

# **Efficacy of management information on organizational performance in the chemical processing industry**

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## **Dedication**

This work is dedicated to my parents, wife and children.

## **Acknowledgement**

I would like to thank the following for their varied but invaluable support throughout the course of this study research.

- The Production Manager of ABC Wax Plant
- My study leader, Professor Piet Stoker
- My wife, Aderoju Ganiyat.

## **Abstract**

Every aspect of management in the modern age relies on information to thrive. Nothing moves without information. It is generally believed that information is power and that he who has it has power. Information is an important resource needed to develop other resources. Changing circumstances and environments have necessitated the need for the proper dissemination of information at various levels of management.

Based on the full realisation of the above, this case study research was carried out in an establishment in the chemical processing industry (CPI) to evaluate the impact of management information on the organizational performance. The choice of the industry is instructive as the primary process in the industry has little to do with information technology.

The results provide useful insights into the connection between management information (and indeed the role played by it) and the overall performance of an organization.

Firstly, for an organization whose primary business is wax production, the level of reliance of management on information was remarkable. This fact is underscored by the number of systems that have been implemented for the purpose of information generation for management. On a second look, however, this becomes understandable as there is the need for accurate information, especially on safety, due to the potential danger of the conditions of operations in the chemical processing industry. In spite of the existence of these management information generating systems, the outcome of the research shows that there is still the need for management of the case study organization to integrate the systems in order to enhance the effectiveness of the generated information on the organization's performance.

Another insight from the study is the fact that despite the negative impact on organizational performance (due to the non-achievement of defined goals), managers do withhold information and decide not to undertake any action. One plausible reason for this might be that using the information could result in a negative impact on the managers' personal interests.

The results of the study also show that the degree of effectiveness of management information may vary from one area of the same organization to the other depending on factors such as the quality/integrity of the generated information and the priority attached to each area by management amongst others.

Ability of managers to accurately specify the information they require was also observed as a factor that affects the effectiveness of management information, as management decision based on inadequate or wrong information invariably does not lead to the organization's set goals, thereby adversely affecting its performance at the end of the day.

In summary, the study results show that information made available to management indeed has an impact on the overall performance of the organization. However, the degree of the impact varies in different areas of the organization due to certain factors. For this research work, the major factors responsible for the variation in these areas as well as the overall impact are as identified in the previous four paragraphs. Using ABC Wax plant, one of the world's leading specialists in the production of petroleum and synthetic waxes related products, as a case study, the research work was concluded with guidelines recommended to enhance the effectiveness of management information on the overall performance of organizations in the chemical processing industry. Remarkably, most of the guidelines are also applicable to organizations outside the CPI.

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# **Chapter 1 - Introduction**

## ***1.1 Background***

Managers need information to practice their profession. They gather the information necessary to support decision-making and to control their organization, by holding meetings with their subordinates, scanning reports, using computer systems and talking to their customers. Intensification of competition, the emergence of new markets, and an increasing number of customer requirements, increase the need to have accurate, timely and relevant information.

Since its maturation, information and communication technology (ICT) has become one way to provide managers with information. Using computers to collect and transform data, information becomes available which is unfeasible to derive manually. The development of Management Information Systems (MIS), Decision Support Systems (DSS) and Executive Information Systems (EIS) has resulted in a collection of systems, all of which are intended to support management with new or better information.

Recently, the development and utilization of information systems designed to fulfil this need has accelerated. Data warehouses, in which the data of different sources are collected for further analysis, have been counted among the most powerful problem-solving tools to enable easy access to information and enhance the effectiveness of decision-making processes (Massa and Testa, 2005). New techniques to analyze the data stored in such a data warehouse have also emerged. For example, techniques like data mining and data visualization, which are employed mainly to find patterns in raw data, are among the new data-analysis tools.

The case is generally not different in the chemical processing industry where the case study organization where this research work was carried out belongs. Different management information systems such as occupational health and safety (OH&S) management systems and safety performance measurement (SPM) are implemented to provide information, help in introspection, in decision-making, and in addressing different information needs.

The implementation or upgrading of information technology to generate management information is often a costly endeavour. Almost two-thirds of the IT budget in organizations is spent on IT infrastructure that consists of computer and communications hardware and software (Owen et al., 2001). Investments have to be made not only in the technology itself, but also in the analysis of information requirements, retraining of employees and conversion of data.

The revenue that should be the result of the IT investments is, however, less predictable. Using information technology to generate management information certainly does not guarantee that the information will contribute to an improvement in organizational performance. It is often the case that ICT-related investment does not deliver value or meet business objectives and indeed regularly results in new problems being introduced in place of old ones with the expected business benefits not being realised (Love and Irani, 2004). This perception of widespread ICT failure is not new, described by Fincham (2002) as being a long-standing problem, reflecting a general incapacity to deliver. The reasons for such underperformance are varied, but according to Gibson (2003), are either technology- or business-related.

### ***1.2 Research Problem Statement and Substantiation***

From the foregoing, it shows that while management realises the importance of information to the smooth running of an organization and thus invests in its generation, the impact of such investments is not usually seen, or at best remains unclear, on the overall performance of the organization. However, it is questionable whether the roots of such deficiencies should be found in the information technology. Although the generation of management information might be heavily supported by IT, there are a number of other issues involved that might obstruct the effective use of management information.

There is thus a need to research further in order to ascertain the true influence of management information on organizational performance, as understanding the direct impact information has on an organization's functioning is crucial to running a successful business.

Other benefits of the research to the CPI may include one or more of the following:

- (1) The detection of inaccurate and inconsistent data sets – this can help achieve the following business objectives:
- Improve the quality of decision making and planning.
  - Contribute to the successful implementation and utilization of data management systems.
  - Enhance the predictive accuracy of neural nets and other forecasting tools.
  - Uncover fraudulent and inappropriate business activities and practices.
- (2) Identification of where problems, bottlenecks, waste, etc., exist and where improvements are necessary;
- (3) Ensuring that decisions are based on facts, not on supposition or intuition.
- (4) Presents opportunity for organizational performance review/measure.

As shown in Figure 1.1, three key organizational resources – people, information and information technology (in that order of priority) – are inextricably linked.

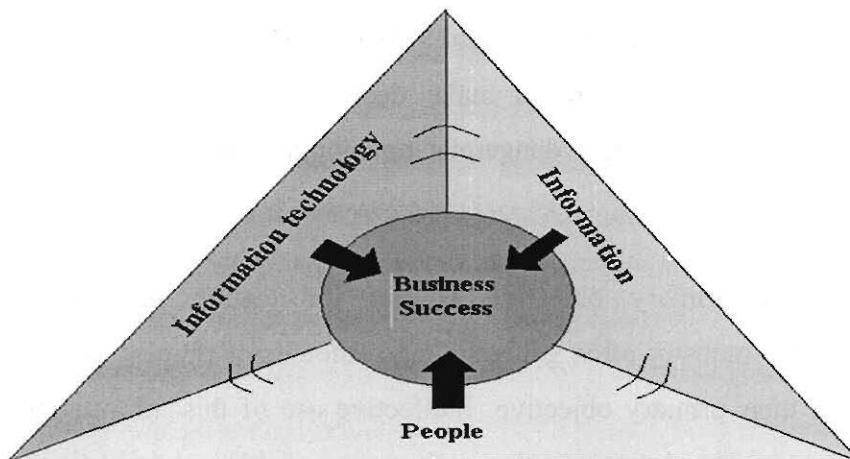


Figure 1.1 Business Success = People + Information + Information Technology (Haag et al., 2006)

In essence

- *people* use
- *information technology* to work with
- *information* (see Figure 1.1)

If one fails, they all fail. Most important, if one fails, the business will fail (Haag et al., 2006).

### ***1.3 Research focus and objective***

To ascertain the true influence of management information on organizational performance, the research was focussed on three major areas:

- The generation of management information – here, sources of management information were reviewed for data accuracy, quality and integrity. Concerns found on these issues, and their causes and consequences were addressed.
- Impact of management information on the performance of the organization – for this focus area, the key performance indicators (KPI) of the case study organization were obtained from the management. The study was then focussed on how the management has been able to turn around the information available to it from different sources (identified in the bullet point above, with emphasis on IT generated information) to enhance the performance of the organization.
- A case study organization was chosen from the CPI where there exists an intense need for the management to make decisions based on accurate information due to the extremely dangerous operational conditions on the plants.

Even though their primary objective is not information processing, organizations in this industry often generate huge amounts of process data in order to achieve their primary objective. Ineffective use of this information may have a huge negative impact on the performance of these organizations, especially if it involves loss of human lives in the areas of safety.

From the foregoing, the results of the research work is thus applicable to the organizations in this industry.

The research objective was therefore formulated as follows:

*to determine the effectiveness of management information on organizational performance in the chemical processing industry and identify guidelines for its improvement.*

The term effectiveness, as stated in the objective, refers to the degree the information contributes to organizational performance, and special interest will be given to management information derived with information systems, using information technology.

## ***1.4 Research approach***

To fulfil the research objective, a research approach consisting of three elements was constructed: the *research philosophy* was used to guide how the case study organization and gathered data was observed for analysis and conclusions-drawing; the *research strategy* provided the basis for a plan, which was carried out to conduct the study; and the *research instruments* were used to measure and collect the necessary data as the study is conducted.

The elements of the research approach were executed in such a way to fulfil the scope of the study as contained in the research objective. For example, ABC Wax, the case study organization, was specifically chosen because of its strategic position/stand in the chemical process industry, such that it is safe to conclude that the results of the study are generally applicable to the organizations in the industry.

### ***1.4.1 Research philosophy***

All research, whether quantitative or qualitative, is based on some underlying assumptions about knowledge and how it can be obtained (Hirschheim, 1992). Examples of different research philosophies based on different assumptions are positivism, post-positivism, critical theory, constructivism, interpretive and critical (Guba and Lincoln, 1994). In practice, the distinction between these philosophies is not always clear-cut.

Meel (1993) advocates a *pluralistic view* regarding the research philosophy. The pluralistic view puts forward the idea that correct research should not necessarily embrace one of the two (positivism and post-positivism) extreme philosophies. Wicks and Freeman (1998) describe *pragmatism* as an alternative framework, which moves beyond the positivism vs. anti-positivism debate. The pragmatic approach is focussed on serving human purposes and the need for research to have practical value. This is in line with the intention of this research, namely improving the effectiveness of

management information, which should result in a better performance of the organization.

#### ***1.4.2 Research strategy***

Inductive-hypothetical approach will be used as the research strategy. According to Sol (1982), the main characteristics of an inductive-hypothetical research strategy are that it:

- emphasizes the specification and testing of premises in an inductive way
- opens up possibilities for an interdisciplinary approach
- enables the generation of various alternatives for the solution of the problem
- permits feedback and learning

These characteristics live up to the requirements to fulfil the research objective. Firstly, though the literature in the field of management information is rather overwhelming, no integral view exists on this research problem domain. In addition, the complexity of the issues involved regarding management information made the deduction of straightforward solutions impossible. These made it hard to fulfill the research objective from a deductive point of view. Also from literatures, the characteristics of reasons for the lack of effective management information illustrate that different issues, related to different disciplines, are involved in the problem area. Therefore, analyzing the problem and finding solutions requires an interdisciplinary approach.

Furthermore, it is not assumed that the creation of a possible solution will certainly eliminate the problem of ineffective management information. Therefore, the intention is to generate alternative solutions.

#### ***1.4.3 Research instruments***

There are a variety of instruments available to conduct research into organizational phenomena and information systems. Vreede (1995) provides a list of instruments and specifies them according to the underlying philosophy and the setting in which they should be used. A subset of this list is presented in Table 1-1.

**Table 1.1 Research Instruments (Vreede, 1995)**

Research instruments	Type of setting			Underlying philosophy	
	Natural	constructed	both	Positivist	interpretive
Lab experiment	-	X	-	X	-
Field experiment	X	-	-	X	-
Case study*	X	-	-	-	X
Action research	X	-	-	-	X
Survey	-	-	X	X	-
Literature review*	-	-	X	-	X

Based on the research objective, philosophy and strategy, the instruments described below was used to carry out the study.

#### **1.4.3.1 Literature review**

The first research instrument used for this research work is literature review. A literature review is a critical analysis of the business and management research on a topic that positions the research in its theoretical context, shows the researcher understands the current state of the research topic and supports any conceptual framework that the researcher plans to investigate (Maylor and Blackmon, 2005). Such a review enables the researcher to compare findings of the case results with findings in the literature and to ask elementary questions such as ‘What is similar?’, ‘What contradicts?’ and ‘Why?’ (ibid.).

In this research project, the literature review was used to obtain a better understanding or explanation of the results of the case study. The objective is to see whether any or all the limitations of management information effectiveness that may be found in the case study is/are reflected on the different approaches and theories described in literature.

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\* Instrument used for this research work

\* Instrument used for this research work

Subsequently, the combination of the literature review and the results of the case study was used to construct the basis for formulating the guidelines for effective management information in the chemical process industry.

#### *1.4.3.2 Case study*

To get a better understanding of the research problem in the chemical processing industry, a case study research was used in addition to the extensive literature review done. According to Maylor and Blackmon (2005), case study research involves the collection of data from multiple sources and using several methods such as surveying, interviewing, participant observation and archival research. The focus of case studies is to answer 'how and why' questions and to examine a phenomenon in its natural setting. A case study may be used when you have no control over the events you are interested in studying and the phenomenon takes place at least partly during the period the research is being carried out (Maylor and Blackmon, 2005).

The characteristics of this case study research matched the need to get a better understanding of the issues affecting the effectiveness of management information. By conducting the case study, a better picture of what really is important was obtained. Also, using multiple instruments for gathering data during the case study, e.g. reports and interviews, led to the emergence of different views on management information.

The results of the case study, along with the knowledge gained from the literatures, were consequently used to construct the basis for formulating the guidelines for effective management information specifically for ABC Wax and generally for organizations in the chemical process industry.

The generalisation of the guidelines was borne out of the choice of ABC Wax as the case study organization. ABC Wax is one of the leaders in the chemical processing industry both in South Africa and globally, with a great deal of awards and recognition from the National Occupational Safety Association (NOSA), a well-reputed body established to promote and prevent occupational accidents and diseases in South Africa. Thus, it is prudent to conclude that the results of the study are generally applicable to the organizations in the industry.

## ***1.5 Research outline***

The research work is presented in five chapters, as briefly discussed below:

An introduction to the research topic is done in chapter one. The research problem statement as well as the justification for the study is also presented in this chapter. This is followed by the research focus and objective. The chapter is concluded with the presentation of the approach that was adopted in carrying out the research.

In chapter two, a literature review was subsequently carried out to identify the difficulties of specifying and generating management information. Literatures pertaining to the performance of an organization were also reviewed and presented.

To accomplish the objectives of this research project, a case study was carried out in a chemical production plant, specifically a wax plant. Chapter three is started with a brief introduction to the case study organization. The description of how the research was carried out as well as data gathering techniques used during the research is then presented.

During the case study, issues bordering on the quality of information available to management were looked at. Thereafter, the impact of this information on the performance of the organization was explored. Reports of the findings made at the case study organization is contained in chapter four. Discussions and analysis of the findings is also presented.

Chapter four is concluded with the presentation of guidelines for the improvement of management information effectiveness on organizational performance at the case study plant, and by extension for organizations in the chemical processing industry in general, as explained in the previous section.

The basis for the guidelines is the combination of the results of the case study and the literature review.

The thesis is wrapped up with chapter five where the conclusions of the research work as well as recommendations for further research are presented.

## ***1.6 Terminology Clarification***

The list of acronyms used throughout this study is given in Table 1.2 below:

**Table 1.2 List of Acronyms**

<b>Acronym</b>	<b>Description</b>
ADU	Atmospheric Distillation
ATR	Auto Thermal Reformer
BA	Breathing Apparatus
BFW	Boiler Feed Water
BI	Business Intelligence
BPM	Business Performance Management
CIO	Chief Information Officer
CPI	Chemical Process Industry
CPM	Corporate Performance Management
CRM	Customer Relationship Management
DCS	Distributed Control System
DSS	Decision Support Systems
DW	Data Warehouse
EIP	Enterprise Information Portal
EIS	Executive Information Systems
EPM	Enterprise Performance Management
EPM	Enterprise Performance Management
ERP	Enterprise Resource Planning
GJ	GigaJoule
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
KPA	Key performance Area
KPI	Key performance Indicator
MIS	Management Information Systems
NOSA	National Occupation and Safety Association
ODS	Operations Digital System

OHS	Occupational Health and Safety
OLAP	Online Analytical Processing
OLTP	Online Transaction Processing
OPR	Operations and Profitability
P & L	Profit and Loss
PC	Personal Computer
PDP	Personal Development Plans
R & D	Research and Development
RCA	Recordable Case Accident
SBP	Slurry Bed Plant
SCM	Supply Chain Management
SDU	Single Distillation Unit
SHE	Safety, Health and Environment
SPC	Senior Process Controller
SPD	Short Path Distillation
SPM	Safety Performance Measurement

## **Chapter 2 – Management Information and Organization Performance**

Management information is essential for the effective management of an organization and, as organizations today compete for resources, managers must be able to justify and account for the investments made by the organization and for the services provided to the customers. To do this, managers need to be able to access management information to aid decision making and reporting.

An organization needs to have duly designed and management structures and use information management best practices to protect its information asset, which is very important to the organization and can serve as a very powerful weapon to survive a highly competitive environment (Chang and Ho, 2006).

### ***2.1 Management information***

Google recently reported a 200 percent increase in sales of its new Enterprise Search Appliance tool released in 2002 (Reuters News Service, 2003). Companies use the tool within an enterprise information portal (EIP) to search corporate information for answers to customers' questions and to fulfil sales orders. Hundreds of Google's customers are already using the tool – Xerox, Hitachi data Systems, Nextel Communications, Procter & Gamble, Discovery Communications, Cisco Systems, and Boeing. The ability to search, analyse, and comprehend information is vital for any organization's success. The incredible 200 percent growth in sales of Google's new Search appliance tool is a strong indicator that organizations are coveting technologies that help organise and provide access to information (ibid.).

It shows from the preceding paragraph that as businesses move further into the twenty-first century, their managers increasingly need accurate and timely performance indicators to manage and lead them. In this pursuit, enterprises are increasingly turning to software systems to seek support for enterprise performance measures to aid goal setting, monitor progress, identify and draw attention to financial implications of organizational decisions, facilitate internal benchmarking, identify inefficiencies in core business operations, and identify cost saving and operation improvement opportunities (Leahy, 2003a, b).

Companies today operate in an ever increasingly competitive environment. They treat their customers like royalty as they try to lure them to buy their goods and services. Finding and retaining customers is a major critical success factor for most businesses, offline and online. One of the tools companies use to enhance the retention of their customers is customer relationship management (CRM). CRM is a customer service approach that focuses on building long-term and sustainable customer relationships (Rowley, 2004) that add value both for the customer and the company. In today's e-business era, in order to remain competitive, enterprises are forced to respond to their customers' expectations by using the best, most powerful and innovative systems and software (Liataud, 2001).

Within the past several years, not only CRM systems, but enterprise resource planning (ERP) systems, along with many other complex software applications such as supply chain management (SCM) were deployed to record and process every detail of all the business transactions of a corporation. These software systems capture a rich set of data that contains valuable information to the business enterprise (McAdam and Galloway, 2005). They include customer preferences and buying patterns, mission critical business process information, and a wealth of additional business data.

A promising idea is to tie these operational data from enterprise-wide systems to specific strategic goals, and to provide managers with integrated visibility into performance against those goals. To ensure that each enterprise is meeting its strategic goals, the managers need to turn to business intelligence based enterprise performance management (EPM) analytics to keep tabs on enterprise actions for daily comparison to strategic goals and budget targets (Schultz, 2004). Consequently, the managers are provided with a good barometer of where their business is at any point in time, instead of learning about them at quarter's end. Capturing these current updates on company health is becoming more critical for enterprises seeking enhanced visibility into operations (Singh et al., 2000). This kind of "managing in advance" or proactive stance allows management to practice what they want to accomplish as a business rather than simply reflecting on what just happened.

EPM provides visibility into how well a company is maintaining its strategic focus. Developing a corporate strategy is a necessary step for the company in defining who it is and where it fits in the market. Once a strategy is defined, the company needs to

measure how well it is executing that strategy over time. Key performance indicators (KPIs) allow a company to see in what areas it is executing well, and what areas require improvement (Reh, 2005).

## ***2.2 Management Information Systems (MIS)***

Every aspect of management in the modern age relies heavily on information to thrive. Nothing moves without information and it is generally believed that information is power and that he who has it has power. It is an important resource needed to develop other resources. Changing circumstances and environments have necessitated the need for the proper dissemination of information at various levels of management. The development and use of information management systems (MIS) is a modern phenomenon concerned with the use of appropriate information that will lead to better planning, better decision making and better results.

In discussing this topic, certain fundamental concepts need to be understood and appreciated. Some of these are: *the information concept; the information management concept; the information system concept and the management information concept*. These concepts must be fully grasped before the importance of MIS can be appreciated.

These concepts are examined below and related to organizational processes and structures. In addition, management functions and the different levels of management are also discussed. Finally, MIS is related to those functions and levels in organizational settings. This approach helps in explaining the importance and effect of MIS in management.

### ***2.2.1 The information concept***

The concept of information in an organizational sense is more complex and difficult than the frequent use of this common word would suggest. O'Brien (2004) defined information as data that have been converted to meaningful and useful context for specific users. Every society, no doubt, is an information society and every organization is an information organization. Therefore, information is a basic resource like materials, money and personnel. Information can be considered either as an abstract concept (ideas) or as a commodity, usually in the form of letters and reports.

Corbitt (2004) contends that information has become the main competitive tool for many businesses and that currently it is the only meaningful economic resource having overtaken capital and labour in importance. Essentially, therefore, information has become a critical resource, just like energy, both of which are vital to the well-being of individuals and organizations in the modern world.

Like energy and politics, technology is changing the ways in which information is captured, processed, stored, disseminated and used. Information, therefore, like any other resource in an organization, should be properly managed to ensure its cost-effective use. It is an ingredient that is vital to good management and if properly managed, should rank in importance with the organization's personnel, material and financial resources. In an organizational context, it is increasingly being recognized as a resource independent of the technology used in manipulating it.

The implication of this realization is the further recognition that information is the cohesive element that holds an organization together. Information is an unusual commodity, quite unlike most physical goods or consumer durables. Since it is intangible, it is often hard to enforce custody. For this simple reason, it is often crucial to highlight the significant differences between this resource and others when developing a management framework. Its content can be distinguished either by source (internal or external) or by form (numeric or non-numeric). Non-numeric can either be structured or unstructured. Internal information is that generated within an organization and generally is of interest and value only to decision makers within that organization. External information can be regarded as that created by others, that is, outside the four walls of the organization, generally by publishers in the form of books or journals, or by Governments, external contacts and the like. Information professionals have a surprising range of ideas on what information is. They have not been able to produce a widely acceptable definition.

As a concept, information has always connoted different meanings to various information professionals, depending on what side of the information profession they belong. Management information is information produced for decision making. It can either be structured or unstructured.

### ***2.2.1.1 Organizational Information***

Information is powerful (Haag et al., 2006); it tells an organization from how its current operations are performing to estimating and strategising how future operations might perform. New perspectives open up when people have the right information and know how to use it.

Every aspect of organizational functioning depends on information processing of one form or another (Applegate et al., 2005). When addressing a significant business issue, managers must be able to obtain and analyse all the relevant information so they can make the best decision possible. Organizational information comes at different levels, formats and “granularities”. (Granularity means fine and detailed or “coarse” and abstract information). Managers must be able to correlate the different levels, formats and granularities of information when making decisions. For example, if managers are using a supply chain management (SCM) system to make decisions, they might find that their suppliers send information in different formats granularities at different levels. One supplier might send detailed information in a Spreadsheet, another supplier might send summary information in a Word document, and still another might send aggregate information from a database. Managers will need to compare these different types of information for what they commonly reveal to make strategic SCM decisions. Table 2.1 displays types of information found in organizations.

Successfully collecting, compiling, sorting and finally analysing information from multiple levels, in varied formats, exhibiting different granularity can provide tremendous insight into how an organization is performing. Taking a hard look at organizational information can yield exciting and unexpected results such as potential new markets, new ways of reaching customers, and even new ways of doing business.

Samsung Electronics took a detailed look at over 10,000 reports from its resellers to identify “lost deals” or orders lost to its competitors. The analysis yielded the enlightening result that 80 percent of lost sales took place in a single business unit, the health care industry. Furthermore, Samsung was able to identify that 40 percent of its lost sales in the health care industry were going to one particular competitor. Prior to performing the analysis, Samsung was heading into its market blind. Armed with this

valuable information, Samsung is changing its selling strategy in the health care industry to recoup its losses by implementing a new strategy to work more closely with hardware vendors to win back lost sales. (Betts, 2003).

Table 2.1 Levels, Formats, and Granularities of Organizational Information (Haag et al., 2006)

Information types	Range	Examples
Information Levels	Individual	Individual knowledge, goals, and strategies
	Department	Departmental goals, revenues, expenses, processes, and strategies
	Enterprise	Enterprisewide goals, revenues, expenses, processes, and strategies
Information Formats	Document	Letters, Memos, faxes, e-mails, reports, marketing materials, and training materials
	Presentation	Product, strategy, process, financial, customer, and competitor presentations
	Spreadsheet	Sales, marketing, industry, financial, competitor, customer, and order spreadsheets
	Database	Customer, employee, sales, order, supplier, and manufacturer databases
Information granularities	Detail (fine)	Report for each sales person, product, and part
	Summary	Report for all sales personnel, all products, and parts
	Aggregate (Coarse)	Reports across departments, organizations, and companies.

However, not all companies are successful when it comes to managing information. Staples, the office-supplies superstore, opened its first store in 1986 with state-of-the-art technology. The company experienced rapid growth and soon found itself overwhelmed with the resulting volumes of information. The state-of-the-art technology quickly became obsolete and the company was unable to obtain any insight into its massive volumes of information. A simple query such as identifying

the customers, who purchased a computer, but not software or peripherals, took hours. Some of the queries required several days to complete and by the time the managers receive answers to their queries, it was too late (ibid.).

### ***2.2.2 The information management concept***

Information management has been seen by Corbitt (2004) as an end-to-end process from identifying information requirements and gaps, through information creation, to the sharing and packaging of information. According to Skyrme (2004), information management relates to management activities concerning information.

Organizations are exposed to a number of challenges regarding information management best practices. According to Marks (2006), when addressing the information strategy for example, several key questions needs to be answered:

- What needs to be protected? What are the information assets that are most critical to business objectives, to fulfil the transactions the business conducts, and to run business operations?
- What needs to be prevented? What are the threats and vulnerabilities that would permit information to be lost, damaged, destroyed, inappropriately altered, or revealed to unauthorised parties?
- What is the likelihood that any given threat or vulnerability will be realised? And how should these risks be prioritised to protect critical assets?
- If a threat is realised, what will be the cost? Can the company tolerate it? If not, what actions need to be taken to mitigate the risk and manage the cost?
- If a company opts not to take action against a perceived threat, how can it manage this exposure or residual risk within acceptable risk-tolerance levels?

The management of information is the philosophy in which information is managed as a strategic resource with the aim to creative competitive advantage. Information management encompasses a huge realm, far beyond someone simply knowing where to find a piece of data at any point in time (ibid.).

### ***2.2.3 The information systems (IS) concept***

The rapid evolution of computer technology is expanding man's desire to obtain computer assistance in solving more and more complex problems: problems which were considered solely in the domain of man's intuitive and judgemental processes, particularly in organizations, a few years ago. Information systems are becoming of ever greater interest in progressive and dynamic organizations. The need to obtain access conveniently, quickly and economically makes it imperative to devise procedures for the creation, management and utilization of databases in organizations. Management information and information systems, in particular those related to effective decision-making processes in an organization, i.e. MIS, are regarded as valuable organizational resources.

Information systems can be defined technically as a set of interrelated components that collect (or retrieve), process, store and distribute information to support decision making, coordination and control in an organization. In addition to supporting decision making, coordination and control, information systems may also help managers and workers analyse problems, visualize complex subjects, and create new products. (Laudon and Laudon, 2003).

Simply put, an information system is a system for accepting data/information as a raw material and through one or more transmutation processes, generating information as a product. It comprises the following functional elements which relate to the organization and its environments:

- perception - initial entry of data whether captured or generated, into the organization;
- recording - physical capture of data;
- processing - transformation according to the "specific" needs of the organization;
- transmission - the flows which occur in an information system;
- storage - presupposes some expected future use;
- retrieval - search for recorded data;
- presentation - reporting, communication; and
- decision making – aids decision making.

Approaching information systems in an organizational content shows that it is a sub-system within an organizational system which is a “living and open” system. Academics interested in information works and information practitioners alike have defined information systems in various ways but with basic ideas of people, information technology and procedures which enable the facilitation of the generation, use and transfer of information.

From a business perspective, Laudon and Laudon (2003) defines an information system is an organizational and management solution, based on information technology, to a challenge posed by the environment. When looked closely, it can be seen that this definition emphasizes the the organizational and managerial nature of information systems.

To fully understand an information system, a manager must understand the broader organisation, management, and information technology dimensions of systems and their power to provide solutions to challenges and problems in the business environment. This broader understanding of information systems, which encompasses an understanding of the management and organizational dimensions of systems as well as the technical dimensions of systems is referred to as information systems literacy (ibid.).

For the purpose of this review, the focus is on management information system (MIS). It therefore must be emphasized that MIS is a sub-system of information systems.

#### ***2.2.4 Management information systems (MIS)***

Haag et al. (2006) defines MIS as the function that plans for, develops, implements, and maintains IT hardware, software, and the portfolio of applications that people use to support the goals of an organization.

One approach by which organizations can utilize computing capability is through the development of MIS. There is no universally accepted definition of MIS and those that exist reflect the emphasis and perhaps prejudices of their authors. However, the

term “management information system” can be seen as a database management system tailored to the needs of managers or decision makers in an organization.

In essence, the processing of data into information and communicating the resulting information to the user is the key function of MIS. It should, therefore, be noted that MIS exist in organizations in order to help them achieve objectives, to plan and control their processes and operations, to help deal with uncertainty, and to help in adapting to change or, indeed, initiating change. The question one may then ask is: What are the management functions that MIS facilitates and what are the various decision levels at which management information can be put into use? It is through a thorough answer to this question that the importance of MIS in management can be realized. However, before management functions can be examined, it is essential that organization processes and structures are discussed.

#### ***2.2.4.1 Organization processes and structures***

It is pertinent to mention that the activities of the information system take place within the organizational structure and that the MIS seeks to serve the organization’s objectives (Adeoti-Adekeye, 1997). Therefore, it is important for information specialists to have a working knowledge of what organizations are, their structures and factors which influence their methods and operations.

Laudon & Laudon’s (2003) defined an organization, from a technical point of view, as a stable, formal, social structure that takes resources from the environment and processes them to produce outputs.

The formal organization is represented by the organizational chart and by official standards and procedures, while the informal organization is the social interaction between the members of the organization, their behaviour and relationships and all the non-standard ways of conducting operations.

The development of effective MIS is dependent on recognition of the organization within an organization because the relationships depicted in formal organizational charts are not always the key relationships, and people have a way of altering standardized, official procedures: “cutting through the red tape” and “beating the bureaucracy” are phrases commonly used to describe this process. It is therefore

important for information systems designers to be aware of various influences on organizational design.

#### ***2.2.4.2 Management functions and levels***

The value of any information is derived from the actions that management takes as a result of using that information. It follows that information specialists need to know what type of tasks and functions management have to perform so that they are able to produce relevant and usable information. The functions of management can be grouped into five areas: planning; decision making; organization and co-ordinating; leadership and motivation and control. Obviously, the emphasis given to each area varies from manager to manager and is especially dependent on the level of the manager in the organization. There are clear differences in information requirements between a manager at the operational or transactional level, such as transport supervisor, and a manager at the tactical level, such as accounts or sales manager, or at the strategic level, such as managing director/board of directors. At the highest (strategic) level, structured, formal MIS may actually be counter-productive, for at these levels informal MIS and external influences become increasingly important.

Another factor which affects the tasks a manager has to perform, and hence his or her information requirements, is the extent of functional authority within an organization. Functional authority is that which is exercised by specialists, managers and staff throughout the various departments and units of the organization. Possibly, the most common example of this is the personnel department which has functional responsibilities for many personnel and industrial relations activities throughout the whole organization. While each of the five functional areas which constitute the task of management needs relevant information, three particular areas - planning, decision making and control - make heavy demands on the organization's MIS.

#### ***2.2.4.3 The nature of planning and decision making and the available techniques***

Planning and decision making have rightly been called the primary management tasks and these tasks occur at every level of management, although naturally the type of planning and decision making will vary between the levels. Planning is the process of deciding in advance what is to be done and how it is to be done. The planning process

results in plans which are predetermined courses of action that reflect organizational objectives and these plans are implemented by decisions and actions. Thus, effective planning and decision making are inextricably linked, for without decisions and actions, the planning process is a sterile exercise.

In order to provide appropriate information, MIS designers must be aware of the types of decisions at the various levels of the organization. A useful classification is that given by H.A. Simon who classified decision making into programmed and non-programmed. Programmed decisions are those that are routine and repetitive and where decision rules are known. Conversely, non-programmed decisions are novel and unstructured and the nature of the problem and decision rules are complex and little understood. It follows from these brief descriptions that radically different information and procedures are required for the different decision types, which have obvious implication for MIS design.

To create value from information, changes in decision behaviour must result and consequently there must be a decision focus to the MIS. This means that MIS must be designed with due regard to the types of decisions, how decisions are taken, how the decision makers relate to the organization, the nature of the organization, its environment and so on. Acceptance and understanding of this emphasis by both managers and information professionals is the primary requisite to effective MIS design.

### ***2.2.5 The importance of MIS to management***

In all but the smallest organizations, management rarely observe operations directly. They attempt to make decisions, prepare plans and control activities by using information which they obtain from formal sources - for example, the organization's MIS - and also by informal means such as face-to-face conversations, telephone calls, through social contacts and so on.

A management information system is generally thought of as an integrated, user-machine system providing information to support operations, management and decision-making functions in an organization. As a matter of fact, an MIS is a special-purpose system useful for management in an organization. MIS is an accessible and rapid conveyor belt for appropriate high quality information from its generation to its

users. The heart of an effective MIS, therefore, is a carefully conceived, designed and executed database. Its level corresponds to adaptive decisions. The characteristics of MIS in practice include:

- an information focus, designed for managers in an organization;
- structured information flow;
- an integration of data processing jobs by business function, such as production of MIS, personnel MIS and so on; and
- inquiry and report generation, usually with a database.

The MIS era has eventually contributed a new level of needed management information. The increasing interest in MIS had led to much activity in developing techniques and software for data management. However, it should be noted that the new thrust in MIS is on the uses to which the information is put and not how it is processed. The emphasis is on managing the information as a resource, which is important, and not on the intermediate processing stage. Managements are faced with an accelerating rate of change and an ever more complex environment.

Managers need relevant information, which is information that increases their knowledge and reduces their uncertainty. Thus it is usable by the manager for its intended purpose. Without relevant information, no manager can function effectively. A worthwhile extension to the well-known adage that “management get things done through people,” would be that management get things done through people, by using relevant information retrieved from MIS. It is not an exaggeration to state that MIS is the lifeblood of management.

The efficient performance of an organization is dependent very much on the internal performance of the organization’s resources. To illustrate the use of a management information system in monitoring the performance of resources, the following examples from the human resource aspect of a management information system will suffice. An organization’s output performance is directly related to the motivation and performance of its human resources. A high staff turnover rate which is monitored by the management information system and identified as occurring in a particular department or in a particular category of staff can indicate poor performance on the part of the employer. Also, a high turnover rate of clerical staff may indicate that

management practices do not assist in providing for career progression, personal development or training opportunities. Through the identification of poor human resource management, corrective measures may be taken which will in turn improve the organization's output performance.

### ***2.3 Data – Accuracy, Quality and Integrity***

Data plays a vital role in organizations, and in recent years companies have recognized the significance of corporate data as an organizational asset. An overview of studies conducted by scholars reveals that data as a corporate resource has been consistently ranked as a top priority for management executives (Kumar and Palvia, 2001). Consequently, a company needs to address the issue of collecting, managing and presenting its corporate data in the form of useful information for effective decision-making.

In today's competitive and information-driven markets, information and knowledge are increasingly becoming valuable organizational assets and determinants of organizational effectiveness and competitive advantage. Powerful and fast computer technologies have enabled organizations to collect and store large amounts of diverse data sets pertaining to their customers and processes. Organizations deploy a variety of computing tools to process and analyze the stored data to uncover useful and interesting relationships and develop prediction models (Hirji, 2001). Therefore, the accuracy and authenticity of the data being processed and analyzed are critical for the quality, value, and usefulness of the obtained knowledge (Lee and Siau, 2001).

Dirty data exists when there are inaccuracies or inconsistencies within a collection of data or when data extraction is inconsistent with intent. Inclusion of dirty data in a data source may pollute the entire data source making it difficult or unwise to use the data for analysis. Dirty data in a transactional system can mean incorrect order taking, products not built to specification, or errors in packaging, documentation, or billing. The result is dissatisfied customers, loss of shareholder confidence, unnecessary material and labor costs, and the real and opportunity costs of time spent correcting errors resulting from dirty data (Vosburg and Kumar, 2001).

Several studies have suggested that data stored in most organizational databases and data warehouses are not always accurate and that data quality represents a major problem in most organizations. Fisher and Kingma (2001) explain that poor data quality leads to major disasters. Consequently, data accuracy has been identified as a principal component and a determinant of data quality (Fisher and Kingma, 2001).

### ***2.3.1 Consequences of inaccurate data***

The impact of inaccurate and poor data quality on organizations has been addressed and documented in previous researches. Using the wrong information can lead to making the wrong decisions. Making the wrong decisions can cost time, money and even reputations. Every business decision is only as good as the information used to make the decision. (Haag et al., 2006).

Because data stored in databases are used as input to other applications, data accuracy and quality become essential for the success and effectiveness of other organizational computing systems such as data mining, expert systems, decision support systems, executive support systems, and neural networks.

There are a number of factors that could result in inaccurate and erroneous data being stored in databases and data warehouses. For example, certain data values may be missing because they were not available when records or transactions were recorded. Some data values may have changed as result of changing data formats, data aggregation, or data consolidation. Errors in data collection, transformation, or entry also lead to inaccurate data being kept in a database. Moreover, there are other cases when data values are modified, altered, or fabricated deliberately to conceal business or managerial misconduct.

### ***2.3.2 Managerial implications***

Assessing data accuracy in large data sets is an inherently complex and expensive process. Additionally, making business decisions or devising operational plans based on inaccurate and inconsistent data is even more “costly” and undermines organizational productivity and efficiency.

High-quality information can significantly improve the chances of making a good decision and directly increase an organization's bottom line. (Haag et al., 2006). Lillian Vernon Corp., a catalog company, used Web analytics, to discover that men preferred to shop at Lillian Vernon's Web site instead of looking through its paper catalogue. Based on this information, the company began placing male products more prominently on its Web site and soon realised a 15 percent growth in sales to men. (Trilliumsoft, 2003).

There are numerous organizations that have used their high-quality information to make solid strategic decisions. High-quality information of course does not automatically guarantee that every decision made is going to be a good one, since people ultimately make decisions. But high quality information ensures that the basis of the decisions is accurate. The success of the organization depends on appreciating and leveraging the true value of timely and high-quality information. (Haag et al., 2006).

#### ***2.4 Management Data Technologies***

Managing enterprise performance is an important, yet a difficult process due to its complexity. The process involves monitoring the strategic focus of an enterprise, whose performance is measured from the analysis of data generated from a wide range of interrelated business activities performed at different levels within the enterprise.

Data warehousing and online analytic processing (OLAP) are the two fundamental technologies used by software vendors as well as enterprise IT application developers in a multitude of businesses or industries such as retail sales, telecommunications, financial services, and real estate for developing EPM systems (Mundy, 2002). A successful data warehousing system provides decision makers with consistent, timely, reliable, and accessible data, without negative impact on the operational systems from which the data is extracted.

OLAP enables users to view the same data in different ways using multiple dimensions. It has the capability for manipulating and analyzing large volumes of data from multiple perspectives. (Laudon and Laudon, 2003).

The characteristics of OLAP applications are quite different from those of online transaction processing (OLTP) systems used in organizations. OLTP is the capturing of transactions and events using technology to (1) process information according to defined business rules, (2) store the information and (3) update existing information to reflect the new information. (Haag et al., 2006). OLTP systems usually offer little or no analytical capabilities as required in EPM. The executive information systems (EIS) developed in 1980s and refined in 1990s (Basu et al., 2000), are also a category of applications and technologies for presenting and analyzing corporate and external data for management purposes (Kumar and Palvia, 2001). Their characteristics include extreme ease of use and fast performance, but their analytical functionality is usually very limited thus they are not suitable for EPM.

Given the importance of EPM in today's business environment and the underlying management data systems technologies that are used to build and use them, the managers need to effectively understand these technologies in terms of how they are used and the issues that are related to their effective management within the broader context of EPM.

#### ***2.4.1 Data warehousing (DW)***

A DW is defined as a structured extensible environment designed for the analysis of non-volatile data, logically and physically transformed from multiple source applications to align with business structure, updated and maintained for a long time period, expressed in simple business terms, and summarized for quick analysis ( Jarke et al., 2000).

The first key concept in the definition above is extensibility, which means that a good DW design must have built into it the ability for expansion because the demands to either include more data from the same application(s) or data from other applications arise rapidly. The second concept is that the data stored in a DW comes from one or more operational applications. Data warehousing therefore involves taking these volatile operational data and rendering them non-volatile, which is required for meaningful analyses. Although operational data stores can be the basis for limited, real-time data analysis needs, operational data stores are, however, not designed for

extensive analyses. The third concept is that a sound DW design is often built around a “time dimension” and therefore the DW contains data over several periods of time.

A general overview of an enterprise DW creation project may be painted as below:

- Data are obtained from different sources,
- manipulated into a common format for the warehouse,
- inserted into the warehouse with any necessary calculations or additional appended data,
- then loaded into appropriate reference tables or data marts for efficient query performance, analyses, reporting, or data mining.

An enterprise DW provides several benefits to an organization. The most important benefit is the creation of a “single source of truth”, that is, a single source of organizational data. Thus it enables valid and consistent reporting and decision-support across the organization. Although an enterprise DW may start with a limited subset of enterprise data, it is designed to expand over time. Most enterprise DWs are managed and controlled by the central IT organization. An organization-wide effort to improve data quality is another important benefit that can be gained from the enterprise DW initiative (Watson et al., 2001).

A data mart is a subset of a DW in which a summarised or highly focused part of the organization’s data is placed in a separate database for a specific population of users. (Laudon and Laudon, 2003). A data mart has a limited scope: it supports a particular region, business unit, or business function. For example, a data mart may contain sales information for a specific region or product line. In comparison, an enterprise DW contains sales data for all regions and most products, or is at least designed with this in mind. A data mart is most of the time built by central IT, but quite often managed independently by a department or workgroup. The difference between an enterprise DW and a data mart is therefore essentially a matter of scope.

### ***2.4.1.1 Data warehouse issues and challenges***

#### ***2.4.1.1.1 Data quality***

Data warehousing efforts may not succeed for a variety of reasons, but nothing is more certain to yield failure than lack of concern for the quality of the data. Data that are inaccurate, untimely, or inconsistent with other sources of information can create serious operational and financial problems for businesses. (Laudon and Laudon, 2003). Nevertheless, why is concern for data quality sometimes not paramount? The reason is not simple carelessness; instead, the huge amount of data that are managed by a typical DW can quickly become unruly and almost impossible to verify. The implementation teams must therefore ensure that they are able to solve the data quality problems in a DW by data cleaning and data transformation operations.

The data cleaning should detect and remove all major errors and inconsistencies both in individual data sources and when integrating multiple sources. The cleaning process should be supported by tools to limit manual inspection and programming effort and should be extensible to easily cover additional sources. The data cleaning should be performed together with schema-related data transformations based on comprehensive metadata.

Data transformations are needed to support any changes in the structure, representation or content of data. They are necessary in situations when one has to deal with schema evolution, migration of a legacy system to a new information system, or integration of multiple data sources.

The data from a DW is typically used for decision support – such as measuring enterprise performance and taking appropriate corrective measures when necessary – rather than for operations. A particular data set within a warehouse therefore often supports several decision processes, which complicates data management because these uses are likely to require different degrees of data quality. The data quality is typically characterized via multiple dimensions, or attributes.

The dimensions of data quality that are commonly used are accuracy, completeness, consistency, and timeliness. The attributes of data quality that are commonly used from the perspective of the end-users of the data include interpretability and

availability or accessibility. Hence, the types of dimensions and/or attributes that are chosen to be present in the DW data to support the varied decision processes contribute to the overall cost for maintaining the DW. Managers often need to make trade-offs in the context of limited resources available for improving the data's quality.

#### ***2.4.1.1.2 Data synchronization***

One of the reasons why companies incur large costs for having “bad data” in various parts of their operations is that their data is out-of-sync – meaning pieces of information related to the same product or service differ between supply chain partners or between systems within the same company. It is not too uncommon for these companies to have business processes that are hampered by the lack of consistent, good data between them and their customers.

The solution to these problems is data synchronization, which means achieving consistent information values for items or products within and between organizations – that is, everyone is working off the same data page. It standardizes product or service or customer information from multiple data stores (applications throughout geographies, operating units and different departments such as marketing, manufacturing, and customer service, and in many disparate places such as departmental databases and commerce-enabled web sites) into a central, continuously updated repository for use by employees and trading partners, thereby significantly minimizing business problems caused by disparate product descriptions.

#### ***2.4.1.1.3 Security***

Security refers to the policies, procedures, and technical measures used to prevent unauthorised access, alteration, theft, or physical damage to information systems. (Laudon and Laudon, 2003). To a chief information officer (CIO) the security challenge of a DW is paramount. Unlike the majority of the other corporate assets found in an organization, the electronic information stored in its DW is not a tangible asset and thus, it is much more difficult to safeguard. The characteristics of electronic information include:

- can be given away and still kept;
- can be stolen and not missed;
- can be owned and no one can tell;
- can be distributed instantly to almost everyone; and
- cannot tell if it is “real” or not.

Ironically the very thing that makes data warehousing so valuable is also the same reason that may cause an organization to be hesitant to go forward with such a project because all the information valued by the organization is stored in a single place that can be accessed by many people. One may think that an organization can simply tighten up access to only those individuals that have a “need-to-know” reason to access the data. However, this is often easier said than done since a dichotomy exists as DW personnel are constantly on the watch for new ways to market and use their resource with executive management while trying to preserve the sensitivity of the same resource.

It is important for business managers to keep in mind that an enterprise DW could be used for numerous unplanned purposes. For example, a court could subpoena an enterprise DW, which could ultimately result in the unintended release of large amount of proprietary information. Management must therefore stay abreast of exactly what information is being stored in their DW and who has access to it. Furthermore, members of the DW development team should provide management with a summary of intended and potential unintended uses of the data contained in the DW. Answers to these questions will enable management to develop a detailed security plan for their DW implementation so that the organization can proactively manage and protect the corporate information stored therein in the same fashion as other corporate assets are protected.

#### ***2.4.2 Online analytic processing (OLAP)***

DW and OLAP technologies are the core of modern decision support systems. DWs store information in an aggregated form suited to decision-making. Because of this aggregation, data warehouses support only OLAP (Haag et al., 2006). Through an OLAP interface the decision makers access the DW to analyze corporate data on various dimensions; view corporate changes over a period of time, to obtain a macro

view of business operations as well as perform a microanalysis in a specific sub-function; perform various what-if analyses; and drill-down and discover the pattern of sales of certain products in a given period of time or find how the sales performance of an individual salesperson affects the company's revenues.

OLAP supports decision making based on multi-dimensionally organised summary (aggregate) data. In multidimensional data analysis a decision maker needs summary data related to a specific subject and he/she must consider that data with respect to certain factors. Summary data are usually numerical and measurable. Therefore, the attributes representing them are often called measure attributes. The factors on the basis of which summary data is analyzed are called dimensions, represented by dimension attributes. By selecting the specific dimensions through which summary data are analyzed one can obtain a view into summary data. By changing dimensions one may construct different views. This happens through OLAP queries, which specify new multidimensional views from the basic views provided by data warehousing.

Decision makers often need to group data, e.g. they might want to consider dimensions at different levels of detail. Therefore, it is important to represent the dimensions as multilevel hierarchies. For example, the dimensions time and geography could be represented as multilevel hierarchies (days, weeks, months, quarters, years) and (cities, states, countries), respectively.

Multidimensional databases are currently developed without any widely accepted formal model. Therefore, there is no consensus on the primitives of and no established terminology in multidimensional modeling. However, a common feature of multidimensional databases is that information is represented as multidimensional arrays. Summary data are often modeled as a multidimensional data cube consisting of measure and dimension attributes. Thus multidimensional data cubes can be considered as the basic logical or conceptual model for OLAP while the operation set for data cube manipulation may vary considerably between models. At the instance level, the values of the dimension attributes are assumed unique to determine the values of all measure attributes.

### ***2.4.3 Enterprise performance management (EPM)***

EPM, also known as corporate performance management (CPM) and business performance management (BPM), includes the combination of planning, budgeting, financial consolidation, reporting, strategy planning, and business scorecard (Walker, 1996) tools. Most vendors do not offer the full set of these components, so they adjust their version of the definition to suit their own product set (Menninger, 2003).

The three general strategic focuses companies may employ in their EPM are described as cost-, differentiation- or growth-based. A cost-focussed strategy emphasizes supplying a standard product or service that meets many customers' needs without customization at the lowest cost possible. A differentiation-focussed strategy includes custom or niche products or specialized services delivered to its customers. Growth-focussed companies place their emphasis on maintaining competitive economic position in the growth of the economy and industry.

Once the strategy is identified, a company must measure performance in terms of how well it is executing that strategy over time. Key performance indicators (KPIs) allow the company to do that – to see in what areas it is executing well and what areas require improvement at the enterprise level or specific to departments. Therefore, within the identified strategy, KPIs help the company define and measure progress towards the company goals (Reh, 2005).

Some KPIs may be simple to define and measure, such as financial performance and other objective measurements. Other may be more subjective such as customer empathy or employee morale. Defining the appropriate KPIs for a corporate strategy can be as important as defining the strategy itself. KPIs are quantifiable measurements, agreed to beforehand, that reflect the critical success factors of an organization. They will differ depending on the organization. Whatever KPIs are selected, they must reflect the organization's goals, they must be key to its success, and they must be quantifiable (measurable). KPIs usually are long-term considerations. The definition of what they are and how they are measured do not change often.

An executive dashboard – also known as a manager's dashboard, an executive cockpit, digital cockpit or a business scorecard – is a software application that provides a single-screen display of relevant and critical business metrics and analytics to enable faster and more effective decision making (Menninger, 2003). In other words, a dashboard is a summary of the critical measurements required to make the daily business decisions that affect an organization's bottom line. The foundation of the executive dashboard is a set of KPIs. Revenue forecasts, gross profit, inventory levels, the list of current top customers; all qualify as KPIs as long as they are important to the business and can be measured.

In summary, an EPM system for business intelligence (BI) is an absolute must for organizations that want to keep their fingers on the pulse of their business activities. Such a system could provide an organization with the following capabilities:

- a single screen, browser-based portrait of the organization with drill-down capability on each KPI monitored;
- real-time presentation of information in chart and graph format, based on data pulled from the corporate DW, data marts, or legacy systems;
- slice-and-dice capability on KPIs that lets users perform what-if and sensitivity analysis; and
- integrated management of KPIs and issues raised by their performance levels – all based on appropriate and individual user-based security clearances.

#### ***2.4.4 Concluding remarks***

Data warehousing, OLAP and EPM concepts have been around for several years; however, the power of and the need for effective implementation of EPM are just beginning to be realized. EPM implementation in organizations is very much in the growth stage where many new strategies are being developed, tested and employed on a fairly regular basis. To reap the benefits data warehousing, OLAP and EPM promises, it is critical to perform an economic evaluation of a project before committing to it. Like any significant IT project, implementing and deploying EPM is subject to multiple risks. Build versus buy? Technology selection? Vendor selection? Return on investment? Do we need consulting help?

Behind these questions hide the details that may spell the difference between success and failure of a project, details that can only be identified in the context of a specific EPM implementation, with specific technology, towards a specific set of goals and requirements, working with a specific team of stakeholders.

## ***2.5 Organizational Performance***

Organizational performance is directly related with the extent the organization achieves its goals. Organizations go into business to create long-term performance and values (Owen et al., 2001). So, a sustainable organization is one that thrives over the long haul, not just the short haul. This does not mean that it is a static organization; rather it implies that it is an organization that is much like a highly adaptive organism, one that beats the evolutionary odds and survives through adaptation. This concept is not theoretical, rather it grew out of attempts to help clients develop and sustain high performance (ibid).

The sustainable high performance organization is one that is able to:

- remain responsive to marketplace expectations; and
- sustain the behaviours required to meet marketplace expectations.

There is a set of core elements that drive the organization's ability to maintain high performance. Success is determined by bringing about the alignment of these core elements. (Owen et al., 2001) proposed a model which shows that the organization's ability to provide quality products and services and create value is determined by bringing about the alignment of five key factors:

- Senior management's perception of the market-place.
- A shared vision, mission, values, and strategies which are aligned with the realities of the marketplace.
- Leadership practices that are congruent with the vision, mission, values, and strategies.
- Infrastructures which support and reinforce the vision, mission, values, and strategies.
- Employee behaviours that meet customer needs.

Further, the model indicates that there is a cause and effect relationship among these factors, that is, when the factors are aligned, business performance will improve measurably. These relationships can be managed by creating and sustaining the alignment of the five key success factors.

## ***2.6 Performance Measurement***

Measuring performance is something that all organizations do. They may do it systematically and thoroughly, or on an ad hoc basis and superficially – but they do it. External agents and organizations also measure performance – shareholders, investment houses, banks, regulators, and so on. Performance measurement is an important aid to making judgements and to making decisions.

According to Parker (2000), the reasons why organizations measure performance are to:

- identify success;
- identify whether they are meeting customer requirements;
- help them understand their processes: to confirm what they know or reveal what they do not know;
- identify where problems, bottlenecks, waste, etc., exist and where improvements are necessary;
- ensure decisions are based on fact, not on supposition, emotion or faith or intuition; and
- show if improvements planned, actually happened.

At the organizational, functional, program, and project levels, there have been several concepts and ideas involved in the measurement/assessment work. The balanced scorecard concept (Kaplan and Norton, 2004) has often been cited.

At the group and individual levels, there were many concepts such as motivational methods based on industrial psychologists, and performance appraisals for salary structure/workload analysis extended by human resource specialists, and piece-rate/standard times determined by industrial engineers (Takala et al., 2006).

Although performance measures are useful, they also attract much skepticism over why, how and when they are used. There are issues of measuring the right things, of comparing like with like, and of comparing yesterday with today. Traditional business performance measures have been financial – measuring such ratios as rate of return, cash flow, profit margins, and so on. These financial data have the advantage of being precise and objective. However, significant arguments against such measures are that:

- they tend to be very insular or inward-looking (although financial data can be, and are, compared with other organizations, the “like for like” argument can make comparison unreliable);
- they fail to include the less tangible factors such as product or service quality, customer satisfaction and employee morale; and
- they are lagging indicators (they show what has happened in the past, and are poor predictors of tomorrow’s performance).

### ***2.6.1 Benchmarking and Balance Scorecard***

Benchmarking provides a means of determining how well a business unit or organization is performing compared with similar units in the organization or externally. This gives the use of performance measures a broader perspective and can provide a measure of “best practice”. Typically, performance measures are monitored over time. While this gives a good indication of the rate of improvement it does not indicate levels of performance in absolute terms. This is where benchmarking is so useful.

Yasin (2002) provides a comprehensive review of the literature related to benchmarking theory and practice. Yasin (2002) states that benchmarking as a management approach has evolved rapidly over the last decade and today not only focuses on internal operations but encompasses supply chain and e-business practices. Yasin (2002) concludes that despite the increasing scope of benchmarking activities and the numbers of organizations utilising benchmarking, the field of benchmarking has no distinctive theory to guide its advancement. Additionally that researchers in the field of benchmarking are faced with the continuous need to develop innovative methodologies to guide benchmarking practices in emerging technologies such as e-commerce and supply chain management.

However, benchmarking is still a lagging indicator, based on yesterday's measures. While attempting to benchmark and identify current best practice, an organization's competitors may be leapfrogging in the performance stakes. What we need are leading, not lagging, indicators. After all, we do not want a medical check-up to tell us we have been ill in the past – we know that. We want to know how well we are now and the prognosis for the future.

More modern approaches have recognised and addressed such limitations. The balanced scorecard is a prime example. The balanced scorecard offers an alternative to the traditional financial indicators (Parker, 2000). It describes and explains what has to be measured in order to assess the effectiveness of strategies.

The balanced scorecard translates a mission and strategy into a set of measures built around four or five perspectives:

- Financial. How does an organization look to its shareholders?
- Customers. How does an organization become its targeted customers most valued supplier?
- Internal processes. What processes – both long and short term – must an organization excel at, to achieve its financial and customer objectives?
- Innovation and improvement. How can an organization continue to improve its processes and systems in order to create value?
- Employees. How do an organization and its employees continue to learn and grow?

The balanced scorecard is a useful predictor of future performance and has shown successful results in many private-sector companies, as well as in some government organizations (ibid.).

## ***2.7 Fundamentals of performance measurement***

### ***Performance measures need to be aligned with the organization's strategy***

The starting point is to determine what to be measured. While this sounds very simple, it is often one of the most difficult tasks. It is not sufficient to create a wide range of measures that covers all of the organization's activities – this is too wasteful

of resources and can be distracting. There must be a focus on those things that are really important – the measures adopted must be selective. This depends on the organizational vision, mission and strategy.

This suggests that the performance regime must be reviewed regularly, in line with the normal strategic planning process, to ensure that the alignment is constant.

***Sub-unit measures must aggregate into organization-wide measures***

An effective measurement regime is an integrated regime. The measurement regime at sub-unit level must be consistent with the regime at the organizational level, and should furnish the raw data for the level of aggregation. This ensures that the lower levels are not sub-optimal, enhancing sub-unit performance at the expense of the organization.

Similarly, no part of the organization should be left out of the measurement regime. If the regime is aligned with the mission and strategy, this sends a signal that the excluded parts of the organization are not central to, or important to, achievement of the mission. If that is so, why do they exist?

Integration also insists that performance measures are integrated with other key measures – of quality, for example. If this is not so, it may be that quality and output measures are mutually destructive.

This should also apply ideally (though this may be harder to achieve) to measures within partner and supplier organizations – to align measurement and performance priorities throughout the supply chain.

***There must be commitment to the measurement regime***

First, it is essential that the senior managers of the organization fully support the measurement regime – they will do this if it makes their job easier, by offering information which is truly helpful. The information arising from measurement must be useful in determining policy and in making decisions. If the measurement regime truly aligns with mission and strategy, this should be assured.

Second, employees at lower levels should understand and be committed to the measures. After all, one of the purposes of the measurement may be to improve performance at these levels of the organization. If this is so, the people at these levels need to know what is expected of them, and why. To achieve this, managers must effectively communicate the purposes and nature of the measurement regime.

### ***Measurement must have an effect on performance***

There must be a complete analysis and feedback loop that ensure that performance measurement is analysed, and translated into action and behaviour which changes the nature of activity and of performance. Measurement must improve performance.

Sometimes, the linkage between measurement and behaviour change is quite direct; for example, when the measurement is used as the basis of workgroup/individual assessment and appraisal or financial reward schemes.

### ***Measures must be reliable***

The benefit of measurement is often dependent on the reliability and comparison of measures over time. It is therefore important to identify measures which can be made reliably and consistently over the desired time period.

### ***Constructing a measurement regime***

Typically, there are four types of measures and any performance measurement regime will almost certainly consist of a mixture of all four:

1. outcome measures (lagging);
2. action measures (leading);
3. input measures (leading);
4. diagnostic measures (leading or lagging).

Outcome measures, as their name suggests, measure the outcome of something. As a result, they tend to lag the events that lead to the outcome.

Action measures (or “performance drivers”) are designed to measure activities that lead to desired outcomes.

Input measures, again, as the name suggests, measure the inputs to a process – for example, the labour consumed by an activity. They are useful in control processes but their main benefit in performance measurement is when they are compared to outputs to measure efficiency and/or productivity. Certainly, a measurement regime based solely on input measures is unlikely to be of strategic benefit.

Diagnostic measures give insight to why an outcome or action measure is at its current level. Typically, they measure components of the outcome or action measure, and a diagnostic measure for one (part of a) process may be an outcome measure for a sub-component of that process.

In all cases, because of the need to clearly establish what is being shown by a measure and to document for audit purposes the calculations on which reported performance is based, the measurement regime must necessarily include an easy-to-understand, detailed definition of each measure.

To summarise, effective performance measurement:

- reflects results, not the activities used to produce results;
- contains normalised metrics that can be used in benchmarking;
- is seen to be practical and easily understood by all;
- provides a continual self-assessment;
- uses reliable and robust measures;
- provides a benefit that exceeds the cost; and
- has clear ownership of all measures.

## ***2.8 Performance Measurement and Productivity***

According to Hoehn (2003) and Helo (2005), it is generally agreed that productivity represents one of the major areas reflecting the term performance, especially for an organization or a production unit. Based on Sink and Tuttle (1989) concept, there are seven performance criteria; i.e.

- profitability,
- productivity,

- quality of work life,
- innovation,
- quality,
- effectiveness, and
- efficiency.

In essence, performance management should not be treated as a separate isolated system. Instead, measurement should be considered at the individual, process and organizational levels. In this way, it can facilitate the alignment of goals of all individuals, teams, departments and processes with the strategic aims of the organization and incorporate the decisions of stakeholders in the planning and management of activities (Yeo, 2002).

The concepts of management information and organizational performance were introduced and explained in detail in this chapter. Literatures that deal with issues relating to data quality and integrity as well as their managerial implications were thoroughly reviewed. These helped to position the research in its theoretical context, and also to understand the current state of the research topic. Furthermore, the knowledge acquired from the reviews proved invaluable during the course of the research work, the results and analysis of which is presented in chapter four.

In the next chapter, the case study organization through which the objective of the research work, the impact of management information on performance of organizations in the chemical process industry, is accomplished is introduced. This is followed by the presentation of the research method as well as the data gathering technique used in carrying out the research work.

## **Chapter 3 – Research Methodology and Design**

In the previous chapter, concepts on management information and organizational performance were introduced and some selected works related to this topic were reviewed. This chapter introduces the setting in which the research work was carried out, that is, the case study organization, and also addresses the research design and the approaches used.

### ***3.1 Case Study***

Fincham (2002) noted that using information technology (IT) to generate management information certainly does not guarantee that the information will contribute to an improvement in organizational performance. Yet, several organizations' senior management still deploy IT in generating information for decision making purposes.

These seeming contradictory concepts may be unravelled by looking into a case study. This will definitely provide a good way to investigate this phenomenon in a real life setting, particularly the dynamics that take place in this setting. One expects to get a better picture of the issues affecting the effectiveness of management information by studying the phenomenon in a real life situation.

#### ***3.1.1. Proprietary and Confidentiality Issues***

The case study was conducted at *ABC Wax plant* located in South Africa. Actually, *ABC Wax plant* is a real chemical plant operating under a different company name. However, during the course of the research, propriety and confidentiality concerns related to most of the information needed for the successful completion of this research on the plant became an issue. After discussing with the author's study leader, it was agreed that an anonymous name be used for the case study organization, hence the emergence of *ABC Wax plant*.

#### ***3.1.2 Management Information***

ABC Wax plant, like every other organization, needs information to ensure a smooth running of its operations, particularly information that directly border on achieving its business goals and objectives. Although processing of data is not the primary activity

of ABC Wax, nonetheless, its management relies heavily on the information from process/production personnel for decision-making.

For instance, being a production plant where heavy machineries are used for production and the operating conditions are extremely dangerous, the safety of personnel on the plant is a critical issue to management. One of the means of ensuring safety is through information gathering and analysis on incidents that have happened on the plants. Most times, information systems are built to allow personnel input such data into the systems which are later analysed by the management.

Other areas of information-gathering concern for ABC wax plant whose primary process is production are monitoring of production volumes, product quality checks, personnel training and development, monitoring of the environmental impact of its processes, and an assessment of its financial performance. Adequate information in these areas could impact positively on the overall performance of an organization if effectively utilised.

From the foregoing, ABC Wax, as a case study for this research, will be studied along these areas in terms of how the management has turned around the information available to it from various sources to improve on the performance of the organization.

Firstly, a description of ABC Wax and its production processes will be given, followed by the company policy statement which spells out the vision and mission of the company.

### ***3.1.3 Introduction to ABC Wax Plant***

ABC Wax is one of the world's leading specialists in petroleum and synthetic waxes related products. Its global operation comprise nine production and blending plants throughout Europe, South Africa, the USA, and China, and boasts of 16 subsidiaries or joint ventures, 14 legal entities and 61 representatives based in 68 countries.

### ***ABC: The Parent Company***

ABC, established in 1950, is one of the world leaders in the commercial production of liquid fuels and chemicals from coal and crude oil. The company has sales of more than US\$ 6-billion per year and is listed on the JSE Securities Exchange with a market capitalization of more than US\$ 7-billion and on the NASDAC in New York.

ABC manufactures more than 200 fuel and chemical products at its South African based facilities as well as at its plants abroad. These products are exported to more than 90 countries. The company has developed world-leading technologies for the commercial production of synthetic fuels and chemicals from low-grade coal as well as the conversion of natural gas to environmentally friendly diesel and chemicals.

### ***Summary of Products***

ABC Wax produces a unique range of paraffin waxes and wax related products. These products include: paraffin waxes, hard waxes, microcrystalline waxes, petrolatum, slack waxes, petroleum jelly, white oils, stearic acid, gelwax, and fragrances for candles, phase change materials, bitumen modifier, candle waxes and liquid paraffins.

Paraffin waxes offer a number of application possibilities throughout the spectrum of low- to high-melting wax grades produced. Hard waxes (“PARAFLINT”), in particular form an integral part of the processing or the final make-up of a variety of products including hot melt adhesives, polishes, printing inks and coatings, plastics, textiles and leather.

### ***The South African Facilities***

The ABC Wax production process in South Africa has benefited from continuous improvement over the last 50 years to meet demands for high quality synthetic waxes and wax-related products.

The raw materials (natural gas, air and steam) are transformed into synthesis gases of constant quality year after year. ABC Wax produces high purity base components free of sulphur and other impurities using catalyst produced on-site and state-of-the-art process technology.

### ***Base Wax (Synthesis) Business Unit***

This business unit includes the following processes:

#### ***Catalyst Preparation – Sections 4200, 2100, and 3600***

Iron based catalyst is manufactured for the fixed bed and slurry bed reactors. These catalysts are also reduced and stored.

#### ***Fixed Bed Reactors – Section 1400 and 800***

This plant contains five fixed bed reactors for wax production and a high pressure methanol production reactor. The intermediate products produced are hard wax, hot condensate and cold condensate. These are fed downstream for further workup.

#### ***The Slurry Bed Process: SBP – Sections 200 and 700***

This process is similar to the fixed bed reactors in terms of the intermediate products produced. A different type of reactor system is used, however, where a single reactor is operated as slurry consisting of a mixture of wax and fine iron based catalyst. The reactor products are combined with the fixed bed products and are fed to downstream work-up processes. Section 700 is the plant where catalyst for the Slurrybed reactor is reduced, that is, tempered to its most productive form.

#### ***3.1.4 The ABC Wax Process***

The catalysts necessary for the synthesis processes originates in the catalyst preparation plants (Section 4200, 2100 and 3600).

There are two wax synthesis plants. The SBP plant (Section 200) uses a slurry bed reactor system. The Arge plant (Section 1400) consists of five identical reactor systems, with a sixth reactor used for methanol production. Both these reactor systems produce primary products from synthesis gas. The products that are manufactured in the reactors are:

- Reactor Wax, which is transferred to tankage and then to the Short Path Distillation (SPD) plant;

- Hot Condensate, which is transferred to tankage and then to the Single Distillation Unit (SDU) plant;
- Cold Condensate, which is transferred to tankage and then to the Atmospheric Distillation (ADU) plant;
- Reaction Water, which is transferred to Section 500;
- Tail gas which is transferred to the Dewpoint Correction plant;

### ***3.1.5 ABC Wax (SA) Company Policy Statement***

Reproduced below is the ABC Wax (SA) Company Policy Statement:

“Our vision is to be the globally respected leader in the high value wax and wax related businesses.

We aim to constantly broaden the use of our product range to increase value to all mankind.

In order to satisfy our customers, we will focus on:

- Providing top quality products at market related prices,
- Reliable and fast deliveries,
- Monitoring of quality performance in accordance to applicable standards and customer specifications,
- Innovative, tailor-made product solutions and
- Using our application know-how to improve our customers’ processes.

We will win with people through their development and empowerment and through goal oriented leadership.

We strive in excellence in all we do by planning, controlling and continually improving our management systems, business processes, safety standard and reduction of impact on the environment, based on international management stands. This extends to our resource utilization and environment effect on our processes and products.

We promote dialogue with interested parties, employees and authorities in an open and transparent manner. We act with integrity.

We provide industry related returns and sustainable growth for our shareholders.

We comply, as a minimum, with all applicable legal and other agreed requirements. We only operate plants and carry out works whose risks we know and we can control.

Safety, Health and the protection of the environment form an integral part of our activities and will include our employees, suppliers, contractors and the company at large.

We strive to have a reasonable balance between, economic, social and environmental needs by practicing the principles of Responsible Care and Sustainable development.

We will provide the resources required to implement the above.”

### ***3.2 Case Study Scope***

It is instructive to note that each of the various business units under ABC Wax has its business goals and objectives which it aims to achieve. These goals and objectives must, of necessity, be in agreement with the overall ABC Wax goals and objectives. Thus, each of these business units operates like a separate entity with the aim of meeting its targets at the end of the day.

This study research was focussed on the Base Wax business unit which may be referred to as the backbone of ABC Wax. The reason for this is that wax, the main product of ABC Wax, is primarily produced by this unit. All other business units are downstream of this unit i.e. their processes are based on refining or marketing of refined products from this unit.

However, data from other units may also be used either to substantiate a conclusion, if necessary, or if data is not available in Synthesis for an area of interest to the research study.

### ***3.3 Research Method***

The objective of this research work is to establish how effectively the management of the ABC Wax has utilised the information it gets to positively impact on the performance of the organization.

Performance of an organization may be determined either by financial or non-financial indicators, or both. For a production plant like the case study organization, there exists a thousand and one factors which may be considered as performance indicators. To attempt to consider all these factors will not only overstretch the researcher but will also unnecessarily overextend the completion time of the project.

A meeting with the production manager, who is the helmsman at the case study organization, gave a lead on the way out. According to the helmsman, the management has already identified areas which it intends to focus on for the financial year 2006-2007. Each of these areas, termed key performance areas (KPAs), has one or more key performance indicators (KPIs) which was used as yardstick to measure the management's overall performance in that area. To demonstrate its commitment, the management documented all the KPAs along with their KPIs in a confidential document called the *strategic objectives document for financial year 2006-2007*.

Consequently it was decided to streamline the research along the identified KPAs for the following reasons:

1. Since the KPAs are identified by management, the chances of having documented materials on the research area is brighter,
2. There is a higher possibility of getting more information during interview sessions since most of the interviewees would be familiar with the issues to be raised during interview sessions,
3. The identified KPAs are a subset of the many factors that may be used to measure the performance of any organization.
4. The KPAs include both financial and non-financial indicators, a situation that satisfies the researcher's intent.
5. Most importantly, the research objectives are not undermined; rather the accomplishment of the objectives was strengthened by the use of the KPAs.

### ***3.4 Data Gathering Techniques***

In order to realise the objectives of the research work, various proven techniques were used to gather data from the case study organization. While some data were gathered through having personal contacts with the employees of the case study organization,

some data were collected through indirect means. Observation, reading and asking questions are part of the techniques used in the data gathering.

The methods used to gather data for the research work include:

- Indirect data Collection
- Nonparticipant Observation
- Structured/Unstructured interview/ discussion
- Existing data sets

Each of these methods is explained in detail below.

### ***3.4.1 Indirect Data Collection***

This is a method which involves collecting and analysing data, data which are not directly collected from an organization (Maylor and Blackmon, 2005). This data could be from published or unpublished materials such as company archives, document analysis e.t.c.

For this research work, due to the confidential nature of the technology used for operations at ABC Wax plant, which necessitated an access restriction to all the data needed for this research work, there is the need to augment data collected from direct methods with those from indirect sources.

In this light, data was indirectly collected from the following sources:

- ABC wax operations newsletter which is published monthly
- ABC Wax Intranet site (Web pages)
- Other materials that are not published.
- Data that were already collected by a colleague whose area of research overlaps with the author's research area.
- Minutes of meetings – which provided valuable data, especially about the timing of issues and decisions.

Some of the merits and demerits of this method are listed in Table 3.1 below.

**Table 3.1: Indirect Data Analysis (Maylor and Blackmon, 2005)**

	<b>Advantages</b>	<b>Disadvantages</b>
<b>Effort</b>	Saves money and time in data collection  Allows more time for data analysis	Need to familiarise oneself with the data  Ned to manage large and complex data sets  May be expensive
<b>Analysis</b>	Access to high quality data  Opportunity to analyse data longitudinally  Comparing subgroups or subsets within the data sample	Lack of control over data quality  Limited to data already collected  May be biased in unobserved ways  May not answer ones research questions
<b>Contribution</b>	Reinterpret the original findings  Fully exploit data sets	May not be seen as being as rigorous or relevant as purposefully collected data  Does not build as many research skills as direct method

Due to its many disadvantages, this method of data collection was not intended to serve as the main source of information. However, one founds the indirect data collection method very useful as it nonetheless complemented the direct methods and went a long way to substantiate the information gathered through them, especially the data gathered through interviews.

### ***3.4.2 Nonparticipant Observation***

In indirect data collection, there is little or no direct contact with the organization being studied and most times only the records speak for the organization. In nonparticipant observation however, data is actually collected directly by watching someone doing something, even though there is still little or no direct interaction.

Nonparticipant observation may be as simple as watching and noting how people behave under different circumstances.

This method proved very useful in the area of safety management in the case study organization. The objective was to see if people have really imbibed the safety culture, or they demonstrate it only to satisfy the management.

As later discussed in the next chapter, safety is one of the key performance areas identified by ABC Wax plant management for the 2006-2007 financial area. This method of nonparticipant observation was chosen to validate the data collected from the organization using the direct data collection method. This served to corroborate conclusions drawn from the directly collected data regarding the effectiveness of management information on the organization performance in the area of safety.

### ***3.4.3 Structured/Unstructured interview/ discussion***

One of the most common techniques used in all types of business and management research is the interview – asking someone questions directly. Unlike indirect data collection and nonparticipant observation where there is little or no direct contact with the organization being studied, the structured/unstructured interview involves more contact with the people or organization. This information gathering technique was extensively used during the research work.

To achieve the objective of this research project, gaining an insight into the key performance areas (KPA) as identified by the case study organization is a good point to start. These KPAs are contained in the case study organization's 2006-2007 strategic objectives document. After obtaining this document, an interview was scheduled with the plant production manager, who is the helmsman at the plant, for discussion regarding the document. One of the outcomes of the interview session is a

list of staff identified by the production manager as champions for each of the key performance areas. Interview sessions were subsequently scheduled with each of the identified personnel.

A key issue was the structure of the interview. Should it be structured or unstructured? The structured approach where every interviewee is asked the same question in the same order is the type of interview mostly closely associated with the scientific approach. Taking a structured approach ensures that the data collected are consistent across interviews, by minimising the differences between the people interviewed. In an unstructured interview however, one does not need to go in with an interview schedule with precisely worded questions in a strict order. Despite this unstructured format, this does not mean going in without a plan or agenda. Table 3.2 below compares the structured and unstructured interview.

**Table 3.2: Structured versus unstructured interview (Maylor and Blackmon, 2005)**

<i>Highly Structured</i>	<i>Unstructured</i>
Directed discussions, closed questions, limited range of responses	Interviewee directed only to the general area for discussion, open questions seek further clarity or meaning
Imposed Concepts	Concepts emergent
I need the interviewee to answer all the question on my sheet	I am going to explore the area with the respondent

Looking at the characteristics of both options within the wider concept of the research objectives, it was decided that both be utilised. This proved a wise decision as exploratory research questions which necessitate the unstructured approach as well as closed questions which called for the use of structured approach was asked during the interview.

Even though the production manager suggested more than one name for each key performance area, a one-on-one interview was preferred (and adopted) over the group type after a careful examination of the benefits of each of them. Table 3.3 compares the one-on-one interview with the group (of interviewee) type.

**Table 3.3: A comparison of individual and group interviews (Maylor and Blackmon, 2005)**

<i>Interviewer</i>	<i>Interviewee</i>	
	<i>One</i>	<i>Group</i>
<i>One</i>	Most common type of interview	Can generate a lot of data in a short time
	Relatively easy to arrange	Susceptible to biases and group dynamics
	Susceptible to the biases of both parties	Can be difficult where there is a lack of true consensus in the group.
	The most appropriate method for confidential or sensitive subjects	Can be difficult for a new researcher to manage alone

The issue of confidentiality and sensitivity of the information involved at the case study organization is a more compelling reason for choosing the individual type of interview. Thus, for an area where more than one champion was assigned by the production manager, each of them was interviewed separately.

#### **3.4.4 Existing Data Sets**

Saunders et al. (2003) observed that despite the volume of data available in business and management research, few researchers consider analysing data already collected for other purposes. However, it may be worth looking to see if the data that may be relevant to one's research problem has already been collected by someone, or better still, has been structured in an appropriate format.

A data set is a set of information collected by professional researchers about one or more social units using a consistent research design or protocol, while a database is a structured data set, usually a matrix of data that allocates a row to each social unit, an a column to each variable or other measure related to that social unit. An archive is a collection of documents or other data in an unprocessed form, which may be processed into a data set or a database. The three sources of information defined above were tapped into during the course of the research work.

A source of information that proved almost indispensable to this research work is the existing data sets at the case study organization. Although these data sets were produced for purposes other than the research project, yet they provided useful information necessary to achieve the research objectives.

Several documents that were stored in data repositories such as archives were collected during the course of the research work. Since the data sets were originally created for other purposes, some of them have undergone analysis, while some of the data sets are still raw data that have not been analysed.

### ***3.5 Data Validity***

Validity refers to how accurately a research was conducted (Maylor and Blackmon, 2005). It has to do with having enough responses to justify a claim, using the correct process to measure a concept, and so on. Since this research work is focussed on a case study, data validation was done using one or more of the following:

1. Interaction with the Area Champions: Most of the interviews conducted were with the respective leaders of the areas concerned. This ensures that the data collected are those that have been verified. In cases where sessions were held with subordinates, at least a meeting was scheduled with the leader of such area to ratify the data collected via the subordinates.
2. Cross-checking of information: Information collected directly from people was cross-checked with those gathered through indirect sources such as the organization's intranet as well as published and unpublished documents. Cross-checking was also used to verify same data which were collected from different sources due to the overlap of functionalities in those areas. An example is the Volume Area and the Cost Area. While the data collected from the volume area relates to how much of final products produced the data from the cost area deals with the unit cost of producing a given amount of the final products. In any case, the amount of products produced, for instance, in a month, features in both data sets.

In the preceding sections, ABC Wax plant, the case study organization for this research work was introduced. Information presented about ABC Wax showed its

impressive status amongst the organizations in the chemical process industry. It is remarkable that the facility at ABC Wax presented a fair platform for the accomplishment of the research objective such that it is safe to conclude that ABC is an adequate representation of a typical chemical processing company.

From the facility on ground, it became obvious that the management of ABC Wax appreciates the value of information to the running of its business. It thus became more interesting to find out the impact this management information has on the performance of the organization. Results and analysis of these findings are presented in the next chapter. Based on the findings, guidelines which are specific to the case study organization and generally applicable to the chemical processing industry are also presented.

## **Chapter 4 – Findings and Discussions**

The case study organization was introduced in the last chapter, as well as the research method and approach. In this chapter, the research findings is presented along with discussions on them.

The chapter is structured as follows. Firstly, the key performance areas (KPAs) identified by ABC Wax management is listed, and a detailed discussion of each KPA will then follow. An overview of each KPA will be given, followed by a list of the KPIs identified for the KPA. The source of management information for the KPA will then be discussed and analysed. Discussion of the KPIs defined for each KPA is discussed next, and this will be concluded by examining the impact the management information has on the achievement of each KPI in the KPA, and hence the performance of the organization.

### ***4.1 Key Performance Areas (KPAs)***

As explained in chapter three, the base wax business unit comprises of Catalyst Preparation (Sections 4200, 2100, and 3600), Fixed Bed Reactors (Section 1400 and 800), the Slurry Bed Process: SBP (Section 200 and 700), and Wax Work-up.

The key performance areas (KPAs) for ABC Wax Synthesis as contained in its strategic objectives document for the year 2006-2007 are:

- SHE (Safety, Health and Environment);
- Leadership and People Development;
- Volume/Productivity; and
- Cost.

Also defined in the document are the Key performance indicators (KPIs) for each of these KPAs.

### ***4.2 Research Methodology***

To determine the performance of the organization in each of the area it has identified as a KPA, each of the KPIs defined for each KPA will be thoroughly assessed. Since

the objective of the research is to determine the effectiveness of management information on organizational performance, each of the KPIs will be examined through the lens of the information available to management regarding the KPI, and how management has effectively utilised the information towards improving the performance of the organization in that area.

### ***4.3 KPA 1: SHE (Safety, Health and Environment)***

In the last decade, companies' management has widely agreed on the importance of the implementation and certification of structured management systems, such as quality management systems, environment management systems, and recently, occupational health and safety (OH&S) management systems (Zhang et al., 2001). The implementation of such systems requires that companies can be able to measure their results and achievements concerning each particular system. As a part of the OH&S management system, the performance measure is as important as other issues, such as financial, production or service delivery management.

Being a chemical production plant, safety has always been part of the KPAs for ABC wax. To underscore this, the management puts it thus in its policy statement -

*“Safety, Health and the protection of the environment form an integral part of our activities and will include our employees, suppliers, contractors and the company at large”.*

#### ***4.3.1 Generation and Analysis of Management Information***

##### ***4.3.1.1 Generation***

Data gathering and subsequent analysis in this area is done with the aid of an application built with Microsoft Excel spreadsheet. An employee is designated to this duty. The designated employee has the responsibility of compiling the data from different sources such as forms or documents that have been filled by staff, reports from unplanned visits made to the plants, online data keyed in for safety observations and so on.

After the gathering, the data is analysed using Microsoft Excel spreadsheet application. The result of the analysis is then presented to the management.

#### ***4.3.1.2 Analysis***

The data generated in this area as management information leaves much to be desired. Even though some of the KPIs defined for this area were achieved, the information on which the management based its decision may not be free of errors. The mode of data gathering, as well as the integrity of the data, is of particular concern.

Firstly, since the designated employee normally has to check files and documents to extract data for compilation, there is a high possibility of error such as typographical, or miscalculation, which invariably calls to question the quality of such data. Also there exists a high risk of redundancy in the compiled data, wherein the same data is captured and stored in different locations. This leads to information inconsistencies which makes it difficult to determine which values are the most current or most accurate.

Another issue worthy of mentioning is the information security. As it were, the application used for processing the data for management use presently sits on a personal computer (PC) meant for general use. Even though the application resides within the designated employee profile, and needs his username and password to be accessed, the fact that every employee has access to the PC makes the data in the application vulnerable and raises issues about the security and integrity of the data within the application.

On the positive side, the application performance as regards query process time is relatively fast, probably due to the somewhat low number of records or data it presently handles. With time, this may also become an issue as the records needed for proper analysis grow bigger. The subject of flexibility may also be brought up as the data grow bigger, as there may be limitation to the kind of analysis that may be performed with the application.

#### ***4.3.2 Key Performance Indicators (KPIs)***

The following are the KPIs defined for SHE as contained in the ABC Wax Synthesis strategic objectives document for the year 2006-2007

- Reporting of all incidents, Recordable Case Accident (RCA) and closure rate of min 70%
- Compliance to ISO 18001/Alfons system
- Four safety observations per person per month
- Housekeeping index targets (Dec 06: Level 3, June 07: Level 4)

##### ***4.3.2.1 KPI 1: Reporting of all incidents, RCA's and closure rate of min 70%***

The philosophy behind this KPI is to ensure that all incidents (which include injuries and illnesses to operations employees) are reported so that such cases would be investigated by management and measures would be put in place to prevent reoccurrence.

After the occurrence of an incident, the shift supervisor or the most senior person on shift is expected to document the incident in the incident report book. Some of the columns in the book include the name of the personnel involved, a brief description of the incident, immediate actions taken after the incident, e.t.c.

A panel is then constituted by management to investigate the root cause of the incident/accident so that appropriate measures may be put in place to prevent reoccurrence of such incidents. The panel normally consists of the personnel's (victim) shift supervisor, the production manager, and a safety department representative.

Closure rate indicates the rate at which reported incidents are investigated and concluded. The higher the closure rate, the better, since this will earnestly provide the management with information regarding the root cause of the incident among other things, and the panel's recommendation. Hence, the identification of high closure rate as a KPI.

#### 4.3.2.1.1 Impact of Management Information

Information gathered in this instance is of great significance to the management as it forms a basis by which the panel will recommend an approach to rectify any damage done and prevent such incidents from happening again, or at least drastically reduce its frequency. However, one finds that the report of the incident may not be accurately given by the personnel involved if the incident is as a result of a mistake or oversight on his part, since this may lead to a disciplinary action/ warning recommended against him by the panel. Thus, we see a case of management acting on wrong or inaccurate information.

Below is a graph showing the closure rate of incidents reported in the four shifts at Synthesis during the 2006-2007 financial year.

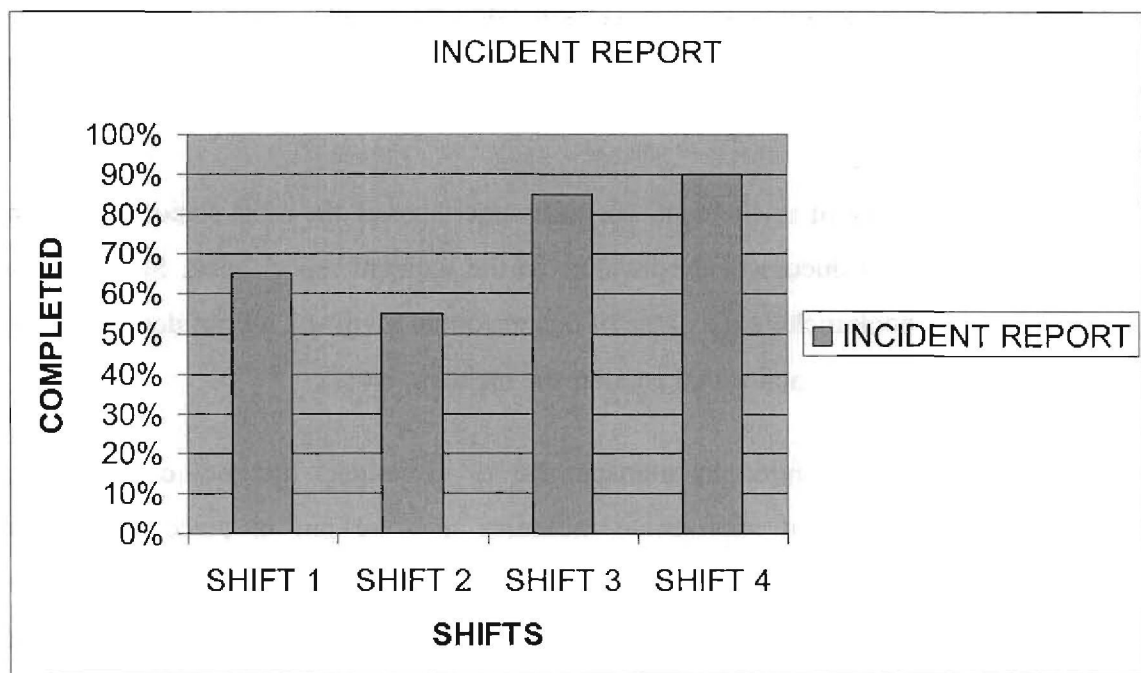


Figure 4.1 Incident Closure Rate in Synthesis

From the graph, it is obvious that the management is unable to achieve the target of 70% minimum closure rate it set for itself across all the shifts. This notwithstanding, there are ample evidences that the information made available to management regarding this KPI has indeed impacted positively on the performance of the company.

The first observation is that there is rare recurrence of the same type of incidents. This observation, from my research, has a direct link to the action taken by management after it has received any information on an incident. For instance, after every incident, it is mandatory for the supervisor (or the most senior person) on a shift to send a mail to the company's email system informing everyone of the incident. The details contained in the document (Appendix 2) include the description of the incident and the facts gained at preliminary investigation. Other details include the immediate corrective actions taken at the incident site, the preliminary root cause analysis and the preliminary preventive actions implemented.

With this information, most employees are made aware of incidents on the plant and their causes. The awareness is even more strengthened by the entrenched culture in the company where most communications are done through email.

Thus, albeit the inability of management to achieve the target closure rate, its decision, based on the information made available to it, to mandate the publicity of incidents even before the final investigations on the incidents are concluded, has rubbed off positively on the safety performance of the company. This is evidenced by the rare recurrence of same type of incidents.

#### ***4.3.2.2 KPI 2: Compliance to ISO 18001/Alfons system***

The Alfons system is another tool used by Synthesis to ensure the safety of its personnel and processes on the plant. Some of the elements of the Alfons system relate to hygiene on the plant, availability of first aid boxes and checking of their contents, availability and workability of safety equipments such as fire/gas alarms, fire extinguishers, and rescue equipments such as breathing apparatus (BA) and oxygen resuscitator. Other elements of the Alfons system pertain to the safety of personnel while working on the plant such as the inspection of scaffolds, and even the inspection of personnel safety wears while on the plant.

The Alfons system serves both as a preventive safety system by monitoring that personnel keep to safe working procedures, as well as a safety system which ensures that emergency situations may be adequately arrested by continually verifying that the

plant has in place reliable equipments that may be used in case of such emergencies, given the level of risks involved in the operations of a chemical plant.

Information gathering with the Alfons system is done through forms which the operations personnel are required to fill. Some of these forms are filled on a daily basis, while some are filled on a weekly, monthly or quarterly basis. After being filled and signed off by a responsible person on the shift, an Alfons form is also countersigned by the shift supervisor.

#### 4.3.2.2.1 Impact of Management Information

Monitoring of compliance to the Alfons system is done by a designated safety officer who keys in the data from the filled forms into an Alfons information system, and then produces graphs therefrom showing personnel compliance to various elements of the Alfons system.

One of such graphs is reproduced in Figure 4.2 below. The graph shows, between October and December 2006, the compliance of personnel to the Alfons system in S200 and S1400 (two of the sections that make up Synthesis).

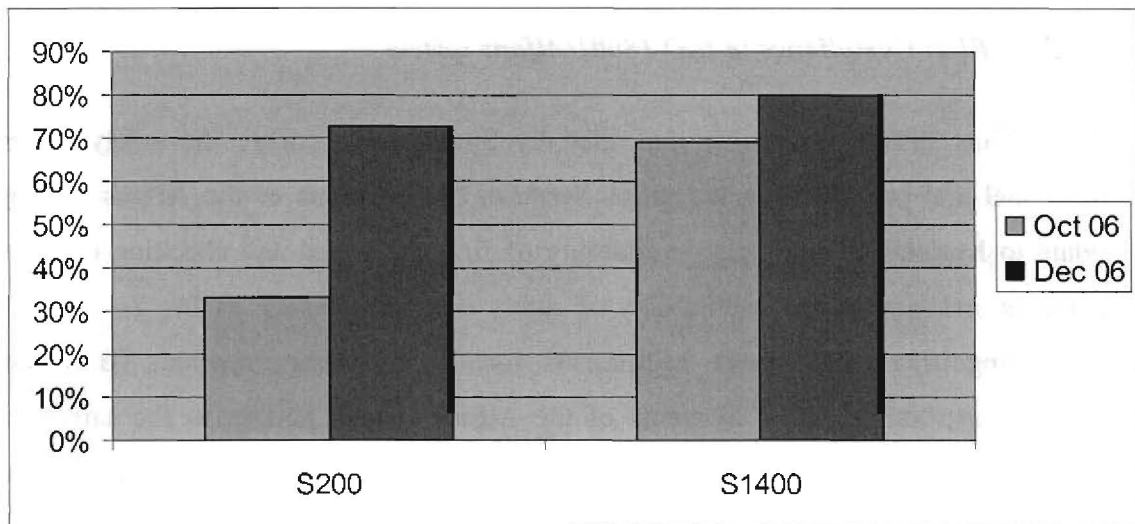


Figure 4.2: Compliance to Alfons System in Synthesis

As seen from the graph, there is an improvement in personnel's compliance both in sections 200 and 400 between the periods depicted on the graph. Again, action taken by management based on the information it has played a significant role in this improvement. After receiving a not-too-encouraging information on employee's

compliance, the management had decided to start checking the Alfons forms on an impromptu basis, and issued a memorandum to discipline any non-compliant employees. This had led to a significant improvement during the successive months.

#### ***4.3.2.3 KPI 3: Four safety observations per person per month***

Another KPI for which an information system has been built by the Synthesis management is the safety observation.

Management's philosophy for introducing this system is to imbibe a culture of safety in both the Synthesis employees and the contractors on the plant. Management believes that with the system, information may be gathered on the behavioural compliance of personnel to safety on the plant. Such information will be analysed and appropriate actions will be taken when a particular trend is noticed from the analysis. This, the management believes, will lead to higher performance in the area of safety.

One of the required fields to be filled while completing the safety observations form is the field which specifies the number of persons spoken to during the observation. This is strategic towards safety performance enhancement as it allows for the culprit in a particular instance to be enlightened on his/her failure to comply with the safety rule pertaining to his action(s) at that instance.

With this system, an operations personnel is required to make at least four safety observations in a month, and key in such in the safety observations application installed on the personal computer systems located in the various control rooms of the sections in Synthesis. A responsible personnel then analyses the information and report back to management on a weekly basis.

##### ***4.3.2.3.1 Impact of Management Information***

The objective of this research work is to determine how well the information gathered by management from this system has helped to improve the performance of the organization. To achieve this objective, a graph showing the average number of observations made per shift in Synthesis was obtained and reproduced below in Figure 4.3.

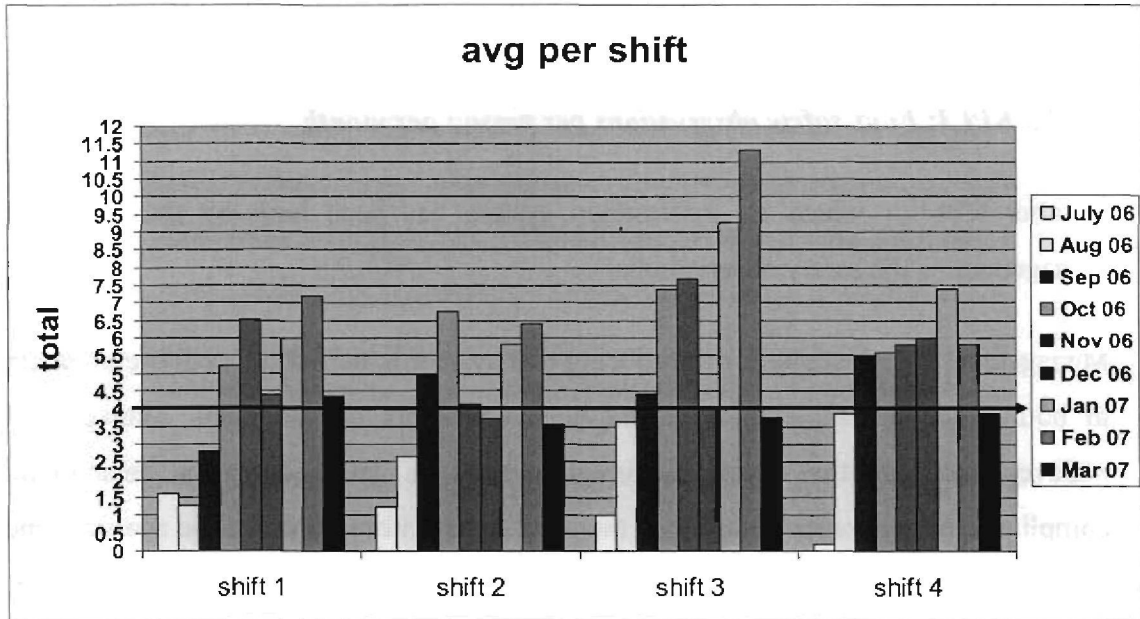


Figure 4.3: Average number of safety observations made per shift

The first three months, as seen in figure 4.3, reflects a below-average performance across the shifts. This is because the KPI was actually introduced in July 2006, and most employees are yet to be fully aware of it. The management got to know of this general low-level awareness through the monthly report made available to it.

In response, an awareness campaign was launched throughout the company whereby all employees and management were trained in the purpose and method of safety observations. Another strategy deployed by management is that it sets the searchlight on itself by compelling the management staff to also get involved in safety observations in order to lay a good example and motivate staff to participate. Lastly, a committee was set up to review the effectiveness of the observations and set a specific performance target to assure sustainability.

All these yielded fruits in the following months. February 2007 is of particular interest when there were shutdown activities on the plant which involved the use of many contract staff on the plant, which also indirectly leads to a high number of several observations.

Thus, the information available to management has been instrumental to the achievement of this KPI, and has thus impacted positively on the safety performance of the organization.

#### ***4.3.2.4 KPI 4: Housekeeping index targets (Dec 06: Level 3, June 07: Level 4)***

The management also sets for itself as a KPI the achievement of Level 4 in the Housekeeping Index. This is expected to be achieved by June 2007.

The concept of housekeeping monitoring entails an unarranged visit by a safety delegation to a plant with the purpose of ascertaining the level to which the plant complies with housekeeping regulations. Some of the elements of housekeeping include how organised the plant is in terms of putting the right tools in the right place, how tidy the plant looks, and how properly maintained the equipments on the plant are. Management believes that a plant with high level of housekeeping culture is less prone to safety incidents/accidents, and such plants will provide easy pathway for escape to personnel in cases of emergency.

Levels 1 to 5 have been defined as housekeeping index, with level 5 signifying the best housekeeping culture a plant could achieve in any area observed. Points are scored for each level attained by a plant. Since level 5 is the best that can be achieved, every plant strives to attain this level, and with high points.

The visit by safety delegation is usually done quarterly in Synthesis. After every visit, the safety delegation makes available the report of its findings on each plant to a responsible person who inputs such into the housekeeping application. An analysis of the data is done and the management is advised of such. It is this information (i.e. the trends and analysis from the report) that management uses as a basis for decision making towards the achievement of the KPI in question.

Figure 4.4 below graphically represents the housekeeping trend in Synthesis.

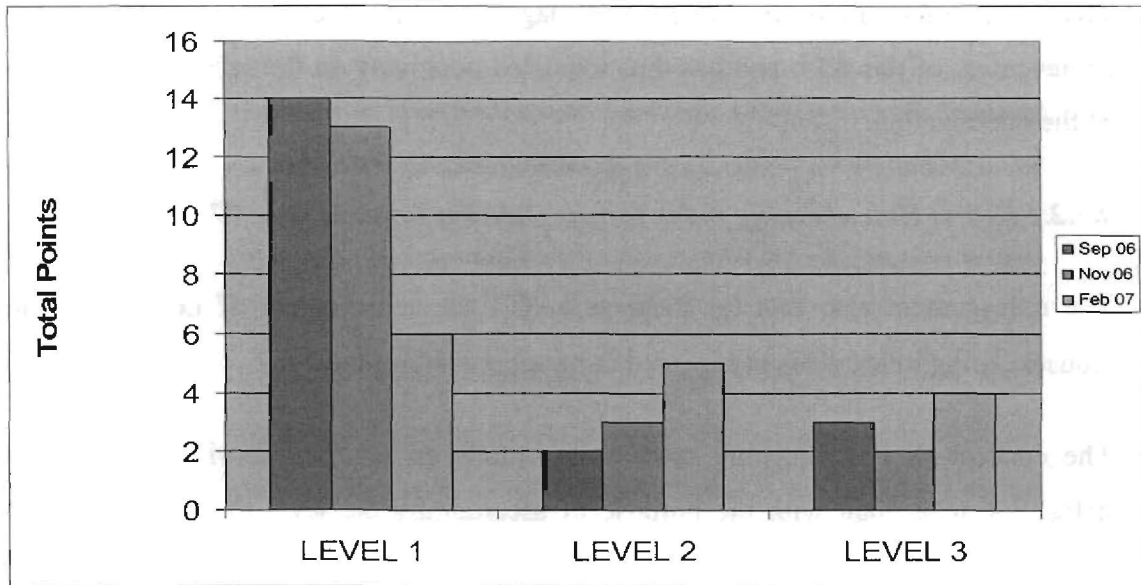


Figure 4.4: Housekeeping Index on ABC Plant

#### 4.3.2.4.1 Impact of Management Information

From figure 4.4, it shows that target of level 4 set by management was yet to be achieved by February 2007, four months to the end of the financial year. However, there seem to be an improvement over the six-month period depicted by the graph. The total number of Level 3 points earned increased from 3 in September 2006 to 4 in February 2007, while the Level 1 points reduced from 14 to 6 during the same period. This indicates an improvement on the housekeeping index since higher points are desirable in the higher levels, and lower points needed in the lower levels.

In spite of this, the question remains whether the information made available to management on housekeeping culture on the plants in Synthesis has in any way contributed to this improved performance of the organization. On a closer look, we see that management's action on the report it has on this KPI has indeed played a role in this improvement.

The norm in ABC Wax is that the safety bonus for employees is tied to the safety performance recorded in the year. The management incorporated housekeeping index as one of the factors used in arriving at the safety performance. By this, shift leaders were indirectly compelled to be stricter with the shift members with regards to housekeeping. The consequence of this is an improvement on the index as depicted in figure 4.4.

## ***4.4 KPA 2: Volume/Productivity***

No doubt, productivity is one area that goes a long way to determine the performance of an organization. According to Hoehn (2003) and Helo (2005), it is generally agreed that productivity represents one of the major areas reflecting the term performance, especially for an organization or a production unit. Little wonder then that the Synthesis unit of ABC Wax identified volume/productivity as one of its key performance areas (KPA's). As it relates to Synthesis, production volume may be defined as the quantity of the products (primarily wax) which are produced as measured in kilograms or pounds, while productivity refers to the relationship between production of an output (wax) and one, some, or all of the resource inputs used in producing the output.

### ***4.4.1 Generation and Analysis of Management Information***

#### ***4.4.1.1 Generation***

There are two major sources of information through which the Synthesis management get information that relates to volume/productivity. These are:

1. Operations Digital System (ODS) – This is a database application system through which the operations on the plant are captured real-time. The Distributed Control System (DCS), operated by a senior process controller on a shift, acts as the front-end for the ODS. Being a chemical plant where the operating conditions are far above the normal room temperature and pressure, there is a need to continuously monitor the conditions of the plant in order to primarily ensure the safety of the plant personnel. Also, parameters such as flows, temperatures, pressures and volumes of input and output products need to be measured real-time. All of these can only efficiently be done through instrumentation, and this is what obtains on the Synthesis plants.

Signals are relayed from the various instruments installed at different parts of the plant to a control center and this is then displayed on the DCS. Through the DCS, the DCS operator is able to monitor and manipulate the operating conditions of the plant.

The information that may be retrieved from the DCS is quiet vast. The information displayed on the DCS are also stored on the ODS but this is not visible to the

operator. An engineer regularly pulls data from the ODS, analyses it, and reports back to management.

2. Daily Log Sheet – All the plants in Synthesis run a 12-hour shift. At the end of a shift and before a shift hand-over (which involves intimating the incoming shift members with the present conditions of the plant), each shift is mandated to log, in a prepared template, the major activities that have happened during the 12-hour shift period. This is usually done by the most senior person on the shift and sent to the shift supervisor, who makes it available to the management.

#### ***4.4.1.2 Analysis***

To a large extent, the reliability of the information retrieved from the ODS and DCS is very high due to the non-existence of the human factor in the data recordings. Also, the risk of error during data transfer is reduced since the data is usually retrieved by designated personnel directly from the system.

Data in daily log sheets may not be completely free of error due to the human factor during recordings.

However, it is noteworthy that the management only uses the daily log sheets as a backup or corroborating information source, rather than being the primary source.

#### ***4.4.2 Key Performance Indicators (KPIs)***

With the introduction and analysis of the two major sources of information for Synthesis regarding volume, one can now examine how the information made available to management has helped in achieving the KPIs defined for this area.

The following KPIs are defined by ABC Wax Synthesis in its strategic objectives document for financial year 2006-7 for the Volume/Productivity KPA.

- 200000 tons of wax from Synthesis
- Zero process related trips on all reactors
- Utilise all available gas at all times
- Ensure optimum operating conditions on reactors for maximum yield

#### ***4.4.2.1 KPI 1: 200000 tons of wax per annum from Synthesis***

As stated earlier, all other ABC Wax business units are dependent on Synthesis business unit because wax, which is the main business of ABC Wax, is produced in Synthesis. The production volume, therefore, is of essence not only to the Synthesis business unit, but to all other business units as well.

With the ODS, the Synthesis management is able to monitor, on a daily basis, the volume of wax produced both from the Slurry Bed Process (S200) and the Fixed Bed Unit (S1400). The result is then compared with the goal set for this KPI.

As this KPI, i.e. the amount of wax produced, is one of the first line indicators through which performance improvement may be determined, the management views seriously any issue at all that may stand in the way of achieving the predetermined amount. For example, during his routine morning plant visits, one of the first things the production manager asks the senior process controller (SPC) on shift is how many tons of wax produced.

However, the amount of wax produced is not as simple as it seems. This is because of its dependency on so many factors which may vary from the availability of the desired amount of inputs such as Natural gas and Catalyst, to the well-being of the reactor where the reaction takes place or even to the availability of utilities such as steam.

##### ***4.4.2.1.1 Impact of Management Information***

Despite all the challenges enumerated in the last paragraph, the management strives to ensure that the KPI is achieved. It (the management) relies heavily on the data from the ODS to keep tab on the amount of wax produced.

Any volume deviations from the goal are further analysed. Part of the analysis usually include verifying, also from data extracted from the ODS, the amount of inputs, for example Natural Gas, that led to the production of the said volume as the production engineers have an idea of what amount of wax should be produced from a particular amount of Natural gas. If there are no issues with this, the analysis is taken to another level. The production engineers may then focus on another input material like catalyst and do a thorough analysis on it.

The data in Table 4.1 below is used to illustrate this. The data in the table is extracted from the ODS. The table shows the amount of products produced daily in the month of January, 2007. This kind of tables provides the management with first hand information on the performance of the plant as it relates to production volume. With this, the management is able to know whether the plant is still on track toward the achievement of the management's objectives regarding volume.

The data in Table 4.1 presents an interesting analysis to management. For instance, on 11<sup>th</sup> January, 2007, only 126 tons of wax was produced. The four preceding days saw a production of 181.8, 164.8, 191 and 183.2 tons of wax respectively. Ordinarily this should be of concern to the management since 126 tons represents a significant deviation from the productions recorded in at least the four preceding days. However, a closer look at the data in the table provides succor to the management. The total feed gas for the 11<sup>th</sup> of January is 1296, a relatively low amount compared to the total feed gas used during the preceding days. As explained earlier, what ABC Wax does is to convert synthesis gas to wax, and as such the amount of synthesis gas fed in to the process is a major factor in determining the amount of wax produced.

Since there are other factors, apart from the total feed gas input, that determine the amount of wax produced, the information in Table 4.1 (extracted from the ODS) helps in streamlining the possible causes of the low production of wax recorded on the 11<sup>th</sup> January. Thus, with the information available via the ODS, the management is able to direct performance improvement efforts toward the right channel; in this case, to determine the cause of reduction in the total feed gas for the particular day in question.

With the source of the problem determined, the ABC Wax management is able to rectify the situation and, as is evident from Table 4.1, the amount of wax produced generally increased for the rest of the month. This shows an improvement in performance of the organization due to the prompt action of its management to information available to it.

It is noteworthy that most of the data used for the analysis is extracted from the ODS which records the activity on the plant real-time into a database.

Table 4.1 Daily Wax Productions in Section 200

Date	WAX ton/day (excl wpp)	HOT COND ton/day	COLD COND ton/day	REACT WATER ton/day	TOTAL HC produced ton/day	TOTAL HC Yield	Total feed gas	D203 Pressure	Fresh Gas
7-Jan-07	183.2	63	37	312	284	0.53	1479	6990	533
8-Jan-07	191.0	61	34	298	285	0.57	1457	7006	504
9-Jan-07	164.8	57	33	292	255	0.51	1459	7015	499
10-Jan-07	181.8	64	36	309	281	0.61	1436	6899	461
11-Jan-07	126.0	47	32	223	204	0.63	1296	6738	323
12-Jan-07	181.0	62	40	309	283	0.63	1431	6955	449
13-Jan-07	157.2	58	35	307	250	0.54	1416	6909	464
14-Jan-07	199.3	68	37	336	304	0.63	1457	6907	480
15-Jan-07	165.7	67	37	331	270	0.60	1436	6903	452
16-Jan-07	200.3	68	36	341	304	0.62	1449	6947	487
17-Jan-07	179.6	63	35	335	278	0.56	1448	6934	501
18-Jan-07	198.2	69	36	352	304	0.61	1452	6952	497
19-Jan-07	175.4	71	39	333	286	0.62	1305	7017	461
20-Jan-07	208.9	72	39	344	320	0.66	1319	7028	482
21-Jan-07	197.8	65	38	355	301	0.59	1412	7000	508
22-Jan-07	188.8	70	35	357	293	0.58	1463	6960	506
23-Jan-07	208.5	75	36	377	319	0.61	1468	6914	523
24-Jan-07	195.7	74	36	353	306	0.66	1475	6910	461
25-Jan-07	158.0	62	35	294	255	0.64	1334	6736	397
26-Jan-07	187.9	71	33	330	292	0.63	1452	6826	465
27-Jan-07	185.6	72	37	334	294	0.67	1464	6851	438
28-Jan-07	174.8	71	35	338	281	0.62	1468	6833	451
29-Jan-07	198.6	73	33	351	305	0.67	1462	6879	452
30-Jan-07	188.8	72	35	347	296	0.65	1445	6903	455
31-Jan-07	175.7	72	35	350	283	0.62	1449	6875	453

#### 4.4.2.2 KPI 2: Zero process-related trips on all reactors

Reactors are vessels where chemical reactions occur between several input components and an output product is made. In ABC Wax synthesis, there are various reactors. Some are used for the production of intermediate products while some are for the production of final products.

Trips, on the other hand, are situations where there is a deviation to the normal operations of the plant due to a fault. The fault could be as a result of temporary stoppage of an input to the production system, such as Natural Gas, which is required to be in constant supply, or as a result of defective critical machinery on the plant. The fault may also be process-related.

Process-related trips are trips caused by abnormal process conditions such as temperature run-aways, undue high pressures, or high levels in fluid-holding vessels or reactors.

#### ***4.4.2.2.1 Impact of Management Information***

The state of the plant is normally monitored and controlled real-time through the DCS by a trained personnel. With the DCS, the trained personnel is able to keep watch on the conditions of the plant's processes.

With the information pulled out of the DCS over time, the management is able to come up with the appropriate limits within which the plant may be run without experiencing any process-related trips. This came about after rigorous study of the causes of process-related trips on the plant.

The impact of management information regarding this KPI is discussed below along with that on the next KPI.

#### ***4.4.2.3 KPI 3: Utilise all available Gas at all times***

Both of the two sections - Fixedbed and Slurrybed – that form Synthesis unit get their gas intake from the Auto Thermal Reformer (ATR) plant. Usually, the management of both plants i.e. ATR and Synthesis agree on the volume or amount of gas to be supplied by ATR. This agreement will be binding until there is a planned shutdown for maintenance of either plant. The plants are then said to be offline. However, in-between planned shutdowns, the ATR plant consistently supplies Synthesis with the agreed volume of gas. It is now left with Synthesis what it does with the supplied gas as ATR not only prepares a bill based on the agreed amount of gas supplied but are also paid upfront.

Given this scenario, it only makes business sense for Synthesis to utilise all the available gas toward the production of its own output products. However, this is not just as simple as it sounds as the plant may trip due to many reasons which invariably will lead to the plant being offline. While offline, the plant will not be able to utilise the gas supplied from ATR for production purposes. As the gas will still continued to be supplied as agreed by both management, it (the gas) ends up being *flared* by the Synthesis plant. Flaring, as used in the chemical plants, means directing gas to a flame where the gas will get burnt off. Normally, the idea of flaring is to ease or maintain the pressure in the system. It is not a desirable thing to do as it implies wasting an

expensive resource. However, it is a built-in sub-system used to relief the system from being over-pressured.

The other option for Synthesis, while its plant is offline and it cannot make use of the gas supplied by ATR for production purposes, is to inform the shift coordinator (who coordinates the interrelationship between processes of the different plants) of the situation. The shift coordinator may then inform ATR to cut back on the gas supply or another plant may be 'forced' to increase its gas intake.

Either option translates to loss of revenue to Synthesis as it has paid in advance for the gas supply from ATR.

#### ***4.4.2.3.1 Impact of Management Information***

To prevent the avoidable loss of revenue through flaring, the Synthesis management puts a system in place which will constantly monitor the amount of gas being flared.

One way this has been done is by having an electronic tag on each of the flare lines. Each tag communicates with the ODS. With this design, the amount of gas flared within a period of time is easily determined. This information is very important to the management since the amount of gas flared is not dependent only on the deliberate action of the DCS operator. The system has been designed such that the flare system will open to prevent overpressure in the system or to maintain a safe operating condition in the system. So, by having information about the amount of gas flared, and comparing it with the other operating process parameters as well as tasks performed by outside operators during the same period, the management is able to determine optimum operating conditions for the plant which will lead to minimal or zero flaring.

One of the process-related reasons for cutting back on the gas intake is if the reactor level goes too high. As explained earlier, the reactor is where reactions between various inputs – gas, catalyst, e.t.c. - into the system take place. The raw final product - wax - is produced in the reactor as a result of these reactions. As the process is continuous, there is a need to constantly take away the products being produced in the

reactor in order to create space for the production of more products. Otherwise, the reactor level will be 100% full, and the system will be overpressurised.

In turn, there may be many factors responsible for the high reactor level. There are many consequences as well; and some of them may ultimately lead to a plant trip. Of the factors that may lead to a high reactor level is a blockage on any of the paths through which the wax is removed from the reactor.

Since the reactor level has a direct consequence on the gas supply, the management deemed it necessary to continually monitor it. This is done both through the DCS by an operator, as well as through the ODS. After thorough analysis of this information, the Synthesis management is able to come up with a strategy, which includes, but not limited to, standing instructions to DCS operators, on what to do in the event of high level in the reactor, without having to cut back on the gas supply from ATR.

**Table 4.2a Total Gas flow and Reactor Level**

Date/Time	Total feed gas flow	Reactor level	Reactor Pressure	Reactor Temperature
13-FEB-07 09:00:00	0.0	68.3	103.6	49.7
13-FEB-07 10:00:00	0.0	68.3	103.0	49.0
13-FEB-07 11:00:00	0.0	68.3	103.0	40.9
13-FEB-07 12:00:00	0.0	68.3	102.9	39.8
13-FEB-07 13:00:00	0.0	68.3	101.5	44.3
13-FEB-07 14:00:00	0.0	68.3	101.3	45.9
13-FEB-07 15:00:00	0.0	68.3	101.1	47.7
13-FEB-07 16:00:00	0.0	68.3	100.3	50.9
13-FEB-07 17:00:00	0.0	68.3	100.5	53.2
13-FEB-07 18:00:00	0.0	67.7	101.4	54.7
13-FEB-07 19:00:00	0.0	67.9	103.0	56.1
13-FEB-07 20:00:00	0.0	68.3	103.3	54.4
13-FEB-07 21:00:00	0.0	68.3	103.4	52.7
13-FEB-07 22:00:00	0.0	68.3	103.5	52.5
13-FEB-07 23:00:00	0.0	68.3	103.7	52.1
14-FEB-07 00:00:00	0.0	68.3	104.0	51.5
14-FEB-07 01:00:00	0.0	68.3	104.4	50.8
14-FEB-07 02:00:00	0.0	68.3	104.6	50.4
14-FEB-07 03:00:00	0.0	68.3	104.4	50.1
14-FEB-07 04:00:00	0.0	68.3	104.7	50.0
14-FEB-07 05:00:00	0.0	68.3	104.8	49.7
14-FEB-07 06:00:00	0.0	68.3	104.5	49.4
14-FEB-07 07:00:00	0.0	68.3	104.1	49.2
14-FEB-07 08:00:00	0.0	68.3	103.6	49.3
14-FEB-07 09:00:00	0.0	68.3	103.2	50.5
14-FEB-07 10:00:00	0.0	68.3	102.4	51.7
14-FEB-07 11:00:00	0.0	68.3	101.8	53.1
14-FEB-07 12:00:00	0.0	68.3	101.9	53.4
14-FEB-07 13:00:00	0.0	68.3	100.7	54.2
14-FEB-07 14:00:00	0.0	68.3	100.2	55.8
14-FEB-07 15:00:00	0.0	68.3	100.4	57.9
14-FEB-07 16:00:00	0.0	68.3	99.8	61.0

**Table 4.2b Total Gas flow and Reactor Level**

Date/Time	Total feed gas flow	Reactor level	Reactor Pressure	Reactor Temperature
08-APR-07 19:00:00	940,646.9	60.2	7,354.8	841.1
08-APR-07 20:00:00	946,087.6	60.3	7,267.6	839.2
08-APR-07 21:00:00	949,247.9	60.5	7,220.5	839.8
08-APR-07 22:00:00	947,200.6	60.5	7,216.9	840.2
08-APR-07 23:00:00	947,676.0	60.6	7,219.9	840.3
09-APR-07 00:00:00	947,228.6	60.4	7,215.4	840.1
09-APR-07 01:00:00	947,539.6	60.4	7,217.2	840.2
09-APR-07 02:00:00	946,774.1	60.5	7,218.8	839.9
09-APR-07 03:00:00	946,780.3	60.5	7,215.1	839.9
09-APR-07 04:00:00	944,924.0	60.5	7,202.4	839.9
09-APR-07 05:00:00	945,402.5	60.8	7,198.2	840.1
09-APR-07 06:00:00	945,147.1	61.1	7,196.4	840.5
09-APR-07 07:00:00	948,769.1	61.1	7,247.9	840.6
09-APR-07 08:00:00	948,354.5	61.1	7,242.8	839.9
09-APR-07 09:00:00	947,020.6	61.0	7,236.3	840.0
09-APR-07 10:00:00	944,150.7	61.0	7,240.5	839.8
09-APR-07 11:00:00	941,687.7	60.7	7,238.1	839.8
09-APR-07 12:00:00	943,200.3	60.8	7,242.5	840.4
09-APR-07 13:00:00	944,555.5	60.8	7,236.8	839.9
09-APR-07 14:00:00	943,748.2	60.8	7,243.0	839.8
09-APR-07 15:00:00	943,712.0	60.8	7,233.6	840.3
09-APR-07 16:00:00	943,965.6	61.1	7,236.9	840.3
09-APR-07 17:00:00	944,165.8	61.4	7,237.7	840.1
09-APR-07 18:00:00	943,903.6	61.0	7,236.4	839.6
09-APR-07 19:00:00	944,331.6	61.0	7,225.0	839.9
09-APR-07 20:00:00	943,897.5	60.8	7,217.4	839.8
09-APR-07 21:00:00	947,055.2	61.1	7,216.4	840.3
09-APR-07 22:00:00	947,635.9	61.4	7,219.9	840.3
09-APR-07 23:00:00	945,735.0	60.9	7,243.3	839.7
10-APR-07 00:00:00	944,700.9	60.8	7,231.3	839.7

Tables 4.2a and 4.2b show the relationship between the total gas intake into the system and the reactor level. The data in Table 4.2a was captured by the ODS when the plant was offline. This is evidenced by the zero values under the ‘Total Feed Gas Flow’ column. It means that there was no gas flow during the time monitored. Actually, this was during a plant shutdown i.e. when the plant was shutdown for maintenance. Worthy of note during this period is also the ‘Reactor Level’ column. All the values under this column show 68.3.

Table 4.2b however shows the data captured by the ODS when the plant is online. As can be seen from the table, the reactor level was 60.2 at 19H00 on the 8<sup>th</sup> of April and the level was kept in this range throughout the period shown, with the highest level in the reactor during the period being 61.1.

Summarily, the management, through the information retrieved from the ODS is able to put plans in place to ensure that all available gas is utilised at all times. This KPI is

closely related to the one last discussed above i.e. Zero process-related trips on all reactors, as one of the objectives of this KPI is to prevent trips on the trips which advertently leads to underutilisation of the supplied gas. To underscore the management's performance in this area, the number of trips between September 2005 and March 2007 is analysed.

**Table 4.3 Causes of Trips/Shutdowns in Synthesis**

s/n	Date	Trip/Shutdown	Cause	Process-Related?
1	12-Sep-05	J201D tripped at 23:00; could not start up straight away again due to fault on card and leaking water pipe	Power failure in factory	No
2	22-Sep-05	Plant shutdown; Reactor Pressure decreases to 10 bar. Start-up immediately again	BFW pump failure at Power station	No
3	13-Oct-05	Plant trip	Electrical fault on J201D Compressor	No
4	15-Oct-05	Plant trip	Electrical fault on J201D Compressor	No
5	19-Oct-05	09:05 J201D trip; 12:39 Started picking up gas again	Electrical fault on J201D Compressor	No
6	20-Oct-05	Plant offline; started taking in gas at 07:00	ATR tripped	No
7	2-Nov-05	Plant trip; ATR trip cut gas to 60000 for only couple of hours	ATR tripped	No
8	22-Nov-05	Decommissioned S200 for work on J201D	Maintenance	No
9	1-Dec-05	Shutdown	Quench Tower Flooding	No
10	8-Apr-06	Shutdown	Quench	No

			Tower Flooding	
11	3-Jul-06	Shutdown	Quench Tower Flooding	No
12	9-Aug-06	Shutdown	Maintenance	No
13	9-Oct-06	Shutdown	Maintenance	No
14	21-Mar-07	J201D tripped at 15H16	Electrical fault on J201D Compressor	No
15	21-Mar-07	Later at 20H40 the plant tripped again due to low boiler feed (BFW) water in the steam drum	Low level in BFW drum	Yes

From Table 4.3 above, as well as Figure 4.5 below, it can be seen that process-related trip/shutdown i.e. trips that were caused by error or incompetence or oversight on the part of trained personnel, is almost zero. Within a period of almost two years, the percentage of process-related trips on the plant is only 1/15 or 6.67%. Going by this, the Synthesis management has been able to curtail the major factor, from among those within its powers, which contributes to the non-utilisation of available gas at all times. This achievement has largely been made possible with the information captured through the ODS and made available to the management.

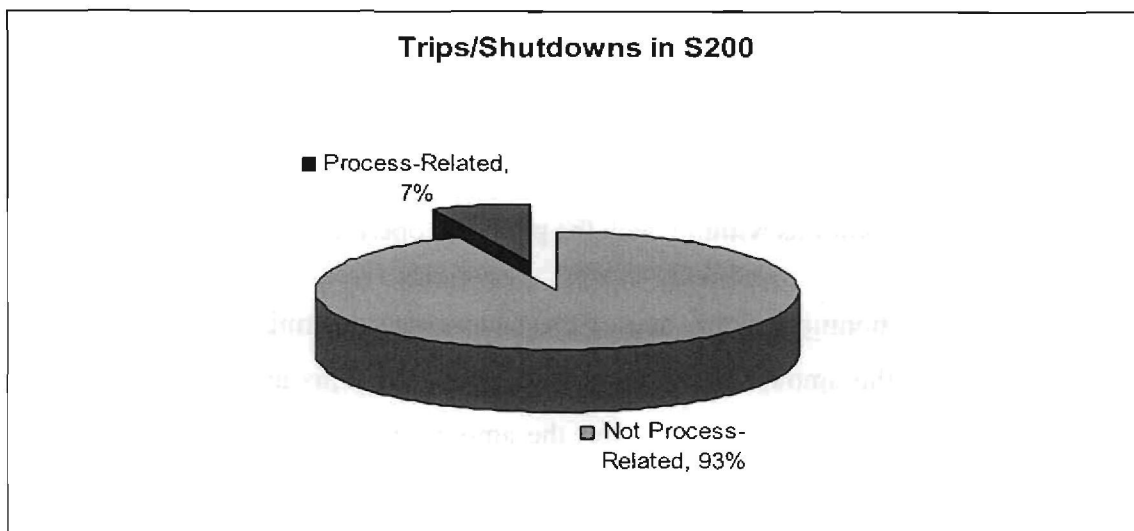


Fig 4.5 Trips/Shutdowns in Section 200

#### ***4.4.2.4 KPI 4: Ensure optimum operating conditions on reactors for maximum yield***

In section 200 of the Synthesis plants, there are basically two reactors used in the production of wax. In the first reactor, the catalyst from section 4200 is reconditioned before its transfer into the main reactor. In the main reactor, the reconditioned catalyst reacts with other inputs to produce the final products.

To obtain maximum yield of the final products, there is a need to ensure that the operating conditions in both reactors are at their optimum. Again, the Synthesis management makes use of the ODS to achieve this objective/KPI.

##### ***4.4.2.4.1 Impact of Management Information***

Various teams are set up by management to analyse the data obtained from the ODS. Usually, these teams are composed of personnel who have the technical expertise in the field. Reports of such analysis are then made available to the management, and it is on these reports that management makes decision regarding the affairs of the plant.

One of the functions of these teams is to determine which data needs to be analysed from the sea of data normally retrieved from the ODS. This task saves the management the rigour of having to sieve through the enormous amount of data from the ODS.

As it relates to achieving optimum operating conditions on the reactors, about three teams are involved. These are Research and Development (R & D) team, Operations and Profitability (OPR) team and the Productions team. These teams meet once in a week to determine the variables that needed to be analysed from the ODS in order to realise the best conditions within which the plant can operate.

For the preconditioning reactor, one of the factors that determine the quality of its final product is the amount of reaction water produced. This amount is continually monitored through the ODS. The higher the amount of reaction water produced the better. All of these have been arrived at through a series of laboratory tests and simulations.

With the data from the ODS, the teams are able to see the products' yields from the reactors under particular conditions. From their technical experience and expertise, the teams then decide on which operating variable needed to be altered to achieve optimal products yield.

However, altering the operating conditions on the reactors is not just as simple. To do this, the laboratory team is also incorporated. Usually, samples are taken from the reactor and put in a microreactor at the laboratory. The operating conditions in the microreactor will be the new or desired conditions to be operated in the life reactors. Results from such research are used to eventually arrive at the optimal operating conditions for the reactor, and the management is so advised.

Thus, with the aid of the data retrieved from the ODS, the operating conditions in the reactors are monitored and regularly optimised. After receiving the report of the research from the technical teams, the Synthesis management regularly issues a document to the production personnel on a weekly basis. This document is known as the *standing instruction*.

The *standing instruction* contains information regarding the conditions within which the plant must be operated in a week. In the document, limits are given for each of the variables that may be controlled by the DCS operator. Such variables include pressures or levels in the reactors or other vessels, rate of flow of gas along pipelines or temperatures of fluids that must be maintained either in vessels or along pipelines.

The management continues to do this on a weekly basis based on recommendations from the technical team. The essence of the weekly basis is to continue to operate the reactors, and indeed the plant, at optimum conditions, since the composition of any or all of the various inputs into the system (the regulation of which are beyond the powers of the Synthesis management) may change; and this change may lead to a disruption in the operating conditions on the plant which then results in the plant being run at a sub-optimal level. A good example of this is a change in the chemical composition of the natural gas and/or catalyst which are/is a vital input(s) to the system. Although there is an acceptable range within which any of the input may be accepted, there is the need to determine the conditions at which the input(s) may produce the best output in terms of quality and quantity, even within that range.

### ***4.5 KPA 3: Leadership and People Development***

Effective leadership is key to the optimal performance of any organization. The continuing success of an organization is shaped and influenced by the knowledge, skills and personal attributes of its leaders in every sphere of its operations. The better the quality of its talent, the greater an organization's abilities to benefit from current and future opportunities to improve and grow its businesses.

Without people development, no organization can maintain its competitiveness in the market place. This is so since the workforce is the resource that makes things happen in the workplace. Most times, the performance of an organization has a direct linkage to the quality of its workforce. Besides, there is the issue of succession which a serious-minded organization would not tinker with, for the sake of continuity.

To demonstrate its commitment to the development of its people, ABC wax plant included leadership and people development as one of its key performance area.

#### ***4.5.1 Generation and Analysis of Management Information***

##### ***4.5.1.1 Generation***

To achieve the KPIs set in this area, the management obtains information from the following sources for decision making:

1. Operational Training Department: This department is set up to see to the training needs and development of personnel of ABC Wax. Although it does not have specialised software, it makes use of Spreadsheets and Word documents to capture and monitor the progress of staff training development, and regularly reports back to the management on same. The training department is also responsible for the update of plant modules, which is a write-up which explains the operations of the plant. The modules are to be updated regularly, especially when there is a modification on the plant.
2. The HR department gives feedback to the management regarding the personal development of each employee. It keeps documents where the yearly/quarterly goals of an employee are set out, and regularly updates such as the year rolls by. It works in tandem with the operational training

department to update employee files on their operational targets achieved on a quarterly basis.

#### ***4.5.1.2 Analysis***

It is noteworthy that both sources of management information in this area are not computerised. This fact may have a far-reaching impact on the performance of the organization, chief of which may be on data availability and timeliness.

Even though there was no evidence that such was the case as at the time of this research work, probably either due to the sizable number of employees in the organization or the efficiency of the personnel in both the operations and the HR department, there still exists the possibility that information availability and timeliness may become an issue sooner than later if the system for generating management information in this area is not computerised.

There is also the issue of information not reaching either the training or HR departments in good time, which invariably also adds to the time lag before the analysis of such information is presented to management.

Regarding data integrity and quality, there is much still to be desired since management completely relies on the information given to it by the designated personnel, which he also got from shift supervisors. Such information is open to error and manipulation.

Lastly, there is the likelihood that the management may not have been acting based on optimal information resource. This is also attributable to the fact that the designated personnel may only be able to derive a relatively non-complex trends or graphs from information available to him, and thus advise the management accordingly. However, with an information system, several simple and complex trends may be derived which definitely will offer a more robust information resource to the management. This will afford the management the opportunity to look at issues that may arise from this area from a holistic point of view.

#### ***4.5.2 Key Performance Indicators (KPIs)***

The following are the KPIs defined for the leadership and people development area.

- Plant training competency level of minimum 75% for personnel
- Quality and active performance agreements and personal development plans (PDPs) for every employee

##### ***4.5.2.1 KPI 1: Plant training competency level of minimum 75% for personnel***

New recruits as well as old hands are continuously trained and tested to determine their level of competency at ABC.

For a beginner, he is first made to undergo classroom training where he is introduced to the theory of operations of the equipments on the plant. He is then allocated to a shift where he will be learning the live plant under the supervision of a superior. As he spends time on the plant, the newcomer will be practically tested on some tasks which are of routine nature. The idea is to determine its competency and independence regarding the carrying out of these tasks.

On successful completion of the tasks, the newcomer will write a theoretical test to demonstrate his understanding of the operations of the section of the plant where he has been undertaking his training.

Lastly, the trainee is made to face a panel where he will demonstrate both his theoretical and practical understanding of the section of the plant where he works. This stage is the toughest and most critical as its successful completion puts a seal on the competency of the trainee, and his ability to work independently at that section of the plant. Due to the criticality of this stage, it is a requirement that a shift supervisor and at least one senior process controller (SPC) be members of the panel.

At ABC, for an employee to be 100% competent, he has to be successful both in the written and panel tests in three areas which are:

- Structure Area
- Towers Area



#### 4.5.2.1.1 Impact of Management Information

What was observed regarding the effectiveness of management information toward the achievement of this KPI has little or nothing to do with either the quality or integrity of the data made available to the management. Rather it has much to do with the decision or action taken by the management after the information is made available to it.

As can be seen from table 4.4, an overall average of 78.51% was achieved for the KPI (which is more than the 75% target), but a critical look into the table as well as information gathered during the research work do not point to the fact that the above-average score may be credited to the actions taken by the management as a result of the information it has. Instead, the achievement seems more as a result of decision of the employees to progress in their own personal development, at their own pace!

A quick look at Table 4.4 shows that three out of the four shift supervisors are yet to complete their competencies. Indeed two of them (shift 3 and shift 4) still have zero percent, meaning that they are yet to commence their competency tests! According to the operational training department coordinator, the three shift supervisors were actually brought in from another section (section 1400) under ABC Wax, hence their low competency rating. What could however not be explained is the fact that none of them has been a supervisor for less than a year, in fact two of them have been supervisors for more than two years. The situation is as depicted in Figure 4.6 below.

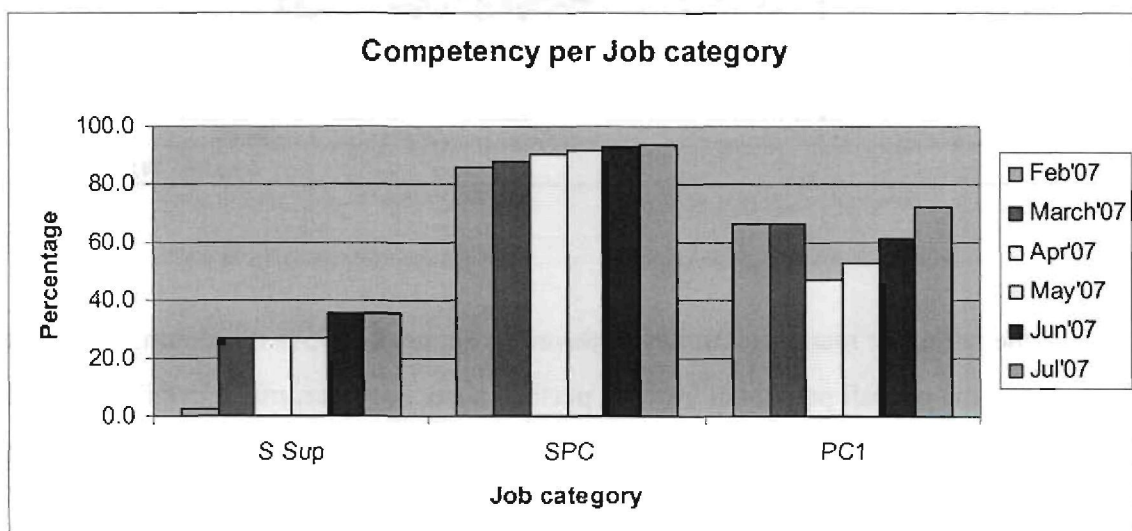


Figure 4.6 Competency in S200 per job category

The same trend is noticed in the other two job categories. Three SPCs are still to complete their competencies, yet according to the training coordinator, even though they were also brought from some other plants, they have spent more than average of two years on the plant.

In conclusion, one sees a lapse on the part of management making a deliberate attempt towards ensuring that the goal set for this KPI is met, even though the information about the state of things is available to it.

#### ***4.5.2.2 KPI 2: Quality and active performance agreements and personal development plans (PDPs) for every employee***

The activation of quality personal development programme for every employ is another performance indicator in the leadership and people development area. By this, employees are required to sit with their supervisors/mentors at the beginning of the year to agree a set of goals which they must achieve before the end of the year.

ABC being a production organization, much emphasis is placed on the operation goals agreed by employees and their mentors. Since this aspect is one of the primary functions of the operational training department, the HR department which is responsible for this KPI, works alongside the former to update employee progress on operational goals.

However, the PDP for an employee involves more than the operational goals. Plans for the year are made in other areas such as medicals, safety retraining, fire-fighting retraining, Personal Computer usage course, e.t.c.

After the agreement between the employee and his mentor, the documentation of the agreement is kept with the HR department. On a quarterly basis, the agreement is again reviewed both by the employee and his mentor to assess how close the employee is to the achievement of his set goals for the year. Again, the review documentation is submitted to HR department which is then used to update the initial agreement/plan.

What the management intends with this system is firstly to ascertain the level of compliance of employees and mentors to the PDP, and secondly to monitor the

development of each employee. The management intends to achieve these aims by reviewing each employee PDP at the end of the year.

To underscore its seriousness regarding the PDP, a document (Appendix 1) on remedial actions to be taken on non-compliance and/or poor performance of trainees has also been developed by the HR department to guide the management in decision taking on employees.

Figures 4.7 and 4.8 below show how the ABC employees fared in the achievement of the operational goals set in the beginning of the year.

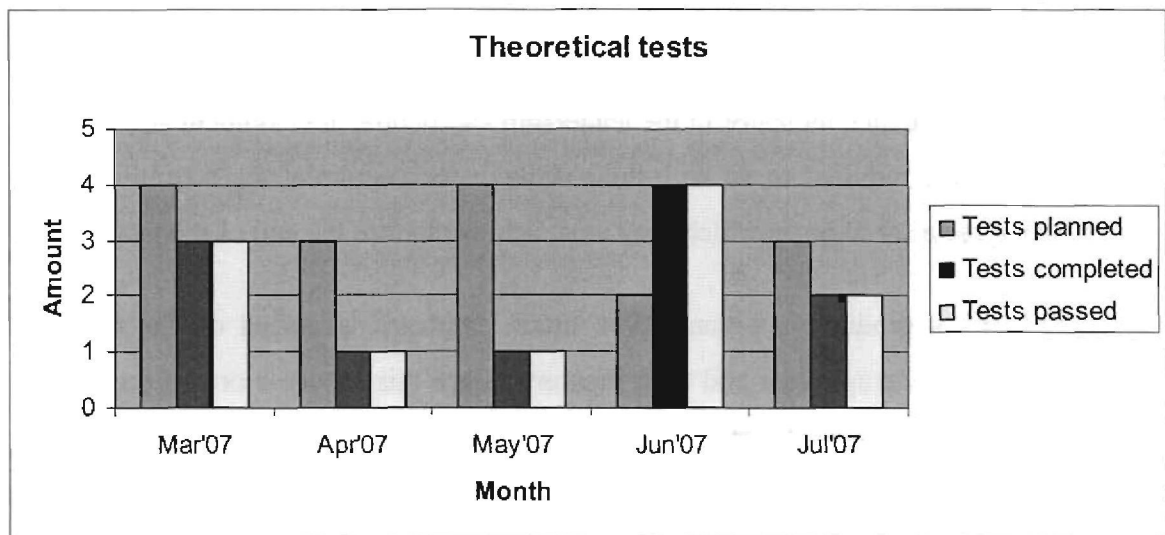


Figure 4.7 PDP progress on Theoretical tests

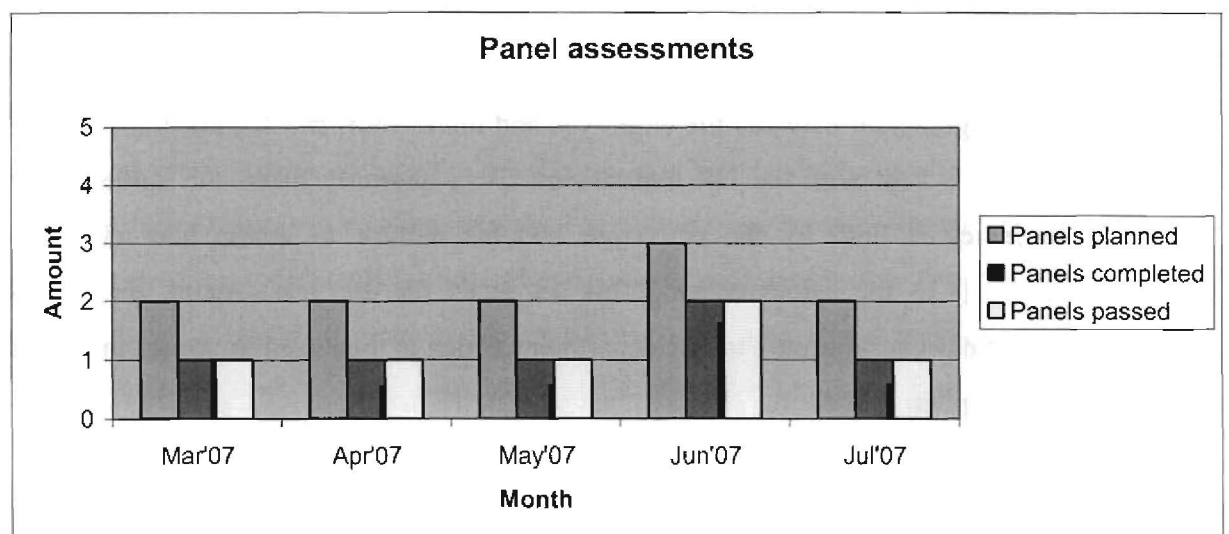


Figure 4.8 PDP progress on Panel tests

#### ***4.5.2.2.1 Impact of Management Information***

What one sees here is a similar trend as observed in KPA 1 discussed above. Just like in the latter, it does not look as if the ABC management has put to any or much use the information available to it in order to reverse the negative trend as observed in Figure 4.7 and 4.8 over a period of five months.

Since the system for providing management information as regards this KPI is also not computerised, the information made available to management is also prone to the same kind of defects as discussed in KPI 1 above.

#### ***4.6 KPA 4: Cost***

In many companies, the familiar cry "everything here is viewed in terms of the bottom line!" can be heard. In this sort of corporate environment, financial indicators remain the fundamental management tool and could be said to reflect the capital market's obsession with profitability as almost the sole indicator of corporate performance.

Opponents of this approach suggest that it encourages management to take a number of actions which focus on the short term at the expense of investing for the long term. It results in such action as cutting back on R & D (research and development) revenue expenditure in an effort to minimise the impact on the costs side of the current year's P & L (profit and loss), or calling for information on profits at too frequent intervals so as to be sure that targets are being met, both of which actions might actually jeopardise the company's overall performance rather than improve it.

In any case, none of the two parties deny the importance of financial indicators in the measurement of an organization performance. The bone of contention is whether it should be used as the sole indicator.

Like most organizations, ABC wax plant also includes cost issues as one of its key performance areas.

#### ***4.6.1 Generation and Analysis of Management Information***

##### ***4.6.1.1 Generation***

To arrive at the unit cost of production, information on costs expended on all the resources that went into the production of wax is needed. For some of this information, ABC wax plant has information systems through which the information is captured, while for others they rely on other plants to source the information.

For instance, volume of wax produced is monitored through the ODS which gives a real-time account of wax production. The same applies to the yield which is also monitored through the ODS. As for unit cost, information from other sources is needed in order to arrive at its final value.

To determine the unit cost, a spreadsheet is created which is programmed to calculate the total cost of producing a ton of wax for a given month. In the spreadsheet, columns exist through which costs which are either sourced from within or outside the ABC wax plant are inputted.

A report on the unit cost is presented to management on a monthly basis based on the output generated by the spreadsheet. Table 4.5 below is one of such report.

##### ***4.6.1.2 Analysis***

Firstly, it is worthy of note that there exists no information management system for this KPA. Considering the significance of the KPA, coupled with the complexity involved in arriving at an accurate figure for the unit cost, one thought it necessary for management to deploy an integrated information system in this area.

The fact that to arrive at the unit cost of production involves the designated personnel in ABC to rely on information from other sources, including plants that are outside of ABC, raises a lot of issues regarding data reliability. Due to the human factor, such data is usually prone to error since it may have passed so many hands before it gets to the intended recipient. The error rate normally increases with the number of persons that handle the file. With an integrated information system however, the data only needs be keyed in from one user interface, while other authorised users would access

it from their own system. It is only users with sufficient authority that may be able to change the content of such file.

The task of computing the unit cost is placed on one employee. This further raises questions regarding the quality of information eventually presented to the management as there is the risk of data being keyed in incorrectly, inaccurately or incompletely. Each of these cases has a negative effect on the final output obtained.

For a chemical production plant like ABC, consumption of utilities such as steam, electricity, and water contributes significantly to the total cost of production, and invariably to the unit cost too. Hence, one expects that ABC Wax management should have a management system for monitoring the amount of utilities it consumes or imports from other plants, in order to cross-check the claims from such plants.

#### ***4.6.2 Key Performance Indicators***

The only KPI defined in the cost area is:

‘Unit cost of production to be less than R2040/ton’

##### ***4.6.2.1 KPI 1: Unit cost of production to be less than R2040/ton***

Even though there could be many factors which may serve as indicators for an organization financial performance, ABC wax plant management decided to focus on the unit cost of production of wax as a KPI for the financial year 2006/2007.

The unit cost of production is a function of so many inputs. This includes the cost of the sum of resources that went into the production of a ton of wax. Some of these resources are:

- Synthesis gas
- Catalyst
- Utilities – Steam, Electricity, Plant Air, Water e.t.c.
- Labour

Table 4.5 gives a summary of the unit cost of production (in Rand) of a ton of wax for the financial year 2006/2007.

Table 4.5 Monthly unit cost of production of a ton of wax

	Volume (Tons)						Yield (Kg/GJ)			Unit Cost (Rand/ton)		
	Target	Actual	Actual Variance	YTD Target	YTD Actual	YTD Variance	Budget	Actual	Actual Variance	Target	Actual	Target Variance
Jul-06	16506	17268	762				1.63	1.53	-0.1	2040	1710	330
Aug-06	16506	12627	-3879	33012	29895	-3117	1.63	1.56	-0.07	2040	1848	192
Sep-06	16506	16662	156	49518	46556	-2962	1.63	1.53	-0.1	2040	1842	198
Oct-06	16506	11405	-5101	66025	58041	-7984	1.63	1.64	0.01	2040	2331	-291
Nov-06	16506	18019	1513	82531	76060	-6471	1.63	1.49	-0.14	2062	1975	87
Dec-06	16506	17187	681	99037	93239	-5798	1.63	1.56	-0.07	2062	1860	202
Jan-07	16506	18178	1672	115543	111415	-4128	1.63	1.69	0.06	2062	1748	314
Feb-07	16506	6963	-9543	132049	118378	-13671	1.63	1.83	0.2	2062	1636	426
Mar-07	16506	16659	153	148556	136037	-12519	1.63	1.69	0.06	2062	1866	207
Apr-07	16506	15532	-974	165062	150669	-14493	1.63	1.77	0.14	2062	1850	212
May-07	16506	16633	127	181568	166904	-14664	1.63	1.58	-0.05	2062	1874	188
Jun-07	16506	16469	-37	198074	183372	-14702	1.63	1.53	-0.1	2062	1868	194

In Table 4.5 above, there are three main columns, each with sub-columns. A brief explanation of each column is given below.

1. **Volume (Tons):** measured in tons, this refers to the quantity of wax produced in a month. The *Target* sub-column refers to the management anticipated amount to be produced while the *Actual* sub-column indicates the actual amount produced. *Actual Variance* sub-column is the difference between the *Actual* and the *Target* for each month.

YTD means Year-to-Date which represents the total amount right from the beginning of the financial year to the current month. Thus *YTD Target* for the month of February 2007 would mean the total amount of wax anticipated for production from the beginning of the financial year (July 2006) till February 2007.

2. **Yield (kg/GJ):** This refers to the mass of wax (measured in kilogram) produced per GigaJoule (unit of energy) of synthesis gas used as input for the production.
3. **Unit Cost (Rand/ton):** The unit cost refers to the total cost (in Rands) of producing a ton of wax. As mentioned earlier, the unit cost is a function of many factors, all of which contribute to the production of the final product.

#### ***4.6.2.1.1 Impact of Management Information***

The impact of management information is significantly seen in this area. A critical look at table 4.5 amply illustrates this fact. There are some interesting trends that may be deduced from the table which could have thrown the management into panic, if not for the availability of management information.

For instance, a closer look at table 4.5 shows an actual variance of -9543 for the month of February 2007. This ordinarily translates to a shortfall of 9543 tons of wax produced for that month as against the budgeted figure. However, the maximum yield for the 2006-2007 financial year was achieved during that same month. It is remarkable that since the volume of wax produced and the yield are two major determinants of the unit cost of production, the lowest unit cost of production for the year was realised in February 2007.

The shortfall of 9543 tons was actually due to shutdown activities that took place in February 2007. High amounts of shortfall are also noticed for the tons of wax produced for the months of August 2006 and October 2006, both of which are due to shutdown activities.

One found out that due to the information it has, the management is able to come to terms with the trends of production, more so as it affects the unit cost of production. In September 2006, a critical compressor tripped in the plant that supplies synthesis gas to ABC Wax. This resulted in the tripping of the whole plant and gas load to the downstream plants (including ABC Wax) was reduced to the minimum. This was one of the reasons why the actual volume of wax produced was just 156 tons more than the budgeted amount.

Even though there are shortfalls and surpluses regarding the volume and yield, the target of less than R2040 for unit cost of production is largely achieved for every month of the financial year except October 2006. From the research, it became obvious that ABC Wax management is very keen with regards to information on costs of production and promptly acts on such too. One way the management keeps tab on the cost activities is through the variance reports which is submitted to it every month. The report normally details any abnormal occurrence or any deviations from budget and the explanations for such.

In conclusion, the impact of the information made available to the ABC Wax management regarding this KPI has been very positive. With the information, the management is able to understand all the development that either positively or negatively affects the production and production costs. This availability of information coupled with management's commitments and prompt actions on it, though not the single factor, contributes to the target unit cost being consistently met over the year as is evidenced in Table 4.5.

#### ***4.7 Guidelines for Improvement***

To increase the effectiveness of management information on the organizational performance of ABC, four major areas were observed that deserve to be improved upon. The areas are:

1. *Disparate Information Systems*
2. *Dirty Data*
3. *Information Requirements Specification*
4. *Management Attitude*

Guidelines for improvement in each of these areas are as detailed below.

##### ***4.7.1 Disparate Information Systems***

Most of management information in ABC is generated through separate systems built on generalized software. These systems, due to their generalized nature, are prone to dirty data generations with direct negative effect on management decisions taken on them, and are also fraught with limitations.

The proposed guidelines for this area are as follow:

- There is the need to use technologies that integrate the disparate data stores in ABC and help clean up their data. Enterprise resource planning (ERP) systems (SAP, Peoplesoft, Baan, J.D. Edwards, etc.) are examples of such systems. The integration of several business functions on a single system holds tremendous potential for reporting. All transactional data will be available from one source. Reporting that was difficult or not feasible in the past will be possible.
- Haag et al. (2006) pointed out that “most important, ERP forces discipline and organization around processes, making the alignment of IT and business goals more likely in the post-ERP era”. Since aligning IT and business goals has always been a top priority for ABC senior management, thus it might be helpful for ABC to implement an ERP system.

Although the literatures are full of pessimism (just as well as optimism) regarding the success of ERP implementation, the current situation of disparate systems, and hence data in ABC still calls for an integrated system approach. This may not necessarily bring to an end all data integrity or quality issues but will put a considerable check to it.

#### ***4.7.2 Dirty Data***

With the present setting of management information generation in ABC, there exists a high risk of dirty data lurking within the system. The following are guidelines proposed toward the improvement of this area.

- Failure to treat data as a strategic business resource is really the start of data integrity problems. ABC senior management should recognize data (and the processes that produce data) as a basic corporate asset and implement strategies to proactively improve them.
- Even with disparate systems, ABC management information still gets generated through different designated personnel using the same data. For instance, the personnel in charge of productivity shares data with the one responsible for unit costs of production. In this case, there is the need to

develop a shared understanding of the uses and value of data among those performing these tasks to prevent the creation of dirty data.

- Stewards of transactional and planning systems in ABC must employ a combination of procedures including systematic safeguards and user-training programs to counteract and prevent dirty data in those systems.
- Users of transactional and planning systems in ABC must understand the origins and effects of dirty data and the importance of and means of guarding against it. This requires a shared understanding within the context of the business of the meaning, uses, and value of data across functional entities.
- To maintain data integrity, ABC management must ensure that only people with an understanding of the origins and results of dirty data and the ways to prevent and correct it are dedicated to the task.
- Most systems for generating ABC management information is manned and controlled individually by a single personnel, a practice that has its many disadvantages. Beyond this however, it must be ensured that such personnel understand their responsibilities with respect to maintaining data integrity which will lead to a better quality system. Such users, and not the IT personnel that develops the system, should be primarily responsible for determining the business value of data.
- The costs of insufficient testing prior to implementation can be very high. To be sure of the integrity of generated data, the individual systems built for the purpose of generating management information at ABC should be tested over and over again. Testing is a crucial aspect of implementing information solutions and there should be no short-cuts in testing.
- Lack of proper training can frustrate users when they begin using a system in an organization. The ABC management can prevent the entry and extraction of dirty data by demonstrating a greater dedication to initial and on-going training for those responsible for entering and extracting data. On-going training is a prerequisite for success in implementing information systems. The obligation of giving adequate training to designated personnel is even more pronounced in ABC where most systems are handled by single individual.

#### 4.7.3 Information requirements specification

The average middle manager is swamped by useless information and spends about a quarter of work time - or two hours a day - looking for the data they need, according to the study by Accenture of 1,009 managers at U.S. and U.K based companies with annual revenue of more than \$500 million. And despite the time spent hunting for the information, once they obtain it, half of the information has no value to their jobs, according to the study.

Results of the progress made so far in some of the key performance areas considered in this research study show that the ABC management is not free from the challenges associated with information requirements specification, where a manager is able to correctly figure out the information he/she needs without unnecessarily asking for load of information that may not be useful to effective decision making.

The following guidelines are proposed for the improvement of this area:

- Information requirements by ABC management should be derived by a thorough analysis of the way the organization functions. If management information is meant to support the control of an organization, it is important to first know *how* the organization might be controlled. Without a clear view on the way an organization is capable of improving or maintaining its performance, management information cannot be adequately specified.
- It is important that the mission and goals of ABC be used as a *reference* for formulating management information. This should constitute the basis for relating action to its contribution to *organizational performance*. Every activity or process within the organization should directly or indirectly contribute to one or several objectives. The reasoning behind this guideline is as follows. The effectiveness of management information is the degree it contributes to the performance of the organization. Furthermore, organizations are seen as purposeful systems and therefore the performance of the organization is assumed to be related to the degree it reaches its purpose, i.e. its mission and goals. So, management information is seen as effective if its contribution to the mission and goals of the organization can be specified.

- The ABC management information needed must initiate the configuration and the specifications of the data to be stored. Instead of primary processes at ABC generating certain data and the collection of these data assumed to support management, the process should start with the management information needed. An appropriate definition of the information requirements should be the starting point to determine what data will be used and subsequently stored to fulfil these requirements.
- The specification of the information requirements and the configuration of the appropriate systems to derive the information should be an iterative process with a balance between feasibility and desirability.

#### ***4.7.4 Management Attitude***

For some reasons, one found out that some of the KPIs identified by ABC management were not achieved not as a result of inadequacy of information on them, but due to what may be termed management's slow reaction to the information provided on these KPIs.

This trend is very evident regarding the target set for the training and development of personnel in ABC. Even though the KPI was met based on overall average, one discovered that more success could have been achieved if the individuals have been focussed on based on information available to management. Also, a closer investigation on the volumes and yields under the Cost KPA could lead to radical improvements in overall plant performance.

The following guidelines are proposed for the improvement of this area:

- The effectiveness or otherwise of an information remains undetermined until the information is acted upon. ABC management needs to attach more significance to generated information, especially on defined KPAs, in order to enhance its decision-making process.

There is a need for active feedback by ABC management particularly on issues that management has information that has to do with the workforce. Failure to do this will only promote a laid-back attitude amongst the workforce, thereby rendering the

management information ineffective as the target for the defined KPI will most likely not be met.

It is noteworthy that the guidelines above are formulated after a thorough case study research and literature review; hence the veracity of their effectiveness is not in doubt.

As stated earlier, the guidelines are not only pertinent to ABC Wax, but generally applicable to organizations in the chemical process industry. If properly followed, the guidelines will drastically improve the impact of management information on the overall performance of organizations in the chemical process industry.

## Chapter Five – Conclusions and Recommendations

The research is focussed on how effective the information available to the management of an organization is on the performance of the organization. The research, conducted in the chemical process industry, was predicated on the observation of an increasing number of new information technologies and several indications of the limited effectiveness of these technologies to positively impact on the performance of organizations vis-à-vis management information generation, transfer and usage.

This observation prompted the author to get a better understanding of management information and resulted in the formulation of the following research objective (see chapter 1):

*to determine the effectiveness of management information on organizational performance in the chemical processing industry and identify guidelines for its improvement.*

Both literature review and a case study were used to accomplish this objective. This was done by examining the key performance areas and indicators, as defined by the case study organization management, and ascertaining the level of achievement of these indicators.

By defining these indicators in the selected areas, the management actually carved out a yardstick on which its overall performance may be measured against at the end of the year of review. This tallied with the objective of this research work for two reasons:

1. The indicators chosen by management is a subset of those anticipated to be used for this research work. Based on relevant literatures, the indicators are broad-based enough to be used as performance indicators for an organization in the chemical process industry.
2. The author agrees with the management's idea that the overall success achieved of these indicators is a good measure of the general performance of the organization.

Based on the above reasons, the role played by information available to management towards achieving the KPAs and their indicators was focussed on. The issues considered are:

- The integrity/quality of the information supplied to management
- The adequacy or otherwise of the management information
- Actions taken by management on the information

## ***5.1 Conclusions***

The situation in which a manager effectively uses management information to improve the organizational performance is not to be taken for granted. Both the literature and the experiences gained in practice seem to provide an abundance of issues that might obstruct the effectiveness of management information.

Even though some of the KPAs were achieved at the case study organization, there were not enough evidence to show that the achievement was as a result of the actions taken by management based on the information available to it. In the same vein, the research showed that some KPAs were not achieved not as a result of a failure in any of the issues considered, but due to other reasons.

One of such reasons may be termed “a tall ambition” on the part of management. In essence, this implies that the management information has a positive impact on the performance of the organization, but not enough to meet the target defined by management. An instance of this in the case study organization is what obtained in the previous financial year regarding KPI 3 (Four safety observations per person per month) of SHE key performance area, where management had defined a much higher number of safety observations to be made per person per month. The target was not met at the end of the year, and it was discovered that this was not as a result of nonchalance on the part of management to the information made available to it, nor a defect on the integrity/quality/adequacy of the information. Rather, it had to do with the goal itself.

Attributing the achievement of success in a key performance area to the information available to management is also a tricky one, as there may have been other measures

that could have contributed in one way or the other to the success. In this case, only the management can actually confirm the role played by management information since they can tell what other measures have been put in place toward the achievement of key performance indicators defined for the area.

To improve the effectiveness of information on the performance of organizations in the chemical process industry, it is important that management information requirements be derived through a thorough analysis of the functioning of the organization. Too often, the information only supports the trigger for action, whereas the support for the appropriate action is missing. The latter is crucial if the performance of an organization is to be improved. For example, weighing the figures against the defined goals at ABC Wax allowed progress made to become apparent; however, a means to evaluate progress, as well as the possible actions needed to control the progress were not supported by the available information.

It is also crucial that the value of data should not be lost on management. As a matter of fact, data should be treated as a strategic resource. This will ensure that its quality and integrity are not compromised, thereby brightening its chances of impacting positively on the performance of the organization. This is particularly relevant to organizations in the CPI where the need for accurate data is high due to the possible risks necessitated by the potentially dangerous operating conditions in the industry.

Despite the fact that its primary function is not information processing/management, but rather chemical production, issues of data integration should also be taken seriously by a chemical processing organization that wishes to improve the impact of management information on its performance because this will help to ease activities such data clean-up, alignment of business goals with information technology and most importantly, management reporting.

Information not acted upon will not by itself bring about any positive impact on an organization, the quality/integrity of the information notwithstanding. A key factor then is the right attitude of management to the information made available to it. Prompt actions and follow up on information is strategic to bringing about a positive impact of management information on an organization performance. This applies to all organizational entity.

In conclusion, information plays a vital role in the management's decision making, and thus the overall performance of an organization. The effectiveness of the information however varies from one area of the organization to the other. For the chemical process industry, factors responsible for this variance include correct specification of required information, priority given to the information by management, and quality/integrity/accuracy of information among others. The good thing is that there exists ample opportunities for management in this industry to improve on the impact of information on their organization performance.

## ***5.2 Recommendations***

Based on a reflection of the research, several topics emerged which need further research. The following recommendations will be presented to get a better understanding of the problem area.

1. Evaluate the approach within other organizations.

During this research, only one organization was used as the case study. The question of whether single or multiple cases are needed depends obviously on the research objective. Given the fact that the project was focussed on learning rather than proving, an in-depth study within the same organization was chosen to get a full understanding of what is going on.

Nevertheless, there is the need that more research should be conducted to evaluate this approach. Selecting other organizations within the chemical industry might result in a refinement of the approach used in this project. However, the main body of this approach may not change significantly as the concepts and ideas underlying the approach are not new. It is the integral combination of elements from different perspectives that should help to derive effective management information.

2. Consider other key performance areas

Due to time constraints, four key performance areas - SHE, Volume, Leadership and Cost - were considered during the course of this research. To further justify the impact of management information on organizational

performance, future research work may consider additional key performance areas on the subject. *Change management, the impact of people dynamics, KPAs that have reference to internal processes and external relationships with clients and suppliers* are some of the important key performance areas that may be looked into.

3. Utilise other performance measurement methods

The key performance areas, as defined by the case study organization management in its official strategic document, were used to accomplish the objective of this research work. Further research work could be done on the same subject using other performance measurement metrics. This may likely throw up newer issues which are not covered in this study.

4. Construct a model

Considering the recommendations above, the research may also be taken further by constructing a model which will link the KPIs to the performance of organizations in the chemical process industry. Such a model should also support the specification of information requirements and the configuration of the technologies needed to generate the specified information.

# Appendix 1 – Remedial Actions of Personal Development Plan (PDP)

NAME: \_\_\_\_\_ COMPANY NO: \_\_\_\_\_

PLANT: \_\_\_\_\_ DATE: \_\_\_\_\_

1. Highlight area/s of poor performance to Employee and the impact it has on the business

\_\_\_\_\_  
\_\_\_\_\_

2. Employee's response to poor performance

- a. Reason for non Conformance

\_\_\_\_\_  
\_\_\_\_\_

- b. Suggestions in regard to assistance

\_\_\_\_\_  
\_\_\_\_\_

3. Employee should be made aware of required standards and consequences of deviation (Refer to signed Personal Development Plan)

\_\_\_\_\_  
\_\_\_\_\_

4. Explain to Employee what is expected of him/her in detail (Refer to signed Personal Development Plan) Decide what assistance is necessary to improve the Employee's performance to a satisfactory level

GAP	ACTION	DATE COMPLETE	RESPONSIBLE PERSON

5. Suggestions taken by Panel

\_\_\_\_\_

\_\_\_\_\_

NOTE: If the gaps were not closed within the agreed time frame, then the further measures will be followed.

**Review Date:** \_\_\_\_\_

SHIFT SUPERVISOR: \_\_\_\_\_

NAME	SIGNATURE	DATE
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PRODUCTION  
MANAGER: \_\_\_\_\_

NAME	SIGNATURE	DATE
------	-----------	------

EMPLOYEE: \_\_\_\_\_

NAME	SIGNATURE	DATE
------	-----------	------

OTHER:  
(SPC, Trainer) \_\_\_\_\_

NAME	SIGNATURE	DATE
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## Appendix 2 – Incident/Injury Flash Notification

**Distribution:**

<b>INCIDENT/INJURY FLASH NOTIFICATION</b>							
Accident Classification	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Injury</b></td> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Incident Environment</b></td> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Fire</b></td> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Vehicle Accident</b></td> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Gas leak</b></td> <td style="width: 15%; border: 1px solid black; text-align: center; padding: 2px;"><b>Health Complaint</b></td> </tr> </table>	<b>Injury</b>	<b>Incident Environment</b>	<b>Fire</b>	<b>Vehicle Accident</b>	<b>Gas leak</b>	<b>Health Complaint</b>
<b>Injury</b>	<b>Incident Environment</b>	<b>Fire</b>	<b>Vehicle Accident</b>	<b>Gas leak</b>	<b>Health Complaint</b>		
Area	<div style="border: 1px solid black; height: 25px;"></div>						
Date	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border: 1px solid black; height: 25px;"></td> <td style="width: 10%; text-align: center; padding: 2px;">Time</td> <td style="width: 40%; border: 1px solid black; height: 25px;"></td> </tr> </table>		Time				
	Time						
Initials and Surname	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> <td style="width: 10%; text-align: center; padding: 2px;">Control No</td> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> </tr> </table>		Control No				
	Control No						
Equipment Description	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> <td style="width: 10%; text-align: center; padding: 2px;">Equipment Number</td> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> </tr> </table>		Equipment Number				
	Equipment Number						
Occupation	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> <td style="width: 10%; text-align: center; padding: 2px;">Section</td> <td style="width: 45%; border: 1px solid black; height: 25px;"></td> </tr> </table>		Section				
	Section						
Agent Involved (what chemical/equipment/machine caused the exposure?)	<div style="border: 1px solid black; height: 40px;"></div>						
Body/ Equipment Part Affected	<div style="border: 1px solid black; height: 25px;"></div>						
Supervisor	<div style="border: 1px solid black; height: 25px;"></div>						
Description of Accident/Incident	<div style="border: 1px solid black; height: 25px;"></div>						
Facts gained at preliminary Investigation	<div style="border: 1px solid black; height: 25px;"></div>						
Immediate corrective actions taken at the incident site	<div style="border: 1px solid black; height: 25px;"></div>						
Preliminary Root Cause Analysis	<div style="border: 1px solid black; height: 25px;"></div>						
Immediate preventive actions implemented	<div style="border: 1px solid black; height: 25px;"></div>						
Follow Up	<div style="border: 1px solid black; height: 25px;"></div>						
Contact Person	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%; border: 1px solid black; height: 25px;"></td> <td style="width: 40%; text-align: right; padding: 2px;">Telephone:</td> </tr> </table>		Telephone:				
	Telephone:						

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