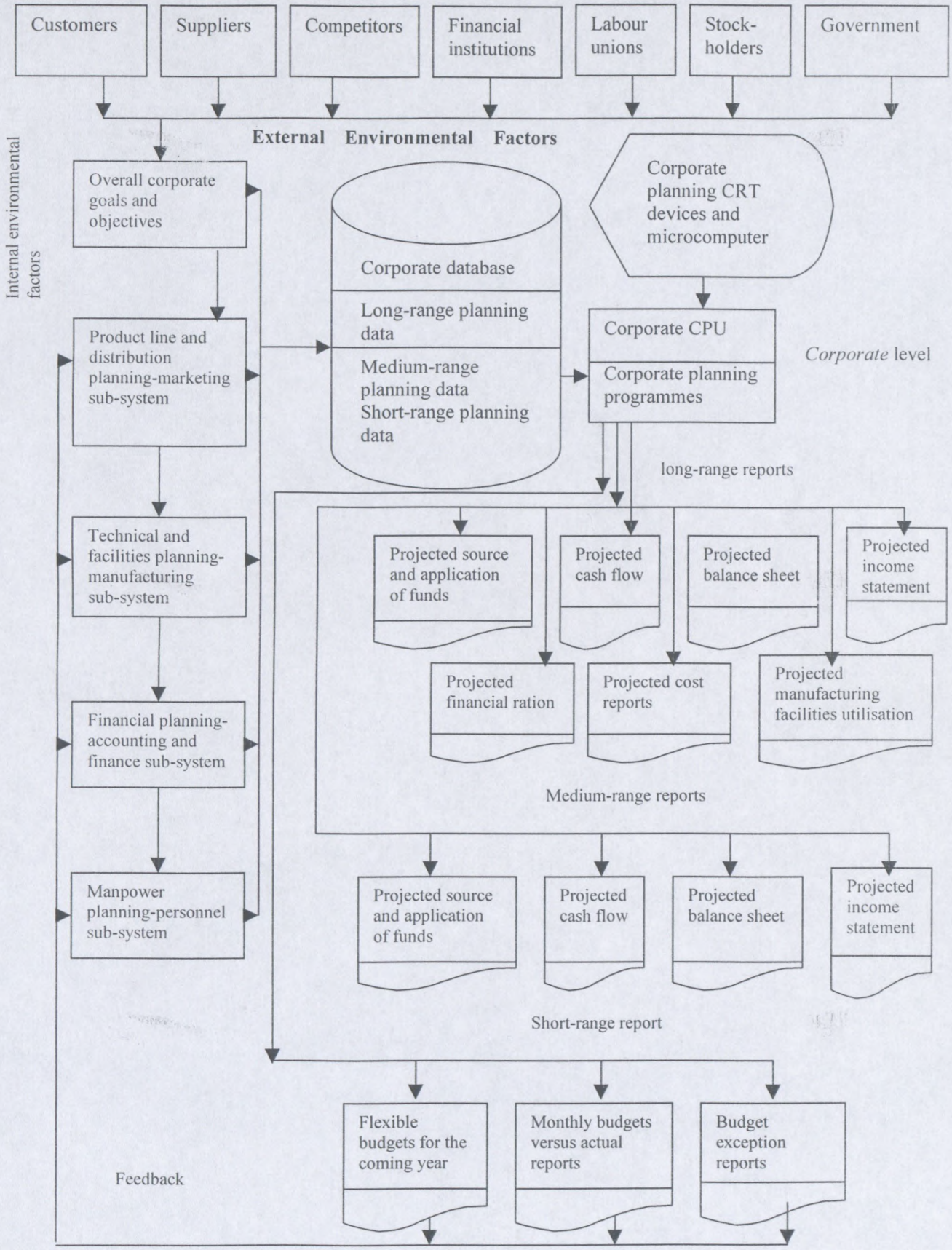

Figure 5.1 Corporate planning sub-system for an effective management information system of manufacturing companies (Adapted from Thierauf, 1987:416)

The illustration of the overview of the major activities in the corporate planning environment of a typical manufacturing organisation is presented in Figure 5.2. The major activities include long-range, medium-range, and short-range planning. To facilitate planning through varying time periods, a large amount of corporate planning data needs to be stored in the corporate database and be retrievable upon request by the planning staff.

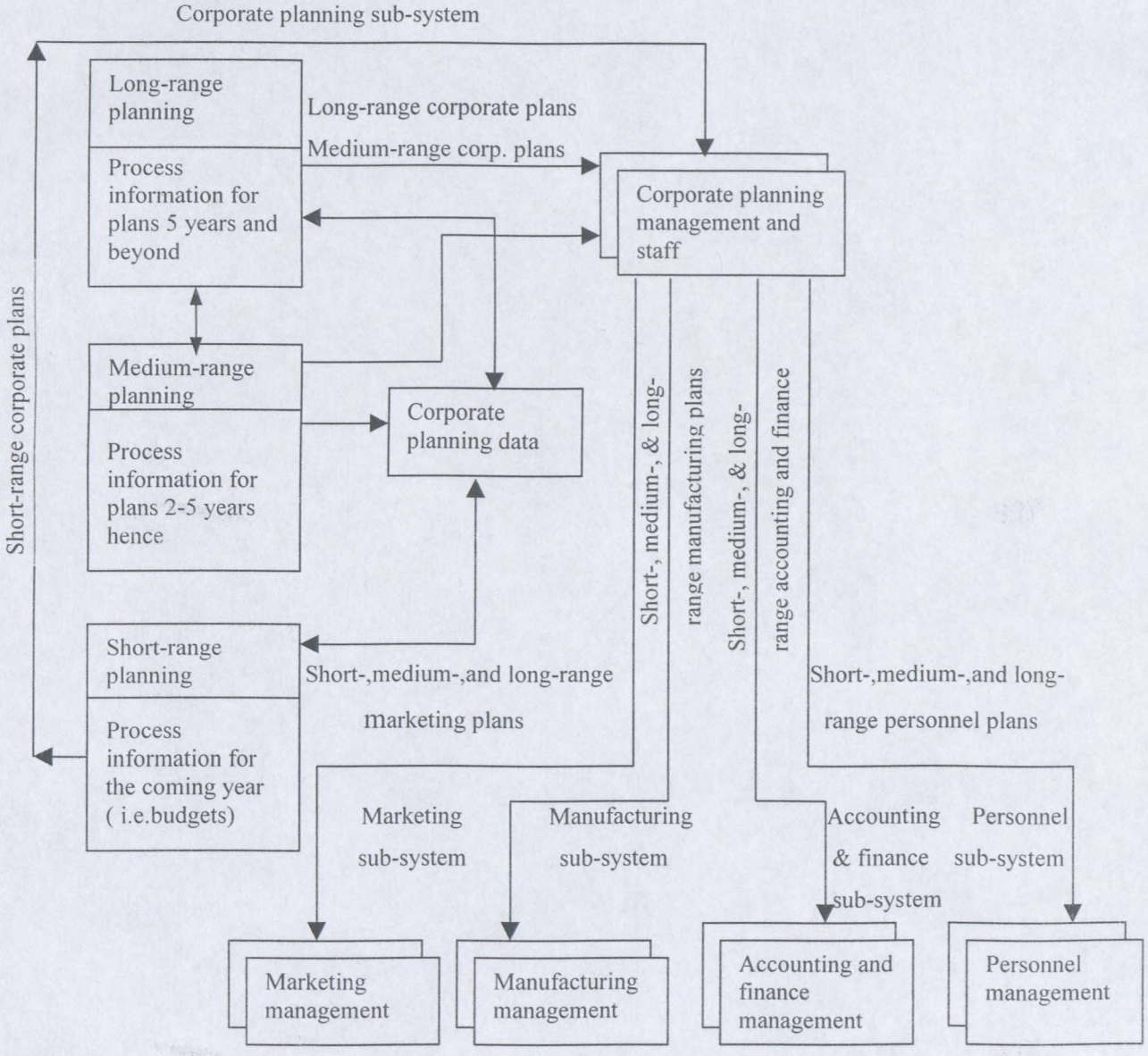

Figure 5.2 Corporate planning data flow diagram (Adapted from Thierauf, 1987:414)

Specifically, flexible budget data as well as current and past results of operations are capable of being extracted as input for forecasting future sales, cost values, and similar

information. Also, data on product lines, distribution, technical matters, facilities, financial, and manpower planning can be retrievable from the database for corporate planning analysis using computer software.

The corporate planning function sub-system operates in a different manner from all other sub-systems. Important internal environmental factors are received from the various sub-systems for short-, medium-, and long-range planning purposes; certain information, in turn, is fed back to the appropriate sub-systems. At any time, major deviations from plans may occur.

5.2.3 The objectives of MIS for corporate planning

- To provide top management with support information necessary to create planning strategy that agrees with its desired corporate objectives and critical success factors.
- To provide analytical tools in the form of newer micro and mainframe software for evaluating alternative planning strategies in order to generate decision-making information.
- To provide an effective means of sensing the impact of the external environment and thus forewarning top management of outside changes that affect the organisation using a problem-finding approach.
- To measure the actual performance against the plans to effect better control over organisational activities by employing "management by exception".

These objectives take into account past and expected conditions with major emphasis on future projections. With this framework, the corporate planning process of successive refinement results in a fiscal plan that is both forward-looking and operationally effective for control during the coming year.

In like manner, feedback is utilised within the corporate planning sub-system itself to alter plans at the various levels. This overall internal data flow, along with data on the external environmental factors, provides the input for corporate planning.

5.3 Marketing and sales function

Marketing and sales function activities are directed towards planning, promoting, and selling goods and services to satisfy the needs of customers and the objectives of the companies. Marketing and sales function systems support decision making regarding the marketing mix, expressed as the so-called four P's (Zwass, 1998:426):

1. What *product* (goods or services) should we offer?
2. At what *place* should we offer our products; that is, what should our distribution channels be?
3. What *promotion* (sales and advertising) should be conducted?
4. What should be the *price* of our products (with mark-ups, discounts, and other terms of sale)?

The outcome of this decision making is integrated into a sales forecast. This forecast used to be made for a year ahead but in the environment of time-based competition; it is now often made for shorter periods.

The marketing and sales function, which is the prime source of determining what must be accomplished soon, is co-ordinated with the corporate planning function. Its major functional sub-parts as shown in Figure 5.3 are sales forecasting, market research, advertising, sales order processing and physical distribution. Their design includes an interactive processing capability. Marketing data may need to be stored on the appropriate database, retrievable as is or manipulated depending on the user's needs.

5.3.1 MIS of the marketing and sales function

The major components of the MIS of the marketing function are sales forecasting, marketing research, advertising, sales order processing and physical distribution. An effective management information system produces sales forecasting, market research, and advertising information at the corporate level only. However, sales order processing and physical distribution are off-loaded from the corporate level to the plant (warehouse) level

(Thierauf, 1987:456). In this manner, a desired level of customer service can be achieved through fast shipment and more accurate handling of customer orders. Although these marketing modules are at different locations, they can be fully integrated with computer networking. The net result of this integration is that this important part of MIS will greatly enhance the support for planning and control of marketing decisions for changing times.

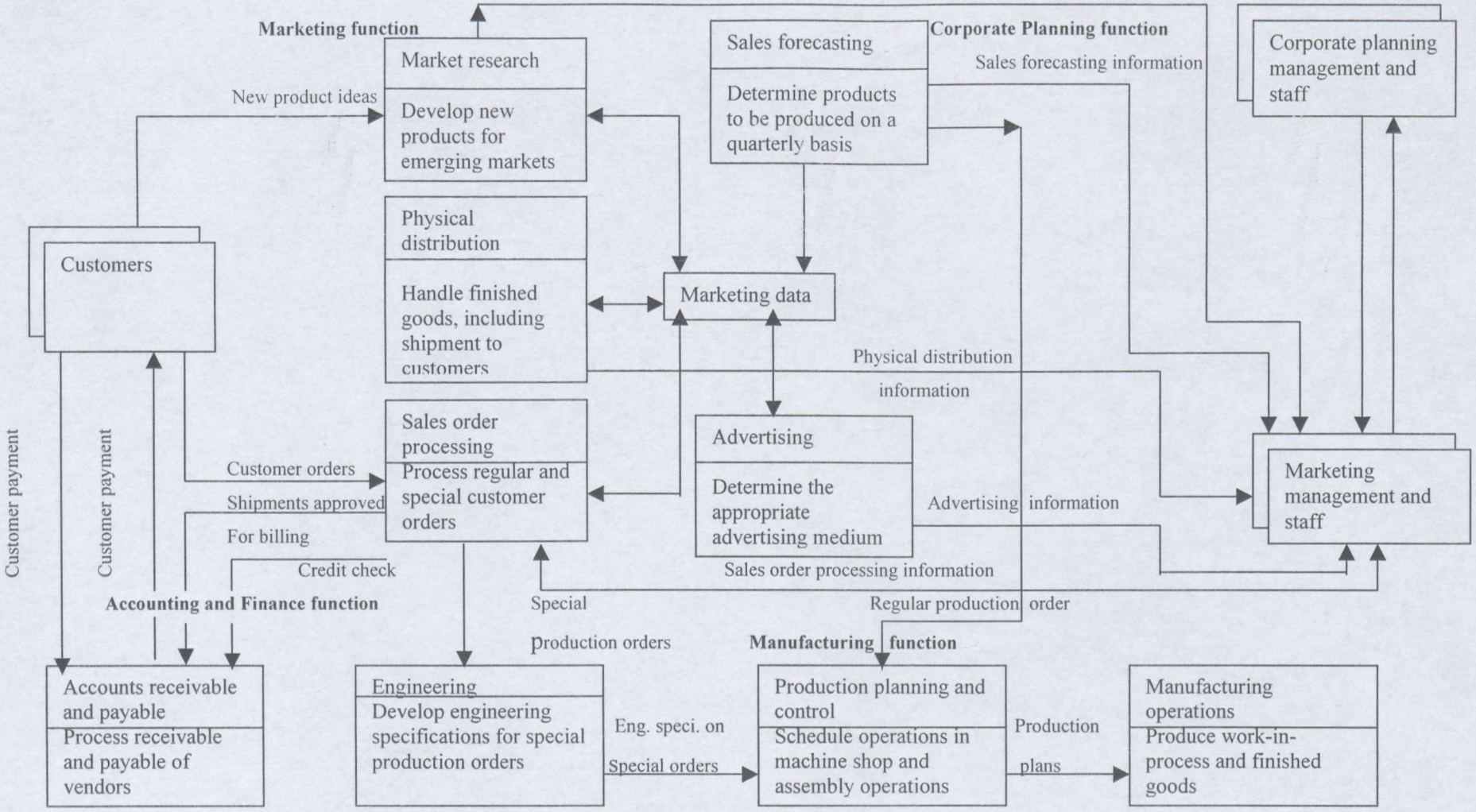

Figure 5.3 Marketing data flow diagram (Adapted from Thierauf, 1987:45)

5.3.1.1 Sales management

Increasingly, computers and networks are providing the basis for sales force automation. In many companies, the sales force is being outfitted with notebook computers, web browsers, and sales contact management software that connect them to marketing websites on the Internet, Extranets, and their company Intranets (O'Brien, 1996:314). This not only increases the personal productivity of salespeople, but also dramatically speeds up the capture and analysis of sales data from the field to marketing managers and to company headquarters. In return, it allows marketing and sales management to improve the delivery of information and the support they provide to their salespeople. Therefore, many companies are viewing sales force automation as a way to gain a strategic advantage in sales productivity and marketing responsiveness.

For example, salespeople use their PCs to record sales data as they make their calls on customers and prospects during the day. Then each night sales representatives in the field can connect their computers by modem and telephone links to the Internet and Extranets, which can access Intranet or other network servers at their company. Then they can upload information on sales orders, sales calls, and other sales statistics, as well as send electronic mail messages and access website sales support information. In return, the network servers may download product availability data, lists of information on good sales prospects, and e-mail messages. This establishes direct electronic links with customers and suppliers, enhances organisational planning and decision making, and reduces costs of business operations and transaction processing (Alavi and Joachimsthaler, 1992:95).

Sales managers must plan, monitor, and support the performance of the salespeople in their companies. So, in computer-based systems, it is possible to produce sales analysis reports that analyse sales by product, product line, customer, type of customer, salesperson, and sales territory. Such reports help marketing managers monitor the sales performance of products and salespeople and help them develop sales support programs to improve sales results.

Production function managers need information to plan and control the performance of specific products, product lines, and brands. Computers can help provide price, revenue, cost, and growth information for existing products and new product development. Providing information and analysis for pricing decisions is a major activity of a sales sub-system.

Sales forecast is the foundation of a marketing plan. It must be stressed that any long-range planning in an environment fraught with uncertainties is not a blueprint. It is rather a continual process through which the company integrates its activities, devises targets to focus on, and learns to improve its performance (Zwass, 1998:431).

The marketing function sub-system may be integrated with other organisation functional sub-systems. For example, corporate plans for various time horizons are an important input to the system, while the sales forecasts are a vital output from the marketing to the manufacturing function.

5.3.1.2 Marketing research

The objective of marketing research is to collect data on the actual customers and the potential customers, known as prospects. The identification of the needs of the customer is a fundamental starting point for total quality management (TQM). These needs will be converted into quality targets for the products. In doing marketing research, many firms gather their own data with surveys or interviews (for example, in focus groups, also conducted over the Internet), or by observing actual buying behaviour. The data garnered by observation are more reliable than the statements of intent of facts in surveys (Zwass, 1998:427).

Electronic commerce on the World Wide Web makes it easy to compile statistics on actual buyer behaviour. With the growth of the information economy, the availability of data from external sources has grown. Such data can be obtained from on-line databases, or from magnetic or optical media (CD-Rom). In a manufacturing environment marketers

might get raw sales data from the wholesalers and retailers. On the retail side, with the persuasiveness of checkout scanners, it is now possible to buy daily and hourly sales records from thousands of stores in various cities.

Marketing research software supports statistical analysis of data. It enables the firm to correlate buyer behaviour with very detailed geographic variables (such as a small community or several urban blocks), demographic variables (age, income, education, etc.,) and even psychographic variables (such as the degree of conservatism). Geographic information systems are particularly helpful in visualising the distribution of customers and non-customers.

There are also models designed to help marketers choose among the various promotion alternatives. A key concept in marketing today is the use of target marketing, in which the goal is to find the consumers who are specifically interested in the products. Advertising and promotions should highlight the relevant features for the people who will see them. To perform target marketing, one needs to know which product features appeal to each group. One also needs audience characteristics for each advertising method.

Along with data collection, MIS can help evaluate the models. Computers are used to identify categories and to perform statistical analyses. Marketing survey data are combined with statistics of advertising media. Data from warranty registration cards, discount coupons, and checkout scanners are analysed to spot changes in preferences, evaluate the effectiveness of promotional campaigns, and provide leads for future promotions.

5.3.1.3 Advertising and promotion

Marketing managers need information to help them achieve sales objectives at the lowest possible cost for advertising and promotion. Computers use market research information and promotion models to help select media and promotional methods, allocate financial resources, and control and evaluate results of various advertising and promotion campaigns.

The promotion of a company's product, one of the most important functions of marketing and of the entire company, is a creative activity carried on largely outside the MIS. Nevertheless, there are certain inputs and outputs of the promotion sub-function integral to the MIS. Promotion needs interaction with other sub-systems and sub-functional areas to get the necessary information and give its output. The input to the promotion includes price schedules, product specifications, and feedback on actual sales performance.

Selecting the best set of national magazines plus audio and visual media to communicate the corporation's advertising message to present and potential customers is a many faceted problem. Important variables influencing the media selection process are (Thierauf, 1987:467):

- Availability of time or space in each medium.
- The advertising budget.
- Exactly what target group the corporation wishes to reach with a given message.
- The value of each repeat exposure.
- The quality of the advertising medium.
- The discounted cost of running a selected medium.

Consequently, it is not a simple task to formulate an effective advertising programme by identifying the key variables and quantifying the relationship among them.

To solve the advertising media problem, companies use different models like linear programming and sales campaign modelling. The linear programming advertising media model chooses the advertising mix that will maximise the number of effective exposures subject to the following constraints: total advertising budget, specified minimum and maximum usage rates of various media, and specified exposure rates to the different market segments. Sales campaign modelling assists the advertising manager in determining how levels of advertising affect sales, so one can now time advertising campaigns to achieve maximum impact.

Media-selection packages assist in selecting a mix of avenues to persuade the potential purchaser, including direct mail, television, print media, and the electronic media such as the Internet and the World Wide Web in particular. The effectiveness of the selected media mix can be monitored and its composition can also be continually adjusted.

5.3.1.4 Sales order processing

The sales order processing or order entry sub-function is responsible for recording sales orders and providing the documents that other sub-systems use to fill those orders, maintain inventory levels, and bill the customer. The sales order processing sub-systems provide sales tax data to the general ledger sub-system for posting to taxing-agency accounts; stock data to the inventory sub-system for updating inventory balances; and sales invoice data to the accounts receivable sub-system for posting to customer accounts.

Computerised sales order sub-systems usually track the sales made by each salesperson and provide input to the payroll system so that salespeople's commissions can be calculated. The sub-system should also provide information to the shipping department to ensure that the correct stock is sent to the customer; provide for backorders when there is not enough stock on the shelves; accurately figure prices, totals, discounts, and taxes on the order; and allow a quick and accurate response to customer enquiries about the status of the order. If the system is computerised and the sales order sub-system is on-line, the salesperson can verify customer credit and inventory levels immediately. This provides the salesperson with a competitive advantage over salespeople without on-line order entry systems. Consider, for example, a field sales representative who carries to the client's premises a notebook computer equipped with a modem to connect with the organisation's mainframe. Using the microcomputer, the salesperson can verify immediately whether the customer can be granted the credit needed for the sale and if there is enough stock on hand. The sale can be closed at that point and picking slips delivered electronically to the warehouse at the same time. Because the system is on-line, the customer should get the goods much faster than if a manual order entry sub-system were used.

5.3.1.5 Physical distribution

Customer shipments are initiated by physical distribution (PD) at the warehouse and plant levels. Customers' shipment orders are forwarded from sales order processing to physical distribution. Goods are then packed at the warehouse and plant levels for shipment to customers or warehouses. All shipment orders provide sufficient information for billing the customer and making the proper adjustments to inventory. This information is utilised for calculating the finished goods inventory.

Basically, the PD clerk interrogates the computer for instant shipping information. The outgoing traffic clerk selects the appropriate means of transportation that is stored online for billing the customer later. The customer shipment order is completed with this information, and goods are shipped.

An organisation may choose to use existing commercial and public delivery systems for its products and services. It may also choose to provide its own products delivery systems to its customers. Regardless of the systems chosen, the goods being distributed must be monitored. It is important to track products or services throughout the distribution system to identify and correct delivery errors and reduce delivery time. The speed with which an organisation can deliver its products is an important customer service.

If the organisation maintains its own distribution system, information about its effectiveness must be collected and reported to management. Information should also be maintained about the acquisition, repair, use, and allocation of equipment.

5.4 Manufacturing function

The manufacturing of finished goods involves many operations. Initially, the product must be designed or formulated by the engineering department. Materials used in its manufacture must be acquired from outside the organisation. Not only must plant, equipment, and tools be provided, but also appropriate personnel must be hired and trained

to utilise manufacturing facilities. Raw materials and goods in process must be available when needed. Production must be planned, scheduled and controlled for output that meets quality standards as well as deadlines. An effective manufacturing MIS then must be fully integrated in its own operations and with other functional areas to meet predetermined organisation goals and objectives.

A manufacturing manager is concerned mainly with material flow from vendors, through the transformation process, and to marketing for distribution. Both personnel and machines are used to expedite and facilitate this flow and transformation. In a manufacturing firm, most of the employees work in the manufacturing function. Also, much use is made of machines that move material by conveyors, cranes, and trucks, and that transform raw materials into finished goods. Many of these machines can be controlled by computers.

5.4.1 MIS of the manufacturing function

MIS of the manufacturing function is generally complex, requiring the use of an integrated approach using computers, that is computer integrated manufacturing (CIM). Fundamentally CIM means integrated manufacturing, with the computer performing the integration and with all of the information linkages being effected by computer (Zwass, 1998:432). Within this broad framework, manufacturing activities must be co-ordinated with many other areas. This is particularly necessary before actual manufacturing operations can begin. More specifically, engineering must get involved in value analysis, to determine if value is being received for cost incurred. Once the product design has been finalised, purchasing must be done on an optimum basis for keeping the acquisition of materials and services at a minimum cost. In turn, these materials become an integral part of a computerised approach to the manufacturing process.

Building upon these considerations, management needs to look critically within the manufacturing area itself. To produce meaningful managerial and operational information for the proper planning and control of manufacturing operations, a broadened perspective is necessary; that is, the use of problem finding where deemed appropriate. The subsequent

sections discuss the major components of MIS in the manufacturing function, namely, purchasing, production planning and control, raw material and work-in-process inventories, manufacturing operations and quality control.

5.4.1.1 Purchasing

To produce goods, one must have the right quantity of raw materials and production supplies on hand. Furthermore, one may want to procure these materials and supplies at the lowest cost and have them delivered at the right time. To assist in this function, the purchasing sub-system has to maintain data on all phases of the acquisition of raw materials and purchased parts used in production. For example, the purchasing sub-system must maintain vendor files with price quotation information of all production materials and supplies so that intelligent choices can be made among suppliers. Also, records must be maintained of those goods already on order.

5.4.1.2 Production planning and control

The production planning and control co-ordinates all activities concerning a production order from its initial recording, through inventory lay-up and manufacturing, to getting the finished goods ready for shipment to customers or to company warehouses.

Many on-line recording techniques can aid the production planning and control sub-function in its everyday operations. The display screen located in each manufacturing work centre, enables the user to enter data regarding the name and location of goods in process. These keyboard entries can be monitored online by the plant computers, and enable the production planning and control department to know when goods enter and leave a work centre. Exception reporting alerts the sub-function when goods are overdue from a specific work centre. Delay reasons can also be entered from the individual work centre's display screen. Prolonged delays, resulting in possible shipment delay, are brought to the attention of manufacturing managers, supervisors, and foremen through exception reports.

More recently, software for manufacturing resource planning (MRP-II) has become available. MRP-II software extends the production information system to finance, marketing, human resource management, and other organisational functions (Schultheis and Sumner, 1992:455). A fully developed MRP-II system includes modules that provide material requirement, and capacity planning. The system also accesses cost accounting data through integration with the financial accounting system. MRP-II software has three different models:

- Centralisation: - All of its applications run on a centralised mainframe, even though production may be distributed geographically.
- Decentralisation: - MRP-II software runs at each plant location without much communication between plants or between any plant and the organisation's headquarters.
- Distributed processing: - In this model, appropriate MRP-II software modules run at each plant site and other appropriate modules run at the organisation's headquarters. Data are usually shared among all plants and headquarters. Software that permits the distributed processing model is called distributed MRP-II software.

5.4.1.3 Raw material and work-in-process inventories

As the marketing sub-system is responsible and accountable for finished goods inventory, the manufacturing sub-system, on the other hand, controls the flow of raw materials and work-in-process inventories. In some cases, inventory management is combined with the general logistic systems, which plan and control the arrival of purchased goods into the firm as well as shipments to the customers.

The management and control of raw materials, goods-in-process, and finished goods inventories are an important part of the manufacturing function. Careful management and control of these inventories usually provide considerable savings to the organisation (Schultheis and Sumner, 1995:465).

Inventory management and control systems use information from other operational information systems, such as the shipping and receiving systems, purchasing systems, and order entry systems.

Maintaining inventories at their proper levels eliminates production shutdown from lack of raw materials and lost sales from lack of finished goods. However, maintaining inventories also represents a number of costs to the organisation including the costs of procuring and carrying the inventory and stock out costs, those costs that result when the right amount of the right item is not on hand at the right time.

In a conventional production system, two basic information tools are used to manage inventories, a re-order point system and a system for determining the least expensive quantity to order, or economic order quantity (EOQ) system. A re-order point system is used to make certain that production materials are ordered in sufficient lead-time to arrive at the plant when they are needed in the production process. The system uses predefined levels of inventory to initiate the purchasing process. The predefined levels of inventory are those levels required to cover the organisation while waiting for new orders of the stock to be delivered. Some organisations do not wish to cut their timing this close, however. As a result, they maintain an additional amount of stock, called safety stock, on hand in case shipments are delayed, some stock items are defective, or some other contingency occurs.

The second conventional inventory management tool provides managers with the means to reduce total inventory costs by identifying the most economical order quantity of each item. Ordering in small quantities reduces taxes, insurance, and other carrying costs but increases ordering, shipping, receiving, and other procurement or ordering costs. Ordering in large quantities reduces ordering costs but increases carrying costs. Thus, the best or most economical order quantity strikes a balance between carrying costs and ordering costs.

Computing EOQ manually for each item in inventory would be a very large and tedious task. Also, for many inventory items, the managers may wish to ask "what if" questions about the values in the EOQ formulas. Without computers, these tasks would be laborious and may prove too time-consuming to keep the order process fine-tuned to current data.

5.4.1.4 Manufacturing operation

The manufacturing operation comprises the physical manufacturing process of products. Many advanced manufacturing methods can be used in this process. Automated processes, including industrial robots, numerical control machine tools, and computer monitored processes are typical ones. With the feedback mechanism of these advanced techniques, machine utilisation reports are no problem. The numerical control (NC) machine work centres may have a great impact on the manufacturing function. The advent of computer controlled machine tools has brought about the added efficiency of operations. Complete and accurate status reporting can be done without manual intervention and operator knowledge. The automatic processes in the machine shop consist of robot operations and fixed-cycle machine tools, such as plastic injection moulding machines. While the robots do their jobs, the minicomputer monitors the robots and produces exception reports to the machine shop's supervisor and the foreman when operations go out of control.

5.4.1.5 Quality control

Quality control sub systems provide information about the status of production goods as they move from the raw materials state, through goods-in-process to the finished goods inventory. Quality control systems also ensure that raw materials purchased for use in the production processes meet the standards set for those materials. The quality control activity of a manufacturing function may relay on the data collected on the shop floor by the sensors embedded in the process control systems. Shop-floor data collection systems can include a rich assortment of input devices such as counters, assembly line data entry terminals, process control sensors, and so on. Shop-floor data collection devices can be connected to a manufacturing work centre local area network (LAN) for local data

collection. The LAN may in turn be connected to a minicomputer or mainframe computer system. A manufacturing work centre LAN is a communication network that often connects very different devices found on a work centre floor, such as robots that handle and load programmable controllers used to sequence processes; vision systems that inspect or sort parts; bar-code readers that count or sort parts; and microcomputers with keyboards or voice recognition systems that allow factory floor personnel to enter data about the time spent on a job order, price control, and the number and types of waste on scrap materials identified.

When inspection, testing or monitoring identify items that fail to meet the standards that have been set, a variance occurs. Since one of the foundations of quality is avoiding variance from standards, statistical quality control is conducted, with continual measurement of the work-in-process as well as of finished products. Based on these measurements, graphs, histograms, and distributions of product sizes and their other attributes are obtained. Sources of variation from standards are sought and future variations are prevented by removing their root causes.

5.5 Accounting and finance function

The accounting and finance management function of manufacturing companies encompasses a number of important responsibilities. These include monitoring and analysing the organisation's financial condition, managing the accounting system, and preparing financial statements and reports. The accounting and financial management functions are also responsible for the budgeting process, and managing customer credit; calculating and paying income, payroll, property, excise, and other taxes; and managing appropriate insurance coverage for the organisation's personnel and assets.

Accounting and finance data can be stored on some machine-processible medium at the appropriate level and be retrievable as the users need it. The system can calculate all financial information on a current basis. Management is always able to retrieve current cost data, financial operating ratios, and cash balances.

Other sub-systems can benefit from the financial statements prepared by the accounting and finance function. The corporate planning staff can evaluate current trends in profitability for last-minute budget changes by using information from the accounting and finance sub-system. Also, manufacturing management can evaluate its inventory investment in the light of current operating conditions. Likewise, manufacturing management can appraise its overall ability to keep the cost of raw materials at a minimum. The ability to extract current accounting and finance information via a display medium can indicate changes to the user as they occur.

5.5.1 MIS of the accounting and finance function

Customer billing is initiated by marketing; vendor invoices are received from purchasing. Payroll, whether factory or office, also originates outside the accounting sub-system. Similarly, feedback of product cost data is forwarded from the manufacturing work centres and inventory. The only real accounting and finance functions that are generated within their own operation are financial statements and sources of funds. Financial statements are forwarded to all sub-systems for management review and appropriate corrective action. Thus, most other sub-systems must be considered in developing an effective management information system of the sub-system (Thierauf, 1987:540).

The input from other sub-systems, along with the accounting-generated information, provides management and their staff with desired output. In addition, accounting and finance exception reports are produced on an interactive basis if so desired. But just as important is the feedback of instantaneous information to operational levels that utilise accounting and finance information for comparing actual operations to budgeted amounts or standards. The major components of MIS of accounting and finance function in manufacturing companies are accounts receivable and payable, payroll, cost accounting, financial statements, and source and application of funds. These major functions are explained in the subsequent sections.

5.5.1.1 Accounts receivable and payable

Accounts receivable sub-systems keep records of amounts owed by customers from data generated by customer purchases and payments. They produce invoices to customers, monthly customer statements, and credit management reports. Computer-based accounts receivable systems stimulate prompt customer payments by preparing accurate and timely invoices and monthly statements to credit customers. They provide managers with reports to help them control the amount of credit extended and the collection of money owed. This activity helps to maximise profitable credit sales while minimising losses from bad debts.

Accounts payable systems keep track of data concerning purchases from and payments to suppliers. They prepare cheques in payment of outstanding invoices and produce cash management reports. Computer-based accounts payable systems help ensure prompt and accurate payment of suppliers to maintain good relationships, ensure a good credit standing, and secure any discounts offered for prompt payment. They provide tight financial control over all cash disbursements of the business. They also provide management with information needed for the analysis of payments, expenses, purchases, employee expense accounts, and cash requirements.

5.5.1.2 Payroll

A payroll sub-system receives and maintains data from employee time cards and other work records. It produces pay cheques and other documents such as earning statements, payroll reports, and labour analysis reports. Other reports are also prepared for management and government agencies. Computer-based payroll systems help businesses make prompt and accurate payments to their employees, as well as generate reports to managers, employees, and government agencies concerning earnings, taxes, and other deductions. They may also provide management with reports analysing labour costs and productivity.

5.5.1.3 Cost accounting

Cost accounting is concerned with costing the organisation's manufactured products as they are produced. Cost accounting depends on data generated throughout the workday in the manufacturing plant. Usage of raw materials, machine time, and labour are recorded by the manufacturing sub-system and are converted to money and serve as input data to the cost accounting process. Cost data are maintained in the database for use in the preparation of future budgets, and discrepancies between actual cost and projected cost are noted in exception reports to appropriate managers.

All minatory transactions such as receipts and expenditures of funds are made available to the financial and accounting sub-system through the database and maintained in journals. Periodically, journal data are used to update basic financial statements such as the balance sheet and the income statement.

5.5.1.4 Source and application of funds

A source and application of funds sub-system focuses on obtaining the needed funds for application to capital projects and current operations. An integral part of source and application of funds is the current and future cash flow.

The information supplied by a cash flow report helps managers to make decisions about investing, purchasing, and borrowing money. If this information is placed on an electronic spreadsheet, managers may simulate a number of possible business conditions, such as increasing or decreasing revenue, increasing or decreasing customer credit problems, deferring the acquisition of an asset or repairing existing fixed assets instead of replacing them by simulating many different possible business conditions. Managers are able to make more informed decisions about the use of or need for cash for the short term.

5.6 Personnel function

The basic objective of the personnel function is to find the right person for the right job. To fulfil the stated purpose it makes contacts with other major functions. Payroll master data

provide a starting point in terms of present personnel costs. Production planning and control require the proper placement of factory personnel to effect the desired level of output. Similarly, shipment of finished goods considers the number of warehouse personnel handling current customer orders. Thus, an effective personnel system must relate to other sub-systems in order to provide the necessary human resources for accomplishing organisation objectives.

5.6.1 MIS of the personnel function

Input for the MIS personnel function of manufacturing companies originates partly in other functions, particularly in the accounting and manufacturing function. However, skills inventory, personnel selection and placement, and wage and salary administration originate within the personnel function. Regardless of the originating data, these input sources are combined with the existing database-skills inventory, payroll master, personnel history, and training data, to produce desired personnel reports. The major functions of personnel sub-systems, namely skills inventory, personnel selection and placement, and wage and salary administration, are discussed in the following sections.

5.6.1.1 Skills inventory

A skills inventory sub-system focuses on keeping track of employee skills for the purpose of retrieving specific information on a specific employee, promoting from within, the preparation of periodic reports to meet the organisation's needs.

A skills inventory contains information about every employee, such as work experience, work preferences, test scores interests, and special skills or proficiencies. The skills inventory provides the human resource manager with a valuable resource for completing operational tasks. For example, the skills inventory can be used to identify potential internal applicants for positions in the organisation. It may also be used to identify employees for transfer, promotion, or training and development programmes. It may even be used to identify employees who are underemployed, those whose skills far exceed their present assignment.

Managers can use employee information systems in numerous other ways. For example, they can identify the percentage of employees who will be of retirement age during selected years and arrange this information by job title, by department within the firm or by minority category. Such information might lead to tactical decisions regarding pension plan funding, recruiting emphasis, or the development of training programmes so that younger employees can fill positions vacated by retirements.

5.6.1.2 Personnel selection and placement

A personnel selection and placement sub-system for manufacturing companies is concerned with three important phases. First, the MIS needs to forecast personnel needs. Second, this department recruits personnel to meet organisational needs. Properly managed, the MIS furnishes information on skills required for all current and upcoming corporation programmes. An essential part of personnel selection is information about an inventory of skills available in the organisation. Third, the personnel sub-system matches available personnel with current labour assignments in order to use employees most effectively.

5.6.1.3 Compensation and benefits

The wage and salary systems or compensation plans an organisation can offer vary widely and include hour wage plans, price-rate plans, incentive pay plans, merit pay plans, monthly salary plans, commissions, and project sharing.

The massive government reporting requirements are an important reason why organisations have implemented computerised human resource information systems. Compensation and benefit plans can also play an important part in improving an organisation's productivity. Linking employee productivity to pay or encouraging increased productivity with incentive pay plans can often improve an organisation's productivity substantially (Schultheis and Sumner, 1992:482). Thus, these information systems provide important support to managers for tactical decisions.

CHAPTER 6: EMPERICAL RESEARCH

6.1 Introduction

The research done in this study can be divided into two distinct parts, namely, a literature survey and empirical research.

- **Literature survey**

  In Chapters 2 to 5, the definitions and explanations of the phrase *management information systems (MIS)* and its components are discussed and the relevant literatures are also described. The application of MIS and its contribution to the effectiveness of the main functions of manufacturing companies are broadly discussed.

- **Empirical research**

  Chapters 6 and 7 cover the empirical research of the study. In Chapter 6, the techniques and methodologies used to collect the empirical data are discussed. The analysis and results of the data are also presented. The final conclusions of the study are presented in Chapter 7.

6.2 Research methodology

One of the objectives of this research was to establish the extent of utilising management information systems and applying information technology in the chemical manufacturing industries in the Cape Metropole area. Therefore it was necessary to gather information from manufacturing companies that have been operating in the specified area. The first stage of collecting the data was to obtain a list of the whole population of manufacturing companies so that it would be possible to draw a sample, on the assumption that many manufacturing companies could exist in the area. The three sources which the researcher used to obtain a list of chemical manufacturing companies operating in the Cape Metropole area were:

- **Statistics South Africa (SSA)**

  Statistics South Africa completed a survey on manufacturing companies in 1996. This was the most recent survey data the researcher could obtain. The report of the survey has been published as a booklet and is available on the market. The names and addresses of most of the manufacturing companies that have been operating in the Western Cape area were listed in the booklet. The list was categorised in different sectors such as: chemicals and chemical products, clothing, food, wood, and metal manufacturing sectors. The researcher had to select only companies operating in the Cape Metropole area from the chemical and chemical products manufacturing sector. Only 100 chemical manufacturing companies were found to be in the Cape Metropole area.

- **Cape Chamber of Commerce**

  The Cape Chamber of Commerce listed the names and addresses of all business organisations that are members of the Chamber of Commerce on its webpage. The researcher managed to select a few companies that are chemical manufacturers and operating in Cape Metropole area.

- **Yellow Pages telephone directory**

  The *Yellow Pages* telephone directory was also used as a source of data. A few companies were found in the directory, which were not listed in the other sources.

From these three sources a total of 148 chemical manufacturing companies were found. These companies still had to be screened through the rest of the requirements of the study. In addition to being chemical companies and operating in the Cape Metropole area, companies that were included in the study had to be medium (50-200 employees) or large-scale (more than 200 employees) companies and operational for at least the past five years. In order to obtain potential companies and maximise the response rate, the researcher made telephone calls to each of the 148 companies' managers. Some of the telephone enquires addressed to the companies' managers were: How many employees does the company have? For how long has the company been operating? Is manufacturing the company's

major activity? Is the company's manufacturing plant in the Cape Metropole area? The manager's willingness to complete the questionnaire was also ascertained.

From the telephone conversations with the companies' managers, the following problems were identified. Of the 148 companies:

- Some were not manufacturing companies but were trading companies or agents, even though they were registered as manufacturing companies in the data sources.
- Some were just shops or head offices and their manufacturing plants were situated in other cities.
- Some were very small (fewer than 50 employees) in size. Most of them were operating in individual's garages or backyards.
- Some had been restructured, merged or shut down after the survey, which was completed in 1996.

Because of the above-mentioned problems with the data, only 30 potential chemical manufacturing companies were identified. Since there were only 30 companies that fulfilled the requirements for inclusion in the study, they were taken as a full population of the data.

6.2.1 Development of the questionnaire

Two types of questionnaire were developed namely, Type A and Type B. Type A questionnaire was designed for the personnel or managing directors of the companies and Type B was designed for other departments' managers. Type A questionnaire consisted of seven sections and a total of 34 questions. The number of sections in Type B questionnaire was six, with a total of 28 questions. The one that was designed for the managing directors had a few more questions in the first and last part of the questionnaire, but otherwise questions in both types of questionnaire were the same. These additional questions were general facts about the companies, such as:

Q2. For how long has the company been operating?

Q3. How many employees does the company have?

Q5. Does the company have an integrated computer system or database system to communicate with its retailers or other shops?

Q6. Does the company have a department or section of management information systems?

Q33. What is the company's measurement of success?

Q34 . How do you rate the recent performance of the company?

The questions were classified in different sections with respect to their concept and each section had a number of questions which resulted in 34 variables to be analysed for Type A and 28 variables for Type B questionnaire. A summary of the sections, and the number of questions and variables in a section for each type of questionnaire are shown in Table 6.1. Copies of the questionnaires are also included as Annexure 1 and 2 of this thesis.

Section	Purpose of section	Number of questions or variables in Type A	Number of questions or variables in Type B
1	To obtain general information about the companies and the respondents' knowledge of MIS.	6	2
2	To determine the extent of utilisation of MIS and information technology in the production functions of the companies.	6	6
3	To determine the extent of utilisation of MIS and information technology in the marketing and sales functions of the companies.	6	6
4	To determine the extent of utilisation of MIS and information technology in the accounting and finance functions of the companies.	7	7
5	To determine the extent of utilisation of MIS and information technology in the personnel functions of the companies.	4	4
6	To determine the extent of utilisation of MIS and information technology in the corporate planning functions of the companies.	3	3
7	To determine the measurement of the success of the companies and present performance of the companies.	2	0

Table 6.1 Summary of the questionnaires

The questionnaires consisted of different sections containing questions on the following topics.

- **General information**

  This section consisted of six questions in Type A questionnaire and only two questions in Type B questionnaire. These questions asked the respondent to give general information such as the respondent's management level, the number of employees in the company, the age of the company, the respondent's knowledge of MIS and the application of integrated computer network systems for the different activities of the companies.

- **Utilisation of MIS in the production function**

  Six questions were asked in this section. The questions focused on the aspects of the effectiveness of the flow of information between the production function and other functions and also within the production function and the extent of using computerised manufacturing systems.

  Welman and Kruger (1999:155) suggest that the 5-point Likert scale could be used to measure the opinions or perceptions of respondents. The respondents therefore had options to choose from the following 5-point scale for questions that asked them to rate the utilisation of MIS in the different functional areas of the companies.

Very good	Good	Average	Poor	Very poor

- **Utilisation of MIS in the marketing and sales function**

  This section consisted of six questions in which the respondents had to rate the efficiency of information flow between the marketing and sales function and other functions, the efficiency of the marketing function database, and the general application of MIS in the marketing function.

- **Utilisation of MIS in the accounting and finance function**

  In this section the respondents were asked to rate the efficiency of information flow between the accounting and finance function and other organisational functions and also the general application of management information systems in this organisational function for the effectiveness of its activities. This section consisted of seven questions.

- **Utilisation of MIS in the personnel function**

  Four questions were included in this section. The respondents had to rate the general utilisation of effective management information systems in the personnel function for the effectiveness of its activities by using the above five-point Likert scale.

- **Utilisation of MIS in the corporate planning function**

  This section consisted of only three questions that focused on the availability of information for corporate planning and decision making activities, and the effectiveness of the distribution of information from the corporate planning function to the relevant functions.

- **Measurement of success**

  This section had only one question. Different companies had different measurements of success. The main four measurements of success, namely, profitability, productivity, customer service and market share, were presented as alternatives. The respondents had to tick those which the company used as the measurement of business success.

- **Performance of the company**

  This section also had one question in which the respondent had to rate the present performance of the company according to the following seven-point scale.

  1 2 3 4 5 6 7

  Highly successful _____ Highly unsuccessful

6.2.2 Pilot study and data collection

To test the questionnaire for clarity, a pilot study was carried out on four chemical manufacturing companies. The pilot survey was done through personal interviews to enable the researcher to have the right perception on the general activities of manufacturing companies. Six managers from each company, a total of 24 managers, were interviewed. As a result, a few questions were modified and improved in such a way that respondents could easily understand them.

To maximise the response rate, the questionnaires were delivered personally to 30 chemical manufacturing companies. Six respondents, two from each management level, namely top, middle and supervisory level, completed the questionnaire from each company. The questionnaires were collected after completion.

6.2.3 Response rate

A total of 180 copies of the questionnaire were distributed, of which 132 completed questionnaires were collected. Therefore, an overall response rate of 73% was obtained.

6.3 Analysis of the data

6.3.1 Frequency analysis

The software application that was used to do the frequency analysis was BMDP2D-Frequency Analysis (Dixon, 1983). The frequency analysis was done for each question and the results are presented below.

- **General information**

  It was attempted to survey an equal number of managers from each management level in the study. Table 6.2 shows a more or less equal distribution of respondents from different management levels.

Management level	Percentage
Top	38.5
Middle	33.8
Supervisory	27.7

Table 6.2 Percentage of respondents from each management level

Figure 6.1 shows the age distribution of the companies covered in the study. The study covered only companies that had been functioning for at least the past five years. Most of the companies (31.8%) covered in the study were of the age group 5-10 years. Age groups of 16-20 years and greater than 30 years comprised 22.7% and 22.73% of the companies respectively.

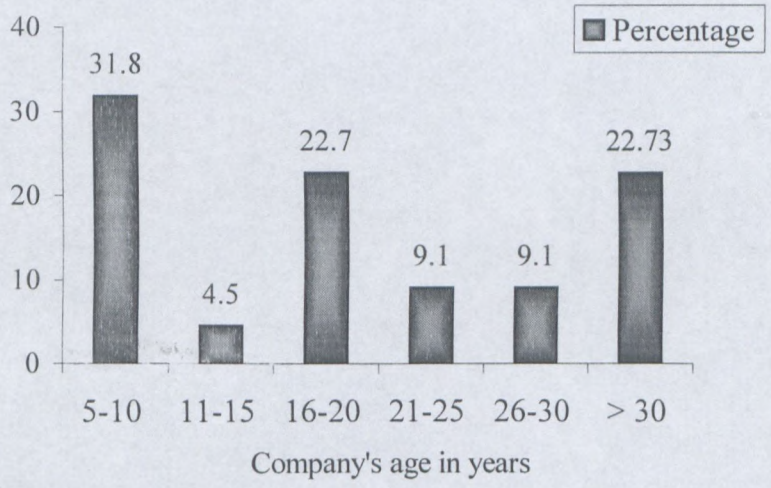

Figure 6.1 Age distribution of the companies

For the purpose of this study, the size of the companies was determined by their number of employees. Companies with fewer than 50 employees were considered small-scale manufacturing companies and companies with 50 to 200 employees were considered medium-scale. Comprises with more than 200 employees were considered large-scale companies.

63.6% of the companies covered in the study were medium-scale chemical manufacturing companies and the rest of the companies (36.3%) were large-scale companies. Table 6.3 shows the percentage of companies in each group of number of employees.

Number of employees	Percentage
50-100	40.9
100-150	13.6
151-200	9.1
201-300	13.6
301-500	13.6
More than 500	9.1

Table 6.3 Number of employees in the companies

Most of the managers had an average knowledge of MIS. As Table 6.4 shows, 44.6% of the respondents had an average knowledge of MIS and 37.7% of the respondents had poor or very poor knowledge of MIS.

Knowledge of MIS	Percentage
Very good	2.3
Good	15.4
Average	44.6
Poor	26.2
Very poor	11.5

Table 6.4 Respondents' knowledge of MIS

According to Table 6.5, 78.9% of the companies use centralised database and/or integrated computer systems for their day-to-day activities.

Centralised database	Percentage
Yes	78.9
No	47.4

Table 6.5 Applying centralised database and/or integrated computer systems

Manufacturing companies may structure MIS as a department. It can also function by being integrated with any other department. As presented in Table 6.6, 36.4% of the companies had a separate department of MIS and 22.7% of the companies had a MIS department that was integrated with other departments, while 40.9% of the companies did not have any MIS department.

Having MIS department	Percentage
Yes	36.4
No	40.9
Integrated with other department	22.7

Table 6.6 Availability of MIS department

In order to determine the extent of the utilisation of management information systems in the companies, it was important to investigate the application of MIS in different functional areas of the companies. Respondents were asked to rate the effectiveness of some activities that imply the extent of the application of MIS in different functional areas. The results obtained are presented as follows.

- **Utilisation of MIS in the production function**

  As it is shown in Table 6.7, the effectiveness of the activities of management information systems in the production section was represented by six aspects listed in the table. The majority of respondents rated the effectiveness of the given six activities in the production function as average. In average, 38.2% of the respondents believed that the overall effectiveness of these activities of MIS in the production function was good and 39.48% believed that it was average, while only 10.5% of the respondents said it was poor. Table 6.7 shows the list of questions asked, and the percentage of respondents under each degree of efficiency.

Questions asked for the respondents to rank	Very good	Good	Average	Poor	Very poor
The efficiency of information flow from the marketing and sales function to production function.	13.1%	40.8%	36.2%	7.7%	2.3%
The efficiency of information flow from production section to purchasing function in the process of ordering and issuing raw materials.	9.2%	43.1%	40.0%	6.9%	0.8%
The total information exchange between different sub-functions or individuals in the production function.	8.5%	41.5%	39.2%	10.0%	0.8%
The efficiency of information flow between production and the finance function and/or other functions for delivering finished products.	10.8%	34.6%	41.5%	12.3%	0.8%
The extent of your application of computerised manufacturing systems for effective and efficient flow of information.	6.2%	34.6%	46.2%	10.8%	2.3%
The activity of generating reports on the quantity of finished goods and the consumption of resources during the production for management control.	14.6%	34.6%	33.8%	15.4%	1.5%
Average percentage	10.4%	38.2%	39.48%	10.52%	1.42%

Table 6.7 The utilisation of management information systems in the production function

- **Utilisation of MIS in the marketing and sales function**

  Six aspects were given to evaluate the extent of the utilisation of management information systems in the marketing and sales function. In average, nearly half (45.27%) of the respondents rated the effectiveness of the activities of MIS in the marketing and sales function as average and 30.12% as good while 15% of the respondents believed that it was poor. Table 6.8 shows the percentage of respondents under each degree of efficiency.

Questions asked for the respondents to rank	**Very good**	**Good**	**Average**	**Poor**	**Very poor**
The efficiency of information flow between marketing and sales and other functions.	4.6%	33.1%	43.1%	16.2%	3.1%
The database efficiency in creating or updating your customer list, price list, product specification list, etc?	6.9%	26.9%	48.5%	16.9%	0.8%
The total information exchange between different sub-sections and/or individuals in marketing and sales function.	4.6%	27.7%	49.2%	16.2%	2.3%
The activity of generating timely sales report for senior management.	13.1%	26.9%	45.4%	13.8%	0.8%
The activity of generating sales forecasts from the relevant department for planning and budgeting.	7.7%	29.2%	48.5%	12.3%	2.3%
The rate of your information supply to the production function about customer's choice based on the result of marketing research.	9.2%	36.9%	36.9%	14.6%	2.3%
Average percentage	7.68%	30.12%	45.27%	15%	1.93%

Table 6.8 Utilisation of MIS in the marketing and sales function

- **Utilisation of MIS in the accounting and finance function**

  The effectiveness of information flow between the accounting and finance function and other organisational functions, and the opportunity that managers have to access the financial database system, were some of the activities in this function that were required to be rated. As Table 6.9 shows, seven main activities of MIS in the accounting and finance function were given to be evaluated. In average, 45.4% of the respondents believed that the effectiveness and efficiency of the listed seven activities of MIS in the accounting and finance function was average and 26.1% of the respondents said it was good, while 14.9% said it was poor.

Questions asked for the respondents to rate	**Very good**	**Good**	**Average**	**Poor**	**Very poor**
The efficiency of information flow between accounting and finance and other functions.	5.4%	24.6%	51.5%	16.9%	1.5%
The efficiency of the flow of information within this function.	7.7%	26.2%	46.9%	17.7%	1.5%
The efficiency of your financial computer software program for your daily activities.	13.8%	20.8%	49.2%	14.6%	1.5%
The activity of supplying the financial report to the management.	11.5	28.5	43.8	16.2	0.0
The opportunity that managers have to access the financial database system.	7.7%	23.1%	51.5%	12.3%	5.4%
The efficiency of your payroll program.	25.4	33.1%	29.2%	11.5%	0.8%
The interaction and integration of your financial computer database with the database of other departments.	7.7%	29.2%	43.1%	19.2%	0.8%
Average percentage	11.9%	26.1%	45.4%	14.9%	1.78%

Table 6.9 Utilisation of MIS in the accounting and finance function

- **Utilisation of MIS in the personnel function**

  The majority of the respondents believed that the degree of efficiency of the activity of generating timely personnel reports for management control was average, which is one of the major activities of MIS in this function. According to Table 6.10, 34.63% of the respondents believed that the effectiveness of the overall activities of MIS in this function was average, and 31.15% said it was rather good, while 13.4% of the respondents said it was poor.

Questions asked for the respondents to rate	**Very good**	**Good**	**Average**	**Poor**	**Very poor**
The effectiveness of your personnel database management system.	20.0%	33.1%	30.0%	14.6%	2.3%
The effectiveness of the flow of information from personnel function to the finance function.	18.5%	30.8%	36.2%	13.1%	1.5%
The activity of generating timely personnel reports based on the database records you have for management control.	16.9%	33.8%	35.4%	13.1%	0.8%
The availability of information that the employee may want to know about.	18.5%	26.9%	36.9%	13.1%	4.6%
Average percentage	18.48%	31.15%	34.63%	13.4%	2.3%

Table 6.10 Utilisation of MIS in the personnel function

- **Utilisation of MIS in the corporate planning function**

  As the major activity of this function is to develop plans and make corporate decisions, the availability of relevant information from different organisational functions is of utmost importance for its effectiveness. On the other hand, the final decisions and plans should reach the relevant organisational functions or individuals in time for proper implementation. As shown in Table 6.11, 45.4% of the respondents believed that the

availability of information and the effectiveness of information flow from the relevant functions to the corporate planning function to perform efficient planning activities were average, while 22.3% said they were good and 16.2% said they were poor. 52.3% of the respondents rated the availability of information and effectiveness of information flow from planning section to different sections as average while 19.2% believed that they were poor.

Major activities in the corporate planning function	Very good	Good	Average	Poor	Very poor
The availability of information and the effectiveness of information flow from relevant functions to this function to perform efficient planning activities.	12.3%	22.3%	45.4%	16.2%	3.8%
The availability and effectiveness of information flow from planning function to different functions.	4.6%	20.8%	52.3%	19.2%	3.1%

Table 6.11 Utilisation of MIS in the corporate planning function

- **The overall effectiveness of the company's MIS**

  Respondents were also asked to rate the overall effectiveness of MIS in the companies according to their perception. The majority of the respondents rated it as average. As is shown in Table 6.12, 56.2% of the respondents believed that the overall effectiveness of the company's MIS was average and 21.5% believed that it was good, while 13.8% said it was poor.

Activity	Very good	Good	Average	Poor	Very poor
The overall effectiveness of management information systems in the companies.	6.9%	21.5%	56.2%	13.8%	1.5%

Table 6.12 Utilisation of MIS in the companies

- **Success measurements of the companies**

  Different companies may have different ways of measuring their success. This depends on the objectives and goals of the company. Various researchers define the success of a company in different ways. For the purpose of this study, four commonly used measurements of success, namely, profitability, productivity, customer service and market share were considered. The respondents had to indicate those which the company used as a measurement of success. According to Figure 6.2, 31.82 % of the companies measured their success with profit, while 13.64% measured success with market share.

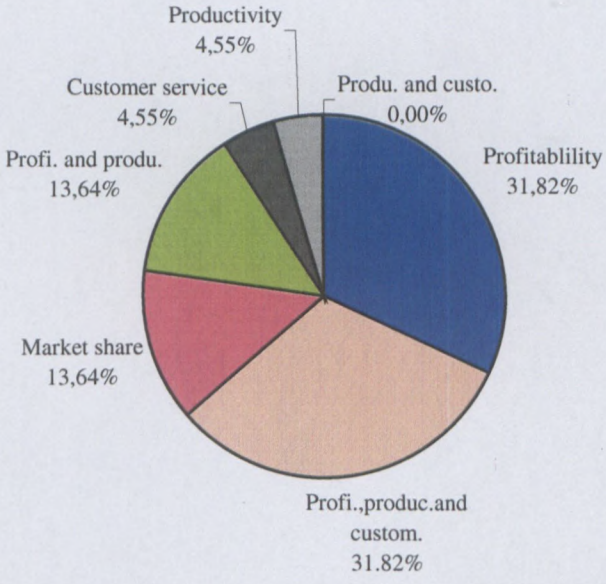

Figure 6.2 Measurement of success of the companies

31.82% of the companies measured their success with a combination of profitability, productivity and customer service, while 13.64% measured success with a combination of only profitability and productivity.

- **Current performance of the companies**

  In order to be able to determine the performance of the companies, respondents had to rate their company's performance on a 7-point scale. Numbers 1 and 7 represent the two extremes of the level of companies' performance, i.e. highly successful and highly unsuccessful, respectively. As is clearly shown in Figure 6.3, 86.4% of the companies were above the average level of success and all the rest (13.6%) were on the average level of success.

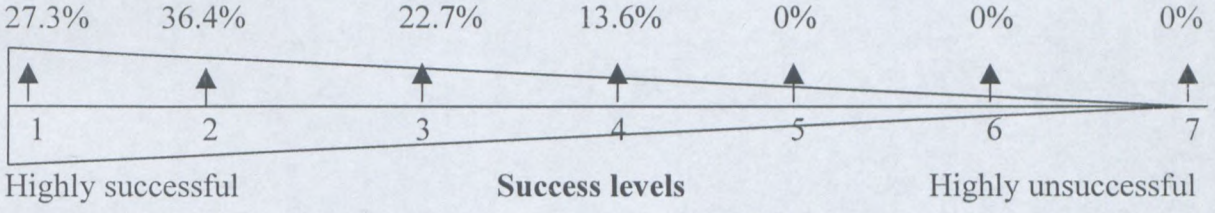

Figure 6.3 Success of the companies

6.3.2 Regression analysis

BMDP statistical software was used for the multiple regression analysis (Dixon, 1983). Stepwise linear regression analysis and all possible subset linear regression techniques were applied to get the best results.

- **The impact of utilisation of MIS on the success of the companies**

  The main objective of the study was to determine the impact of utilising management information systems in the manufacturing companies on the success of their business. With regard to the application of MIS, certain factors are at most important in their contribution to the success of a company. These factors are used in a descriptive model (Figure 6.4).

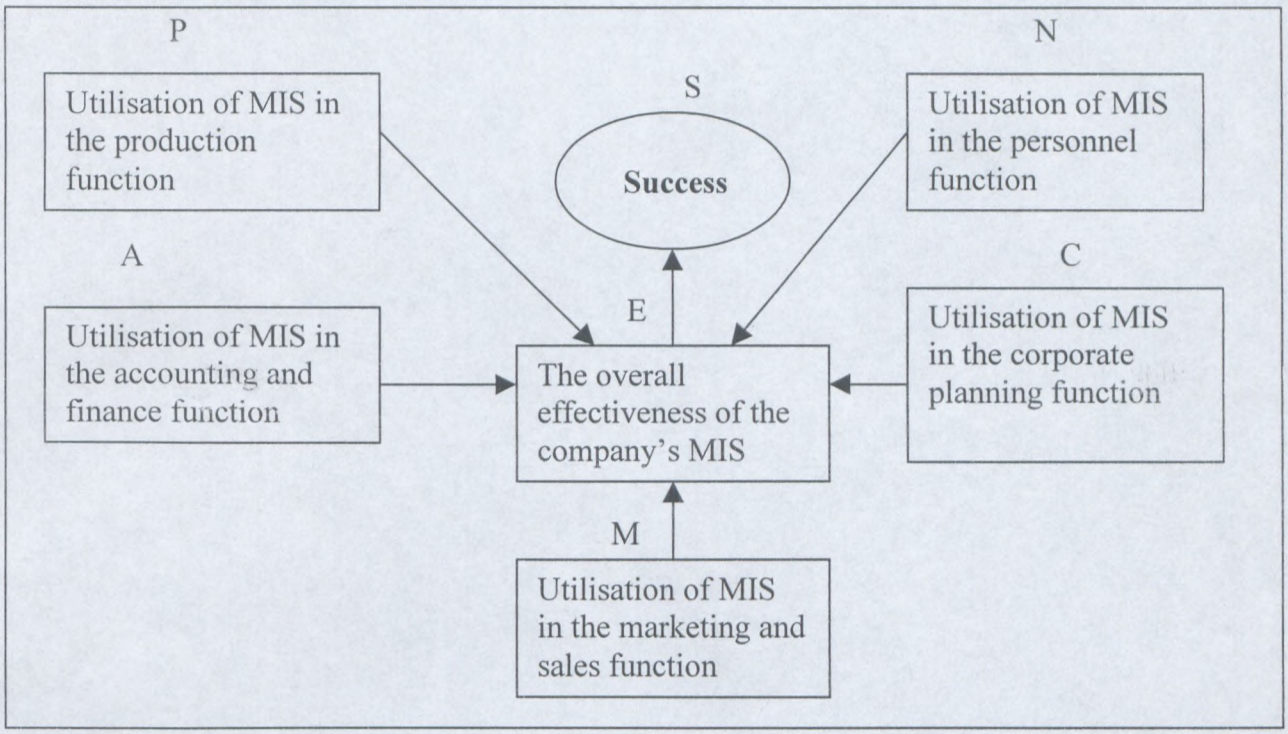

Figure 6.4 Hypothetical research model

In order to be able to determine the relationships as hypothesised in the model, a further analysis of the data was done. In the further analysis of the data, the multiple regression analysis method was used. The utilisation of MIS in each function, namely, production, marketing, accounting and finance, personnel and corporate planning, was represented by some variables as described in Table 6.13. By taking all variables from the five functions, a total of 25 variables were taken as independent variables while success of the company was used as a dependent variable.

Factors	Variables	Number of variables
Utilisation of MIS in the production function.	P_1- P_6	6
Utilisation of MIS in the marketing and sales function.	M_1- M_6	6
Utilisation of MIS in the accounting and finance function.	A_1- A_7	7
Utilisation of MIS in the personnel function.	N_1- N_4	4
Utilisation of MIS in the corporate planning function.	C_1- C_2	2

Table 6.13 Variables in each factor

By using stepwise linear regression with the aid of the BMDP statistical program package, the number of independent variables in terms of which success could be explained was reduced to 17. Since there was a need for as simple a model as possible, all possible subsets regression technique was used to select the "best" subsets of independent variables in terms of which success could be explained. The criterion used to define "best" was the adjusted R^2 (R_a^2). The subsets of variables, which maximised the R_a^2 in the data set, were consequently selected to be the best in explaining the dependent variable. With this procedure a "best" set of 15 variables was selected (Table 6.14).

Variable	Description
A_3	Efficiency of financial computer software
N_2	Flow of information from personnel to finance function
E	Overall MIS efficiency of the company
A_2	Flow of information within the accounting and finance function
M_4	Timely sales report
A_4	Timely financial report
M_1	Information flow between marketing and other functions
P_1	Information flow from the marketing to production function
N_3	Personnel report for management control
A_1	Information flow from the accounting to other functions
P_6	Timely report from inventory control database
N_4	Efficiency of personnel database
M_5	Generating sales forecast report for planning
P_3	Information flow within the production function
P_4	Information flow between the production and finance functions

Table 6.14 Independent variables and their descriptions

Table 6.15 shows the results of the selected variables together with R_a^2-value, and also the relative contributions of each variable to the total variance of the dependent variable. These contributions to R^2 from each variable are the amount by which R^2 would be reduced if that variable were removed from the set of variables under consideration. The selected 15 independent variables explained 95% of the variation of the dependent variable, success.

VARIABLE	REGRESSION COEFFICIENT	STANDARD ERROR	T-STAT	CONTRIBUTION TO R^2
P_1	-2.979	0.230	-12.91	0.362
N_2	-1.616	0.127	-12.65	0.347
E	1.561	0.132	11.78	0.301
A_1	-1.574	0.147	-10.65	0.246
N_3	1.461	0.147	9.93	0.214
A_2	1.611	0.166	9.69	0.204
M_1	-0.633	0.076	-8.30	0.149
P_3	0.925	0.116	7.92	0.136
A_3	0.694	0.131	5.29	0.060
P_6	0.390	0.076	5.10	0.056
A_4	-0.433	0.122	-3.54	0.027
P_4	-0.401	0.113	-3.55	0.027
M_5	-0.458	0.140	-3.25	0.022
N_4	0.286	0.096	2.96	0.019
M_4	0.180	0.095	1.89	0.007

$R_a^2 = 0.95$

Table 6.15 Results of regression analysis of success in terms of 15 independent variables

From the analysis the following regression model is retrieved:

$$\mathbf{S} = 3.5 - 2.979\mathbf{P_1} - 1.616\mathbf{N_2} + 1.561\mathbf{E} - 1.574\mathbf{A_1} + 1.461\mathbf{N_3} + 1.611\mathbf{A_2} - 0.633\mathbf{M_1} + 0.925\mathbf{P_3} + 0.694\mathbf{A_3} + 0.390\mathbf{P_6} - 0.433\mathbf{A_4} - 0.401\mathbf{P_4} - 0.458\mathbf{M_5} + 0.286\mathbf{N_4} + 0.180\mathbf{M_4} \quad \text{(Eq.1)}$$

This model can be used for prediction purposes and the influence of a specific independent variable on the dependent variable is now of interest. Should there be no interdependence between the decision variables, one could merely note the

regression coefficient of the specific variable. In such a situation, it would be theoretically possible to determine the maximum of the dependent variable by making those values of decision variables which have positive regression coefficients as high as possible, and those which have negative coefficients, as low as possible.

By using the contribution of the variables to the multiple regression coefficient (R^2) as a measure of importance, the 15 variables could be ranked as shown in Table 6.16. These, then, are those decision factors for the success of a business, ranked in order of importance.

Priority	**Variable**	**Description**
1	P_1	Flow of information from the marketing to production function
2	N_2	Flow of information from personnel to finance function
3	E	Overall MIS efficiency of the company
4	A_1	Flow of information from the accounting to other functions
5	N_3	Personnel report for management control
6	A_2	Flow of information within the accounting and finance function
7	M_1	Flow of information between marketing and other functions
8	P_3	Flow of information within the production function
9	A_3	Efficiency of financial computer software
10	P_6	Timely report from inventory control database
11	A_4	Timely financial report
12	P_4	Flow of information between the production and finance functions
13	M_5	Generating sales forecast report for planning
14	N_4	Efficiency of personnel database
15	M_4	Timely sales report

Table 6.16 Variable importance in priority order

Out of the 15 variables listed above, seven of them represent the flow of information between and within different functional areas. This indicates that utilisation of the most important resource of the companies, viz. information, makes a difference to the performance of the companies. Five of the variables that have a significant contribution to the companies' success, represent the activity of generating timely reports for decision making. The rest of the variables represent applying efficient computer software programs and database to different activities of the companies.

- **The overall efficiency of MIS in the companies**

  In order to express the efficiency of MIS in terms of some important activities of the companies, multiple linear regression analysis was done by using variable E (efficiency of company's MIS) as a dependent variable while the 25 variables were used as independent variables. In this particular analysis, in order to get a sound result, medium (50-200 employees) and large-scale (more than 200 employees) companies were analysed separately.

- **Regression analysis for medium-scale manufacturing companies**

  By using the BMDP computer package, five variables were found in the "best" subset of independent variables that declared 98% of the variation of the dependent variable, overall efficiency of MIS. The five variables in the "best" sets of independent variables were:

M_5	Generating sales forecast report
A_1	Information flow between accounting and finance and other sub-functions
A_7	Integration of the financial computer database with the database of other sub-functions
A_4	Activity of supplying financial reports to the management
M_2	Efficiency of the marketing and sales sub-function's database

The detailed results of this regression are given in Table 6.17

VARIABLE	REGRESSION COEFFICIENT	STANDARD ERROR	T-STAT	CONTRIBUTION TO R^2
M_5	1.162	0.064	17.96	0.483
A_1	0.395	0.042	9.34	0.130
A_7	0.500	0.053	9.27	0.129
A_4	0.488	0.053	9.17	0.126
M_2	-0.325	0.071	-4.54	0.030

$Ra^2 = 0.98$

Table 6.17 Results of regression analysis for the effectiveness of MIS

The regression equation being the following:

$$\mathbf{E} = -2.302+1.162\mathbf{M_5}+0.395\mathbf{A_1}+0.5\mathbf{A_7}+0.488\mathbf{A_4}-0.325\mathbf{M_2} \quad \text{(Eq.2)}$$

By taking contribution to R^2 as a criterion for variable-importance, Table 6.18 shows these variables in priority order.

PRIORITY	VARIABLE	DESCRIPTION
1	M_5	Generating sales forecast report
2	A_1	Information flow between accounting and finance and other functions
3	A_7	Integration of financial computer database with the database of other functions
4	N_4	Activity of supplying financial report to management
5	M_2	Efficiency of the marketing and sales function's database

Table 6:18 Variable importance in priority order

- **Regression analysis for large-scale companies**

Of the 25 independent variables that have a definite contribution to the effectiveness of MIS, the following six variables were found in the "best" subset of independent variables that declared 97% of the variation of the dependent variable, the overall efficiency of MIS.

C_2 The availability and effectiveness of information flow from the planning function to other different functions

P_6 The activity of generating reports on the quantity of finished goods and the consumption of resources during production

N_1 Effectiveness of the personnel database management system

N_2 Effectiveness of the flow of information from the personnel to the finance function

N_3 The activity of generating timely personnel reports based on the database record

P_3 Total information exchange within the production function

The results of this regression are given in Table 6.19.

VARIABLE	REGRESSION COEFFICIENT	STANDARD ERROR	T-STAT	CONTRIBUTION TO R^2
N_3	-0.187	0.090	-2.08	0.009
N_1	0.454	0.108	4.2	0.040
C_2	0.640	0.060	10.65	0.260
P_6	0.296	0.047	6.25	0.089
N_2	0.262	0.064	4.09	0.038
P_3	-0.108	0.056	-1.90	0.008

$R_a^2 = 0.97$

Table 6.19 Results of the regression analysis

The multiple regression equation being the following:

$$\mathbf{E} = -1.357-0.187\mathbf{N_3}+0.454\mathbf{N_1}+0.64\mathbf{C_2}+0.296\mathbf{P_6}+0.262\mathbf{N_2}-0.108\mathbf{P_3} \quad \text{(Eq.3)}$$

If the value of contribution to R^2 is taken as a measurement of variable importance, Table 6.20 shows the independent variables in priority order.

Priority	VARIABLE	Description
1	C_2	The availability and effectiveness of information flow from the planning sub-function to other different functions
2	P_6	The activity of generating reports on the quantity of finished goods and the consumption of resources during production
3	N_1	Effectiveness of the personnel database management system
4	N_2	Effectiveness of the flow of information from the personnel to the finance function
5	N_3	The activity of generating timely personnel reports based on the database record
6	P_3	Total information exchange within the production function

Table 6.20 Independent variables in priority order

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- **The impact of the utilisation of MIS for the success of manufacturing companies**

  Internal as well as external factors could exist that have an impact on the success of manufacturing companies. However, with regard to the application of MIS and information technology, there are certain factors that significantly contribute to the success of these companies, as hypothesised in this study. In this study the relationship between the success of manufacturing companies and the utilisation of MIS is clearly described in the multiple regression model (Eq.1) with 0.95 multiple correlation. The following three aspects were found to be decision factors for the success of manufacturing companies:

  - Effectiveness of the flow of information between and within different functional areas.
  - Generating timely sales, inventory and financial reports for decision making.
  - Applying efficient computer software programs and databases for different activities of the companies.

  These aspects are the most important activities in the different functional areas of manufacturing companies. The result of the study clearly shows that the application of MIS and IT for the effectiveness of these activities enhances the performance of the business of the companies. It can also be concluded that the utilisation of management information systems in manufacturing industries has a significant positive impact for the success of their business.

- **The extent of utilising MIS and applying information technology in manufacturing companies**

  Most of the companies utilise MIS in their different organisational functions. Most manufacturing companies apply computer database management systems for storing and retrieving data, as well as computer network systems for the effective flow of information.

  From the results of this study, it can easily be identified that most of the manufacturing companies utilised management information systems; as a result they achieved good performance in their business.

  From this research it emerged that manufacturing companies that didn't give priority to using MIS might learn the capabilities and advantages of using MIS in order to be competitive in the business world.

- **Managers' awareness**

  Most managers of manufacturing companies appear to be aware of the capabilities and use of MIS for their success. However, there are still some managers who have no knowledge of MIS.

7.2 Recommendations

This study focused on chemical manufacturing industries only but further studies could also be conducted on other sectors of manufacturing industries such as textiles, automobiles, metals, paper and paper products, etc. Management information systems are increasingly important to both manufacturing and service sector organisations. More and more managers recognise that access to accurate information, available in a timely fashion, can influence decisions and, in turn, can affect the efficiency of the overall organisation. Future research could also be done on the utilisation of MIS in service sectors such as banks, hospitals, insurance companies and schools.

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Appendix 1

Please answer the following questions by ticking in the box corresponding to your appropriate answer.

Company Name_____

1. What is your current management level in the company? X(1)
   1 Top management level ☐
   2 Middle management level ☐
   3 Supervisory and operational level ☐
   4. Other (*Please specify*)
   _____

2. For how long has the company been operating? X(2)
   1. 5-10 years ☐
   2. 11-15 years ☐
   3. 16-20 years ☐
   4. 21-25 years ☐
   5. 26-30 years ☐
   6. More than 30 years ☐

3. How many employees does the company have? X(3)
   1. 50- 100 employees ☐
   2 100- 150 employees ☐
   3. 151-200 employees ☐
   4. 201-300 employees ☐
   5. 301-500 employees ☐
   6. More than 500 employees ☐

4. How do you rate your knowledge of MIS (Management Information Systems)? X(4)
   1. Very good ☐
   2. Good ☐
   3. Average ☐
   4. Poor ☐
   5. Very poor ☐

5. Does the company have an integrated or networked computer system or centralised database which enables it to communicate with its retailers or shops? X(5)
   1. Yes
   2. No
   3. Other (Please specify)

6. Does the company have a management information systems department or section? X(6)
   1. Yes ☐
   2. No ☐
   3. Integrated with other department ☐
   4. Other (*Please specify)*
   _____

Please indicate your answer with a tick mark in the appropriate block.

7. Utilisation of MIS (Management Information Systems) in the production function

	What do you think of:	Very good	Good	Average	Poor	Very poor
7.1	the efficiency of information flow from the marketing and sales function to the production function? P_1					
7.2	the efficiency of information flow from the production function to the purchasing function in the process of ordering and issuing raw materials? P_2					
7.3	the total information exchange between different functions and /or individuals in the production function? P_3					
7.4	the efficiency of information flow between the production and the finance function and/ or other functions for delivering finished products? P_4					
7.5	the extent of your application of computerised manufacturing systems for effective and efficient flow of information? P_5					
7.6	the activity of generating reports on the quantity of finished goods and the consumption of resources during the production for management control? P_6					

8. Utilisation of MIS (Management Information Systems) in the marketing and sales function

	What do you think of:	Very good	Good	Average	Poor	Very poor
8.1	the efficiency of information flow between the marketing and sales, and other functions? M_1					
8.2	the database efficiency in creating/updating your customer list, price list, product specification list, etc.? M_2					
8.3	the total information exchange between different sub-functions and/or individuals in the marketing and sales function? M_3					
8.4	the activity of generating timely sales reports for senior management? M_4					
8.5	the activity of generating sales forecasts from the relevant department for planning and budgeting? M_5					
8.6	the rate of your information supply to the production function about customers' choice based on the result of marketing research? M_6					

9. Utilisation of MIS (Management Information Systems) in the accounting and finance function

	What do you think of:	Very good	Good	Average	Poor	Very poor
9.1	the efficiency of information flow between the accounting and finance and other functions? A_1					
9.2	the efficiency of the flow of information within this function? A_2					
9.3	the efficiency of your financial computer software program to your daily activities? A_3					
9.4	the activity of supplying the financial reports to the management? A_4					
9.5	the opportunity that managers have to access the financial database system? A_5					
9.6	the efficiency of your payroll program? A_6					
9.7	the interaction and integration of your financial computer database with the database of other functions? A_7					

10. Utilisation of MIS (Management information systems) in the personnel function

	What do you think of:	Very good	Good	Average	Poor	Very poor
10.1	the effectiveness of your personnel database management system? N_1					
10.2	the effectiveness of the flow of information from personnel function to the finance function? N_2					
10.3	the activity of generating timely personnel reports based on the database records you have for management control? N_3					
10.4	the availability of information that the employee may want to know about? N_4					

11. Utilisation of MIS (Management information systems) in the corporate planning function

	What do you think of:	Very good	Good	Average	Poor	Very poor
11.1	the availability and effectiveness of information flow from the relevant functions to perform efficient planning activities? C_1					
11.2	the availability and effectiveness of information flow from the planning function to different sections? C_2					

12. What do you think of the overall effectiveness of the company's management information systems? E

1. Very good ☐
2. Good ☐
3. Average ☐
4 Poor ☐
5. Very poor ☐

13. How does the company measure its success? X(33)

1. By profitability ☐
2. By productivity ☐
3. By customer service ☐
4 By market share ☐
5. 1 and 2 ☐
6 1, 2 and 3 ☐
7 2 and 3 ☐

13. According to the company's measurement for success, how do you rank the recent performance of the company? (1 is highly successful, 7 is highly unsuccessful and 2-6 is random in between the two). Please select only one number. S

1 2 3 4 5 6 7

Highly successful ——————————— Highly unsuccessful

Appendix 2

Please answer the following questions by ticking in the box corresponding to your appropriate answer.

Company Name_____

1. What is your current management level in the company? X(1)

   1 Top management level ☐
   2 Middle management level ☐
   3 Supervisory and operational level ☐
   4. Other (*Please specify*) _____

2. How do you rate your knowledge of MIS (Management Information Systems)? X(4)

   1. Very good ☐
   2. Good ☐
   3. Average ☐
   4. Poor ☐
   5. Very poor ☐

Please indicate your answer with a tick mark in the appropriate block.

3. Utilisation of MIS (Management Information Systems) in the production function

	What do you think of:	Very good	Good	Average	Poor	Very poor
3.1	the efficiency of information flow from the marketing and sales function to the production function? P_1					
3.2	the efficiency of information flow from the production function to the purchasing function in the process of ordering and issuing raw materials? P_2					
3.3	the total information exchange between different sub-functions and/or individuals in the production function? P_3					
3.4	the efficiency of information flow between the production and the finance function and/ or other functions for delivering finished products? P_4					

3.5	the impact of your application of computerised manufacturing systems for effective and efficient flow of information? P_5					
3.6	the activity of generating reports on the quantity of finished goods and the consumption of resources during the production for management control? P_6					

4. Utilisation of MIS (Management Information Systems) in the marketing and sales function

	What do you think of:	Very good	Good	Average	Poor	Very poor
4.1	the efficiency of information flow between the marketing and sales and other functions? M_1					
4.2	the database efficiency in creating/updating your customer list, price list, product specification list, etc.? M_2					
4.3	the total information exchange between different sub- functions and/or individuals in the marketing and sales function? M_3					
4.4	the activity of generating timely sales reports for senior management? M_4					
4.5	the activity of generating sales forecasts from the relevant department for planning and budgeting? M_5					
4.6	the rate of your information supply to the production function about customers' choice based on the result of marketing research? M_6					

5. Utilisation of MIS (Management Information Systems) in the accounting and finance function

	What do you think of:	Very good	Good	Average	Poor	Very poor
5.1	the efficiency of the information flow between the accounting and finance and other functions? A_1					
5.2	the efficiency of the flow of information within this function? A_2					
5.3	The efficiency of your financial computer software program to your daily activities? A_3					
5.4	the activity of supplying financial reports to the management? A_4					
5.5	The opportunity that managers have to access the financial database system? A_5					
5.6	The efficiency of your payroll program? A_6					
5.7	The interaction and integration of your financial computer database with the database of other functions? A_7					

6. Utilisation of MIS (Management Information Systems) in the personnel function

	What do you think of:	Very good	Good	Average	Poor	Very poor
6.1	the effectiveness of your personnel database management system? N_1					
6.2	the effectiveness of the flow of information from this function to the finance function? N_2					
6.3	the activity of generating timely personnel reports based on the database record you have for management control? N_3					
6.4	the availability of information that the employee may want to know about? N_4					

7. Utilisation of MIS (Management Information Systems) in the corporate planning function

	What do you think of:	Very good	Good	Average	Poor	Very poor
7.1	The availability and effectiveness of information flow from the relevant functions to perform efficient planning activities? C_1					
7.2	The availability and effectiveness of information flow from the planning function to different functions? C_2					

8. What do you think of the overall effectiveness of the company's management information systems? E

1. Very good
2. Good
3. Average
4. Poor
5. Very poor