An exploration into the Product Life Cycle concept as a strategic decision-making tool at Johnson Matthey South Africa.

By

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CONFIDENTIALITY CLAUSE

Date 2006-12-22

To Whom It May Concern:

Re: CONFIDENTIALITY CLAUSE

Due to the strategic importance of this research it would be appreciated if the contents remain confidential and not be circulated for a period of five years.

Sincerely

D Chetty

DECLARATION

This research has not been previously accepted for any degree and is not being currently submitted in candidature for any degree.

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No undertaking of a project as intense as this study is possible without the contribution of many people. My special thanks and acknowledgement go out to the following individuals without whom this project would not have been completed.

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- Last, but not least, my wife, Joelene for her support and encouragement.

ABSTRACT

This study was an exploration of the product life cycle theory as a strategic decision-making tool in an auto-catalyst manufacturing plant. During the literature review stage of this study, many gaps in the product life cycle theory were identified. The product life cycle theory has come under criticism from numerous academic authors. It was also found that there was a definite lack of empirical studies carried out on South African companies and products.

The main focus of this study was to investigate use and practical applicability of the product life in strategic decision making in a South African organisation, which is a subsidiary of a multinational corporation. A major limitation to this study was that the decision makers at Johnson Matthey South Africa showed a lack of understanding of strategy, and their role in strategic decision making.

From the data collected, using a questionnaire survey methodology, the major findings were that the product life cycle theory has application potential as a strategic decision making tool in future. The decision makers at Johnson Matthey have a good knowledge of their products and where they were on the product life cycle.

Further empirical research, into the applicability of the product life cycle theory is needed, on South African organisations.

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CHAPTER ONE – INTRODUCTION

1.1 Introduction

This will be an exploratory study aimed at investigating the use and application of the product life cycle concept as an instrument/tool in strategic decision-making. The company to be investigated will be an auto-catalyst manufacturing plant situated in Gauteng, South Africa – Johnson Matthey South Africa. Johnson Matthey South Africa is part of Johnson Matthey Plc, a multi-national corporation with auto-catalyst manufacturing plants around the world (UK, USA, India, China, Argentina and Japan).

This study will cover the theories on the product life cycle concept. The empirical part of the study will focus on the use and application of the product life cycle theory in practice. This study will focus on the product life cycle assumptions derived from literature:

i) the described characteristics associated with each stage of the PLC,

ii) the proposed strategies and objectives associated with each stage of the PLC theory.

The manufacturing concern as described above will be used to test the use and applicability of the product life cycle concept as a decision-making tool. There will be no investigation into and questioning of the shape of the sales curve associated with the PLC theory.

Various decision-making models exist and form part of the tools managers should be using to plan, forecast and make strategic decisions. The product life cycle concept is one such model and has been a central element of marketing theory for four decades, from its development in the 1950's. It has been extended to become a stable feature in most strategic management courses, despite criticism and debate over its validity. This study will attempt to shape conclusions on the applicability of the product life cycle theory based on empirical data to be collected and analysed.

1.2 Background of the Research

The product life cycle theory has been extensively applied in the marketing of a product. This study attempts to investigate the relevance of the product life cycle concept to strategic decision-making, for instance: large capital investment.

Johnson Matthey South Africa manufactures auto-catalysts mainly for the UK and US car market. The auto-catalysts manufactured, use precious metals (e.g. platinum) mined in South Africa, which is very expensive, thus making the auto-catalyst itself very expensive. Therefore there is incentive to find alternatives which are cheaper and probably of a more advanced technology. As emissions controls are tightened and introduced in more countries; sales increases but so too does the competition in this sector.
This study will attempt to answer the question: is the PLC theory of any significance to the above organisation, and is it used for strategic decision-making?

The first formal treatment of the PLC theory as a conceptual model is attributed to the work of Joel Dean, who wrote about the concept in a 1950 article, "Pricing Policies for New Products," in the Harvard Business Review (Bensoussan 2003: 364).

The product life cycle theory is based upon the biological life cycle similar to all living organisms. For example, a seed is planted (introduction); it begins to sprout (growth); it shoots out leaves and puts down roots as it becomes an adult (maturity); after a long period as an adult the plant begins to shrink and die out (decline).

In theory it's the same for a product. After a period of development it is introduced or launched into the market; it gains more and more customers as it grows; eventually the market stabilises and the product becomes mature; then after a period of time the product is overtaken by development and the

introduction of superior competitors, it goes into decline and is eventually withdrawn. Refer to the different stages of the traditional PLC in Figure 1.1.

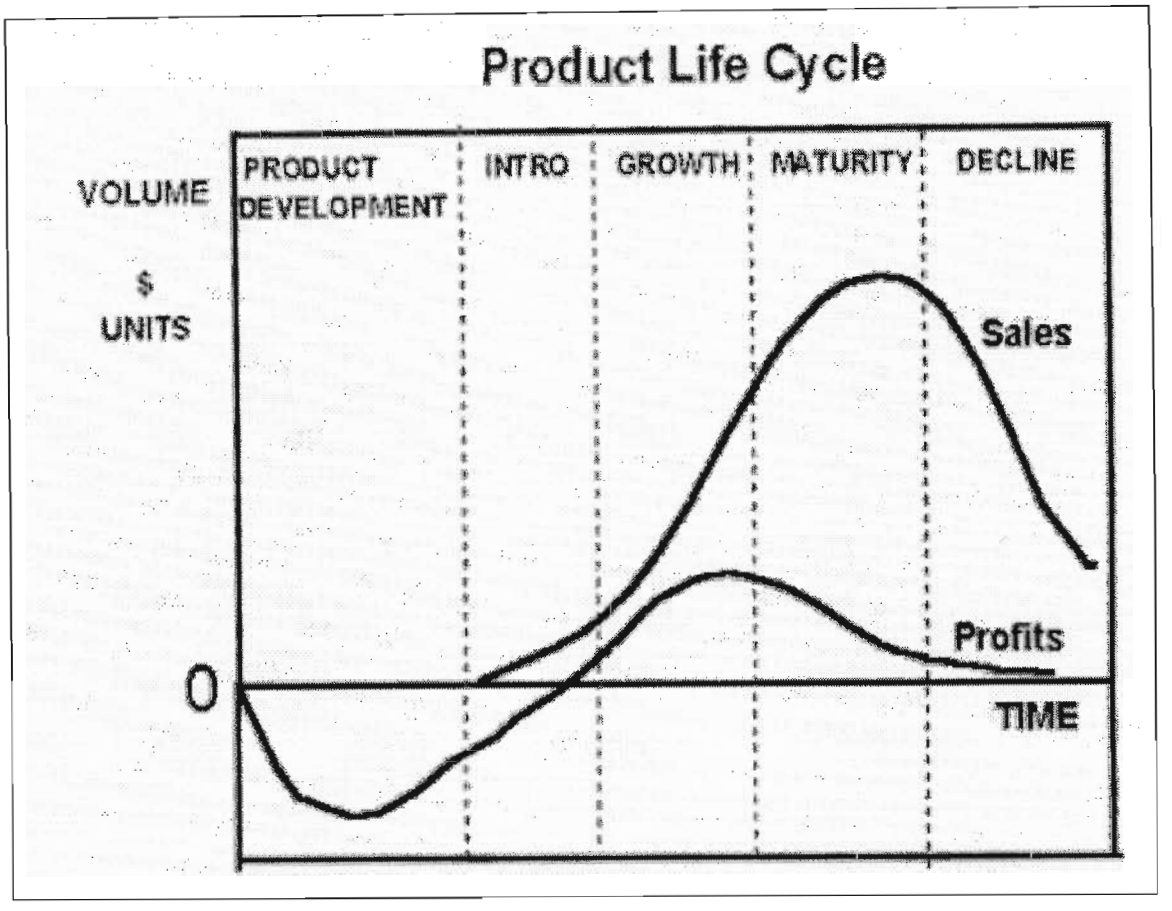


Figure 1.1: The Classical PLC curve

Adapted from: Bensoussan (2003: 365)

The product life cycle theory is one of the most quoted and most frequently taught elements of marketing and strategy theory. However, this theory has been subjected to relatively little public criticism, with only 20% of 271 papers published on the subject between 1971 and 1991 undertaking further research into the subject and only a handful challenging its basic assumptions (Mercer, 1993: 269). This study will add to the literature and will either approve or disprove the validity of the product life cycle concept.

According to Mercer (1993: 269) the influence of the PLC theory can be seen in other theories, from new product development to the BCG Growth/Share portfolio matrix.

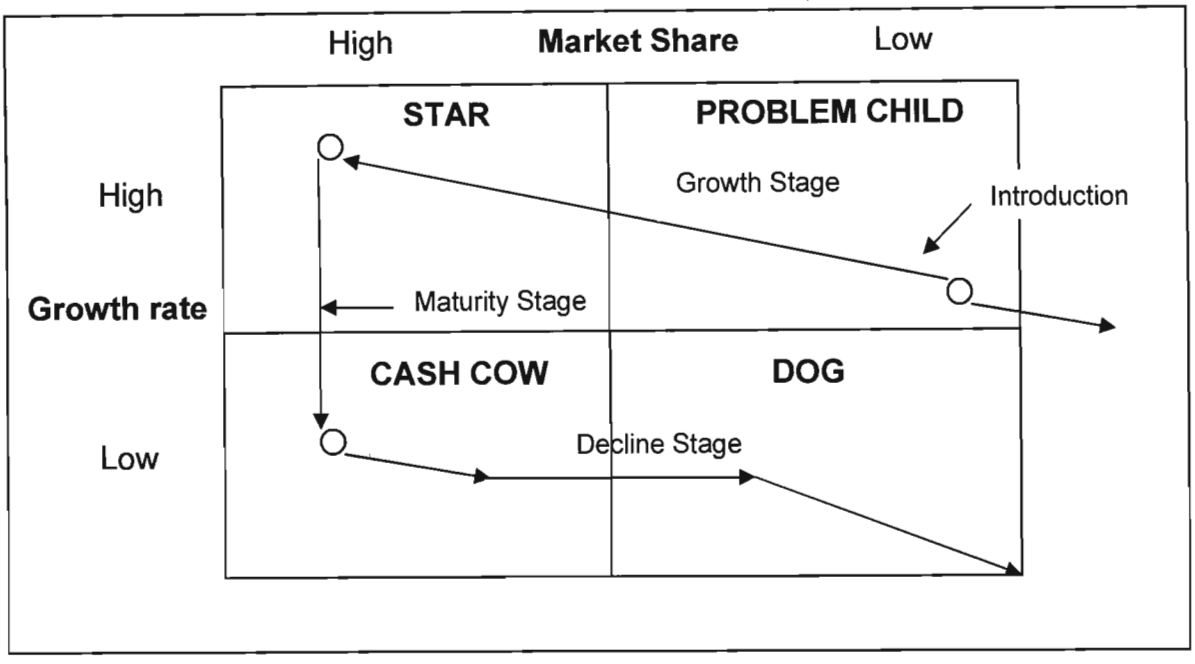


Figure 1.2: Relationship between the PLC and the BCG Growth Matrix
Adapted from: Van der Walt et al. (1996: 521)

As demonstrated in figure 1.2 the introduction stage begins in the problem child's quadrant, the growth phase starts at the end of this quadrant and extends into the star area. The maturity phase begins in the cash cow quadrant and the decline stage is positioned between the cash cow and the dog quadrant.
There is overlap of strategy suggestions given by the PLC and BCG models as to the strategic decision to be taken at each stage or quadrant. Therefore these two models can be used in order to triangulate data and make a specific strategic decision.

The research carried out by Jeffery (1995), Cunningham (1969) and Smith (1980) and numerous other studies all focused on applying the PLC theory to the marketing function. Almost all literature on the PLC theory focuses on the marketing function. This study will attempt to extend the PLC theory to all functions (Production, Operations, Finance, Personnel and Research & Development) within an organisation, as a tool for strategic decision-making as suggested by Pearce & Robinson (2003: 146-147).

1.2.1 Criticism of the Product Life Cycle Theory

Some criticism has been made against the product life cycle concept, contending that it is more misleading than useful. There have been organisations that have ignored the product life cycle concept and achieved success. DuPont's nylon was originally used in the military in the 1940's and 1960's. Their product would have faded into oblivion had they believed that declining sales curve signalled death. Instead they chose to enter the volatile textile market and induced women to switch from silk to nylon stockings. Sales grew and they were very successful with this product. (Dhalla & Yupesh, 1976).

Other well-known brands such as Listerine Antiseptic, Marlboro and Seven-up in contrast have stretched their brands over many decades by sound planning based on the application of the product life cycle concept.

Many gaps have been identified in the literature:

- The application of the product life cycle theory for strategic planning across functional areas has been overlooked (Birou, Fawcett & Magnan, 1998: 38).
- The product life cycle theory has been exposed to comparatively little suspicion (Grantham, 1997: 4)
- There is a definite need for the development of a more sophisticated theory of the product life cycle in order to know more about the shape of the product life cycle (Midgely, 1981: 114)
- The product life cycle is insufficiently uniform to provide a basis for decision-making and therefore planning (Doyle, 1976: 3).

The debate over the product life cycle concept is still continuing and there are still questions about it's effectiveness as a decision-making tool and there is definite need for experiential proof of the application of the product life cycle theory in practice.

1.3 Motivation for the research

The auto-parts industry (specifically auto-catalysts) is a very dynamic industry. It is a very high technology field and competition is fierce due its profitability. Products are always changing and being improved upon, therefore the product life cycle theory could be very effective if it can be practically applied and may become a fundamental decision-making tool.
Johnson Matthey South Africa, our manufacturing facility under investigation, is planning to undertake a very large capital project (approximately R600 rnillion), this major strategic decision is a partial motivator for this study, which will investigate whether the product life cycle was taken into consideration in the above strategic decision. The study will also investigate whether the product life cycle concept is used as an instrument in any decision-making and its applicability to the auto-catalyst manufacturing industry.

There was a need to determine at what stage in the product life cycle the auto-catalyst is in, thereafter, to determine whether the strategic decisions taken are appropriate given the product's stage in the product life cycle.

The principal motivator for this study was to determine the validity of the product life cycle theory and if it can be applied practically. Given that the product life cycle theory is a major part of most marketing and strategic management studies [PLC theory included in Kotler (2000), Bensoussan & Fleisher (2003) and Pearce & Robinson (2003)]. However, from the literature study there is another view that has a common theme of criticism on the value of the product life cycle and, Midgely suggested that there is a need for further investigation into the product life cycle concept in practice (Midgely, 1981; Grantham, 1997; Dhalla & Yupesh, 1976; and Sproles, 1981).

1.4 Value of the project

It is important to test the validity of the product life cycle theory in the current dynamic environment because surveyed literature indicates that the application of the product life cycle is being questioned, based on empirical studies conducted mainly among large manufacturing organisations internationally. Yet, to date no empirical research has been undertaken on the applicability of the product life cycle concept and the use thereof for strategic decision-making in South African. According to the literature study, considerable work has been done on the PLC's relevance to marketing decision-making, but not on its relevance as a strategic decision-making tool in other areas such as production operations, finance, personnel, engineering and research and development (Pearce & Robinson, 2003: 146,147).

This study will be important to the manufacturing concern being investigated – Johnson Matthey South Africa. It will verify or disprove the applicability of the PLC concept in Johnson Matthey's strategic decision-making. It will also test the suitability of Johnson Matthey's existing strategies in line with the product life cycle theory. If not already used, this study will introduce the decision-makers of the manufacturing concern to a new strategic decision-making tool.

The literature study conducted revealed that research mainly concentrated on large organisations internationally and focussed on the marketing function. No published research could be found which specifically focused on a subsidiary of a multi-national corporation operating in SA and used the product life cycle theory as a strategic decision-making tool.

This study will make a contribution to the body of knowledge with respect to strategic decision-making in general and the product life cycle concept theory in particular.

This study intends to investigate the application of product life cycle concept among decision-makers in the subsidiary to effectively make strategic decisions through the various stages of the product life cycle.

1.5 Problem Statement

The product life cycle concept has been formulated as an explicit, verifiable illustration of sales behaviour and tested against actual data in many studies. The product life cycle concept is depicting sales over time and it is a relative good predictor of sales behaviour in most market situations but there are, however, certain questions pertaining to its practical application. When tested in an explicit form for given categories of goods, the product life cycle concept can be a useful tool for planning and sales forecasting (Polli & Cook: 1969).

The application of the product life cycle concept for decision-making has been tested in *mainly large organisations around the globe* but has not yet been researched and tested on a subsidiary of a multi-national corporation operating in South Africa. It has also never been applied to a high technology product such as auto-catalyst in the automotive industry.

There is also a need to determine whether the PLC theory is used by the decision makers in this manufacturing concern (the subsidiary) or ignored when formulating strategic direction. It is suggested by Johnson and Scholes (2002) that life cycle analysis be used to test the suitability of a chosen strategy: Is the strategy appropriate given the stage of the product life cycle.

The product life cycle can be an important and effective tool in an organisations decision making process. The problem statement could be summarised as the hypothesis being that the product life cycle is used in decision making and the null hypothesis is that it is not used decision making at Johnson Matthey.

It is evident from the literature of Johnson and Scholes (2002) that the product life cycle theory has been successfully applied to many situations ranging from the manufacturing industry to financial management. It is also, evident that there have been situations where the product life cycle concept was ignored in strategic decision-making and a more imaginative approach taken. A classic example is the success achieved by DuPont's nylon (Dhalla &

Yupesh, 1976: 107). Therefore, this study is a pertinent one, and will focus on the effectiveness of the product life cycle with experiential evidence thereby providing clarity on whether the product life cycle is to be used or ignored in decision making.

1.6 Objectives of the Study

1.6.1 Primary Objective

The primary objective of this study is to establish what the use and practical value of the product life cycle concept is in the strategic decision-making at Johnson Matthey.

1.6.2 Secondary Objectives

The secondary objectives of his study are:

- To determine whether the decision-makers of the manufacturing concern as described above can identify in what phase of the product life cycle their product is.
- To identify the application of decision-making variables in the various stages of the product life cycle concept.
- To determine whether the strategies employed are consistent with theoretical strategies suggested by the literature with respect to the product life cycle.
- To establish the ability of the decision-makers to identify product life cycle characteristics as depicted in literature.
- To determine the potential of the product life cycle concept for decision-making.

1.7 Research Methodology

According to Malhotra (1996), a research design is a blueprint for conducting a research project. It details the procedure necessary for obtaining the required information, and its purpose is to design a study that will test a hypothesis or propositions of interest, determine possible answers to the research questions and provide the information needed for decision-making (Malhotra, 1996: 21-22).

This study will make use of the exploratory research study method to clarify the problem at hand: the applicability of the product life cycle theory as a strategic decision-making instrument by an auto-catalyst manufacturing plant. The following steps will be used:

1.7.1 Secondary Data Analysis

An extensive literature search on the product life cycle theory and its strategic application will be conducted by consulting a wide range of scientific/business journals and research publications. The literature on strategic decision-making and the product life cycle will be discussed in chapter two.

1.7.2 Qualitative Research

A detailed review of the organisation to be studied will be carried out and their history, products, customers and competitors will be described.

1.7.3 Definition of the Information Needed

Views of the applicability of the product life cycle theory will be derived from the extensive literature search. The literature search will include information on strategy, results from other research on the product life cycle theory, its application areas, and problems and criticism of the theory.

1.7.4 Methods of Collecting Quantitative Data

According to Ghauri & Gronhaug (2002: 85-110) quantity of data, sample control, quality of data, response rate, speed, cost and uses all influences the choice of survey method. After considering all the advantages and disadvantages of the various methods, a decision was taken to use the personal face-to-face interview method for collecting the data. The reason for choosing this method is because there is only one company under

investigation and therefore it will not be too difficult or costly to carry out the interviews face-to-face. This method also yields the most accurate data, as there is little chance for misinterpretation. A comprehensive discussion on the various methods (mail, telephone and e-mail) and more detailed reasons for choosing personal face-to-face interviews will be done in chapter three (Research Methodology).

1.7.5 Interview Questionnaire Design

The questionnaire will be designed using the literature (Saunders *et. al*, 2003 and Ghauri & Gronhaug, 2002) and the principles associated with questionnaire design. Before the questionnaire is finalised it will be pre-tested among a selected few of the decision-makers. Pre-testing standards will be used. The questionnaire design will be described in detail in chapter three (Research Methodology).

1.7.6 Sampling Process and Sample Size

The purpose of sampling is to obtain a representative sample and is often referred to as being more of an art than a science. However, in this study due to the size of the organisation all the decision-makers (directors, managers and supervisors), will be interviewed. This will give us a sample size of seventy two, which will be sufficient to carry out statistical analyses on.

1.7.7 Plan of Data Analysis

The plan for data analysis will be discussed in detail in chapter three; here is brief summary of the plan. The following aspects will be addressed:

- **Data capturing and coding**

Coding involves the assignment of numerical values (codes) to represent a specific response to a specific question (Dillon et al, 1993: 37). The questionnaire was designed in using a Visual Basic programme and made use of user friendly forms. The programme was written in such a way that the data would be immediately captured and stored into a database as it was being entered by the respondent. The stored data in the Microsoft Excel database was then easily sorted and manipulated. Therefore, due to the nature of the questionnaire and the computer programming involved it was not necessary to make use of data coding.

No data capturing mistakes were probable as data was transferred directly from the respondents onto the database. The special functions in Excel would allow for the processing and carrying out of statistical analysis on the data.

- **Validity and reliability testing**

Reliability refers to the extent to which measures are reproducible (Dillon et al, 1993: 293). A method using reliability coefficients; 0.7 (70%) or less will indicate unsatisfactory reliability as suggested by Malhotra (1996: 305-306). Validity, according to Malhotra (1996: 306), is the extent to which differences in observed scale scores reflect true differences among objects on the characteristic being measured, rather than systematic or random errors. These would be discussed in chapter three in the in-depth discussion on the research methodology.

1.7.8 Limitations to the Study

The major limitation to this type of questionnaire is that there is no interviewer present to verify that the data is correct and ensure that no mistakes are made. This limited the questionnaire design as it had to be simple as there was no interviewer present for clarification. This will be further explored in more detail in chapter five.

1.8 Structure of the Study

This introduction and background to the research study is the first chapter, it describes the problem statement, objectives and literature linked to the investigation of the application of the product life cycle concept for strategic decision-making purposes. The rest of the dissertation will be divided into the following chapters:

1.8.1 Chapter Two: Literature Review

This chapter will be divided into three parts; the first part will provide a theoretical discussion on strategic decision-making, strategy planning and the tools used in strategy formulation. The second part will highlight the role of the product life cycle theory as a management instrument as well as all the relevant theory on the product life cycle and the various strategy suggestions

for each of the stages. The third part of this chapter will provide a theoretical background to auto-catalysts and Johnson Matthey South Africa.

1.8.2 Chapter Three: Research Methodology

In this chapter the research methodology will be discussed with special reference to the sample, measuring instrument, the variables and the proposed statistical analysis.

1.8.3 Chapter Four: Reporting of Data

This chapter will present the findings from the research. Statistical techniques will be used to analyse the results and the general trends reported (if there are any).

1.8.4 Chapter Five: Recommendations & Conclusion

The final chapter will first provide an interpretation of the results and present all the major findings. Here recommendations will be made to the company. The chapter will be concluded by a discussion on the limitations of the study and will be enhanced by recommendations for future research.

1.9 Resources

The study has access to computer hardware and software. Access to the company's historical sales and sales forecasts has been negotiated. The company has agreed to allow access to any further data that is required for this study. The company directors and senior managers have agreed to be interviewed, regarding the use of the product life cycle concept for strategic decision-making.

1.10 Conclusion

The dynamic nature of today's automobile parts manufacturing industry (as with almost all industries), places the responsibility on the organisations decision-makers to anticipate, plan and respond effectively to the rapid changes by making sound strategic decisions. The development of these strategic decisions can be critical to the organisation's profitability and sustainable competitive advantage. This study will investigate the potential of the product life cycle theory as a strategic decision-making instrument and its relevance to the organisation.

The next chapter will be devoted to the strategic decision-making theories, theories of the product life concept and background of Johnson Matthey and auto-catalysts.

CHAPTER TWO – LITERATURE REVIEW

2.1 Introduction

A new competitive landscape exists in the 21st century as a result of the technological revolution and increasing globalisation. The technological revolution has placed greater importance on innovation and the global economy, one in which goods and services flow relatively freely among nations, continuously pressures firms to become more competitive.

This chapter will deal with the importance of strategy, strategic decision-making theories and then the product life-cycle theory and finally some background to auto-catalysts.

Strategy can provide an organisation with a reference point for decision-making. Strategy is defined as an integrated and coordinated set of commitments and actions designed to exploit core competencies and gain competitive advantage (Hitt, Ireland & Hoskisson, 2003: 9). Organisations must continuously evaluate their environments and decide on the appropriate strategy. By choosing a strategy, a firm decides to pursue one course of action over another.

2.1.1 Benefits of Strategic Management

According to Pearce & Robinson (2003):

- Strategy formulation activities enhance the firm's ability to prevent and solve problems. Managers who encourage subordinates to aid in the planning process are better able to avoid future problems as subordinates are normally closer to the problems.
- Group-based strategic decisions are likely to be drawn from the best available alternatives. This simply implies that group interactions generate a greater variety of strategic options.
- Involvement of employees in strategy formulation improves their understanding and thus, heightens their motivation.

- Gaps and overlaps in activities among groups or individuals are reduced as participation in strategy formulation clarifies different roles.
- Resistance to change is reduced. Participants in the strategy formulation understand how decisions have been arrived at and even though they may not like them, they have a greater awareness of the limitations and the options available.

2.1.2 Risks of Strategic Management

Also according to Pearce & Robinson (2003):

- Time spent by managers on the strategic management process may have a negative impact on operational responsibilities. Managers need to be trained in this regard, to manage their time effectively.
- If the formulators of the strategy are not intimately involved in the implementation, they may shirk their responsibility for the decisions reached. Managers must be trained to limit their promises to what their subordinates can deliver.
- Managers need to be trained to anticipate and respond to participating subordinates over unattained expectations. Subordinates may expect to be involved in more areas of decision making than is practicable. They may also expect their proposals to be accepted or to get an increase in rewards for inconsequential involvement.

Strategy is the fundamental pattern of present and planned objectives, resource developments and interactions of an organisation with markets, competitors, and other environmental factors (Walker, Boyd and Larreche, 1999: 8). Therefore a good strategy should specify:

- what is to be accomplished,
- where – which industry or product-markets will be the main focus, and
- how – which resources and activities will be allocated to meet your objective.

The strategic management process (refer to Figure 2.1) as described in Pearce & Robinson (2003), uses the inputs derived from the analyses of the

internal and external environment to determine an effective strategy formulation and implementation thereof.

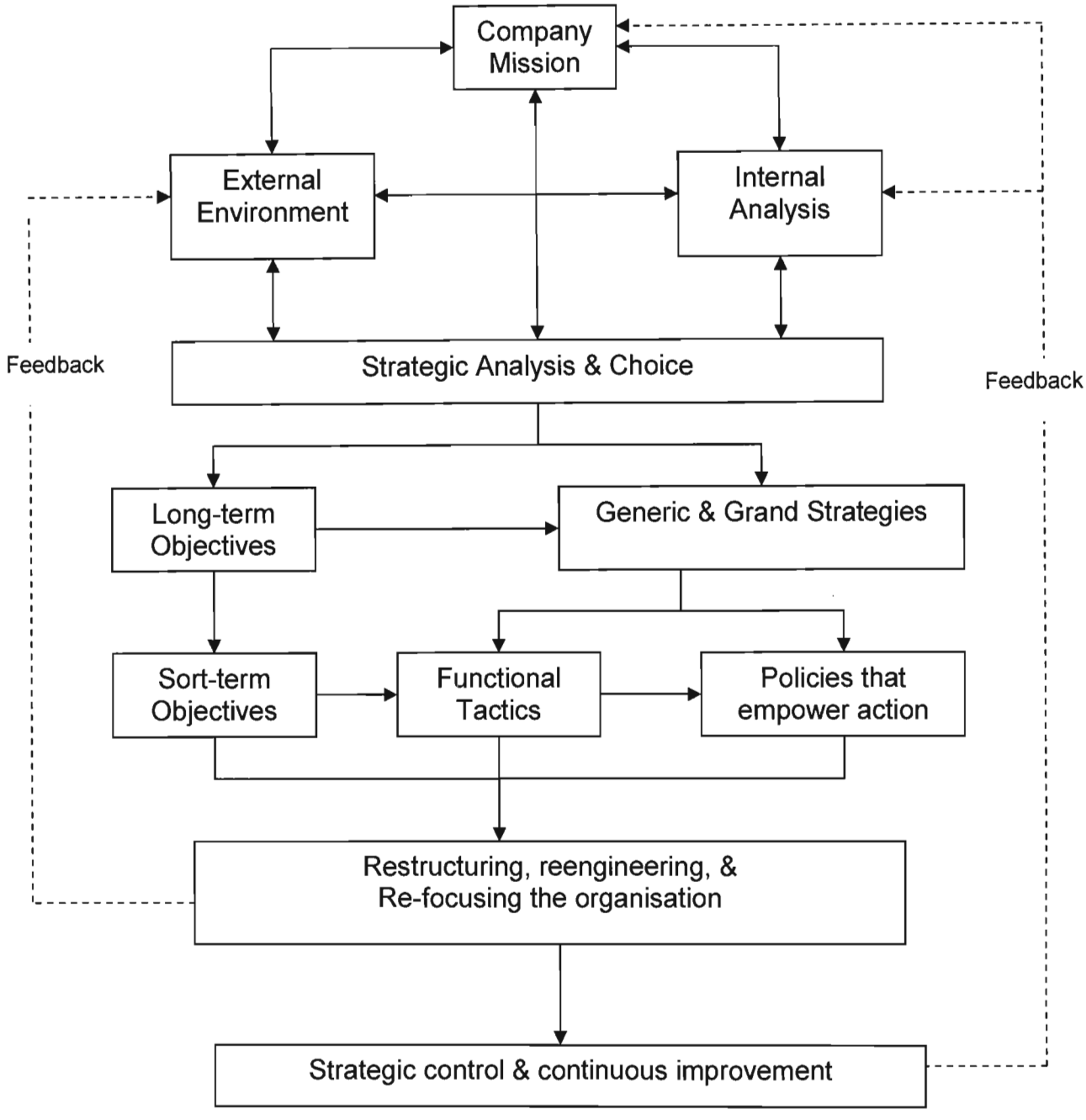


Figure 2.1: The Strategic Management Model

Adapted from: Pearce & Robinson (2003: 12)

2.2 Components of the strategic management model

There are various strategic management models, but the fundamentals are the same. This section will define and briefly describe the key components (as illustrated in figure 2.1); these components will be dealt with in greater detail later on in the chapter. These definitions have been adapted from Pearce and Robinson (2003) and Hitt, Ireland & Hoskisson (2003).

Company Mission – is a statement of a company's unique purpose that sets it apart from other companies. It describes the scope of its operation in terms of its product and market.

External Environment – consists of all the conditions and forces that affect its strategic options and define its competitive situation. The external environment can be divided into three segments, the remote, industry and operating environments.

Internal Analysis – is an analysis of the company's quantity and quality of it financial, human and physical resources. It also assesses the company's strengths and weaknesses.

Strategic Analysis and Choice – at this stage a company would identify a range of possible attractive opportunities for investment. However, these must be screened through specific criterion (normally set out in the mission), to obtain a set of possible and desired opportunities from which a strategic choice is made.

Long-Term Objectives – are the results that a company seeks over a multiyear period.

Generic Strategies – Lowest cost, differentiation, or focus strategies are the three generic strategies and firms adopt one or more intentionally or unintentionally.

Grand Strategies – is a general plan of major actions through which a firm intends on achieving its long term goals. 14 basic approaches cab be identified: concentration, market development, product development, innovation, horizontal integration, vertical integration, joint venture, strategic alliances, consortia, concentric diversification, conglomerate diversification, turnaround, divestiture, or liquidation.

Short-Term Objectives – are driven by action plans over a short period, weeks or months. These action plans should identify the specific functional tactics and actions, have a clear time frame, create accountability and should identify the objectives or outcomes of that plan.

Functional Tactics – within the company's generic and grand strategies, each business function needs to identify and undertake activities that help build a sustainable competitive advantage.

Policies that Empower Action – allow for faster decision-making. Speed is critical for success in today's competitive global market, and one way to enhance speed and responsiveness is to force/allow decisions to be made when-ever possible at the lowest level in the organisation.

Restructuring, Reengineering, and Refocusing the Organisation – at this stage the process takes an internal focus - getting the work of the business done efficiently and effectively, in order to make the strategy successful. This is a critical stage in the process as there may be strong resistance to change.

Strategic Control – is the tracking of a strategy as it is being implemented, detecting problems or changes and making adjustments to stay on track.

Continuous Improvement – provides a way for organisations to respond more proactively and timely to rapid changes. The process should continually be reviewed and improved upon.

The first part of this chapter was dedicated to theories on strategy in general. The second part of this chapter will describe the product life cycle theory and the special emphasis will be given to the various strategies to be employed during the different product life cycle phases.

2.3 The role of the Product Life Cycle Concept

This second part of the chapter will describe the product life cycle as a strategic decision-making instrument. Special emphasis will be given to the characteristics and various strategies to be employed during the different product life cycle stages.

The Product Life Cycle (PLC) uses a biological analogy to describe the evolution of sales as a function of time, (based upon the biological life cycle). For example, a seed is planted (introduction); it begins to sprout (growth); it shoots out leaves and puts down roots as it becomes an adult (maturity); after a long period as an adult the plant begins to shrink and die out (decline) (refer to Figure 2.2).

In theory it's the same for a product. After a period of development it is **introduced** or launched into the market; it gains more and more customers as it **grows**; eventually the market stabilises and the product becomes **mature**; then after a period of time the product is overtaken by development and the introduction of superior competitors, it goes into **decline** and is eventually **withdrawn**. All products and services have certain life cycles.

However, most products fail in the introduction phase. Others have very cyclical maturity phases where declines see the product promoted to regain customers.

"While many products do not follow this prescribed route because of failure, the product life cycle concept is extremely valuable in helping management to

look into the future and better anticipate what changes to make to their strategy" (Walker *et.al.*, 1999: 146).

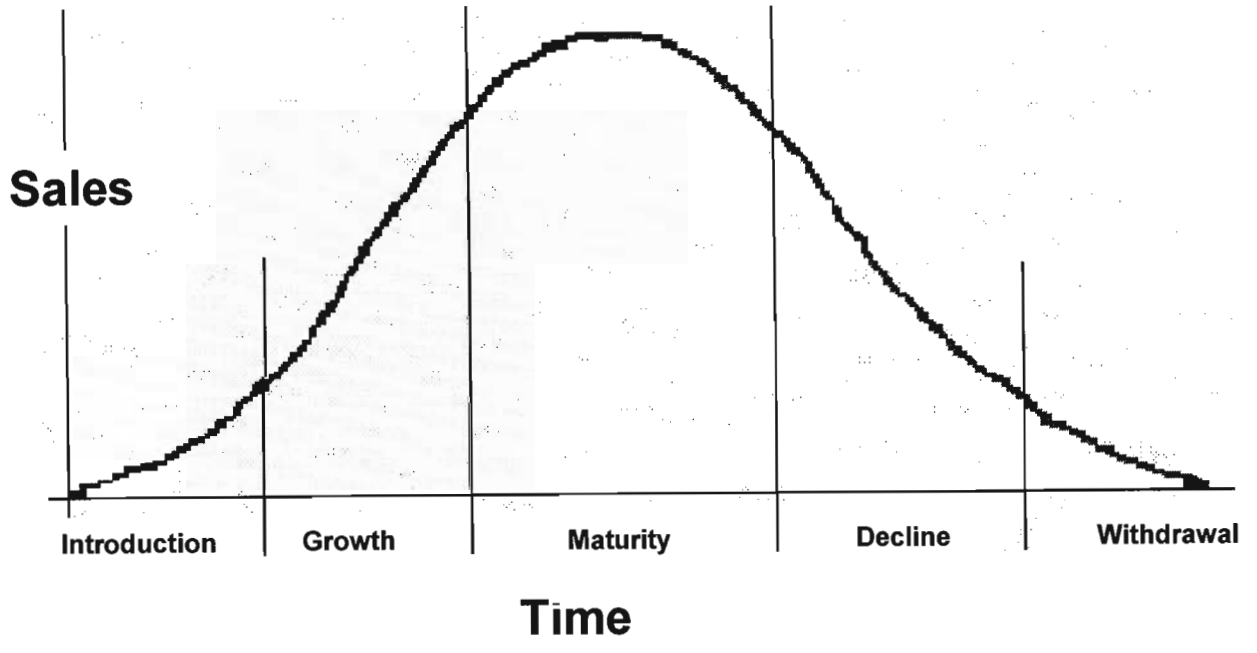


Figure 2.2: The Classical Product Life Cycle Graph
Source: Bensoussan and Fleisher (2003: 365)

2.3.1 Fundamentals of the product life cycle concept

2.3.1.1 Background

The product life cycle theory as a conceptual model is attributed to Joel Dean, who wrote about the concept in a 1950 article "Pricing Policies for New Products," in the Harvard Business Review. Dean (1950) proposed a new way of pricing products at the time, which was largely based on costs and guesswork. He offered the product life cycle as a strategic rationale for pricing products based on changing market dynamics. The product life cycle grew in popularity through the 1960's and the marketing mix variables were incorporated into it. The marketing mix is a combination of four controllable variables which are the product, place, promotion and price also known as the

4P's model. Marketers essentially have these four variables which they can use while crafting a marketing strategy.

Since its inception the product life cycle has remained a stable feature of marketing teaching. It is the one most quoted and most frequently taught elements of marketing theory. This is according to marketingteacher.com (Internet 12) which is a website that describes key marketing topics for marketing learners, teachers and professionals.

According to Mercer (1993: 269) the influence of the product life cycle can be seen in other theories, from new product development to portfolio analysis. It has more recently been incorporated into strategic management teaching as well and has achieved universal acceptance because of its appeal and wide application. There are numerous management strategies that are used by most companies worldwide to optimise a product's revenue in respect to its position on the product life cycle curve. These strategies will be examined after a theoretical analysis of the product life cycle model is made.

However, "despite the praise for the product life cycle concept very few publications contested the assumptions it makes" (Grantham: 1997: 4). The substantiation of the concept has seemed surprisingly difficult to uncover. Despite all the criticism mentioned in the introductory chapter, the product life cycle theory has become accepted and valued as an element of basic marketing theory and has become a building block for strategic management theory.

The product life cycle has mainly been applied to large corporations, businesses and organisations in empirical studies as derived from the literature survey. This, therefore, provides a gap and a definite need to test the product life cycle on a smaller subsidiary (the manufacturing concern under examination), and this will form the basis of this empirical research and will be discussed in chapter five.

2.3.1.2 The Product Life Cycle Model Description

An adaptation of the classical product life cycle graph is the one below (refer to Figure 2.3), and it has an additional stage called product development. Therefore, the product life cycle has five major phases: Product development, Introduction, Growth, Maturity and finally decline. According to the theory, every product or service has a life cycle and goes through the different phases or stages.

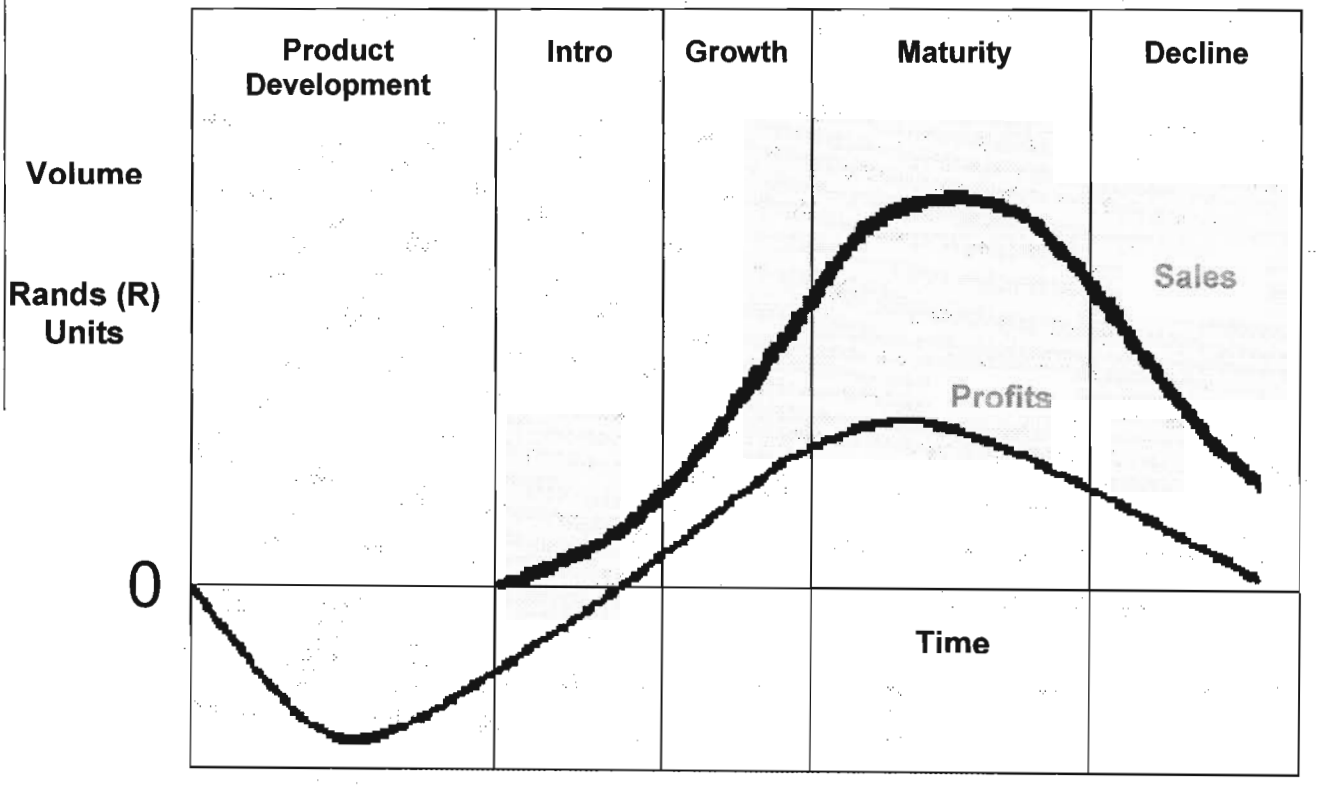


Figure 2.3: The Product Life Cycle Graph

Adapted from: Norman D. (1998:6)

- **Product Development Stage**

This phase begins when a company finds and develops a new product idea. Usually several changes are made to the product as it goes through testing and refinement. Only a few products survive the initial testing and go onto the next stage. During this stage, sales are zero and revenues negative. It is a time of spending with absolute no return.

- **Introduction Stage**

This is the stage when a product is ready for the market and is launched. This period can be described as a "money sinkhole" compared to the maturity phase of a product. Large capital expenditure is required for promotion and advertising. A company must be prepared to spend a lot and get only a small proportion back.

- **Growth Stage**

The growth phase offers the satisfaction of seeing the product take-off in the marketplace. It is also the time to focus on increasing market share by trying to differentiate its products offered from its competitor's ones. At this stage a company must develop efficiencies and improve product availability and service. Accurate estimations in forecasting customer needs are necessary in order to plan production capacity requirements.

- **Maturity Stage**

When the market becomes saturated with variations of the basic product and all competitors have alternative products, the maturity stage arrives. This period is the period of highest returns from the product. A company that has achieved its market share goal enjoys the most profitable period, while a company that falls behind must reconsider its positioning. During this period new brands are introduced even when they compete with the company's existing products. This is the time to extend the product's life.

- **Decline Stage**

Most times it is difficult for a company to accept the decline signals which is usually decline of market sales, due to being too optimistic because of big product success in the maturity phase. This is the time to start withdrawing variations of the product that are weak in their market position.

The above descriptions of the various stages of the product life cycle were adapted from the marketingteacher.com website (Internet 12).

2.3.2 Analysis of the product life cycle model

Competitive advantage is an organisation's ability to perform in one or more ways that competitors will not or cannot match (Kotler, 2000: 316). It was revealed in the literature study that the product life cycle concept is an important aspect to create competitive advantage and is realised through the organisation's strategy. There are various strategic management techniques that have been developed and prescribed for each stage of the product life cycle. These have been designed to optimally guide managers' decision-making through the various stages. "In effect, the theory evolved from a descriptive framework into a predictive and normative strategic management system. Several generalised strategic prescriptions became routinely associated with each stage of the product life cycle," (Bensoussan and Fleisher: 2003: 367). These are described and summarised in Tables 2.1 and 2.2 below.

Hofer (1975: 784-810), had two propositions, namely:

i) The most fundamental variable in determining an appropriate strategy is the stage of the product life cycle

ii) Major changes in business strategy are usually required during three stages of the product life cycle: introduction, maturity and decline.

However, a problem arises as to how; a manager identifies which stage of the product life cycle his product is in. To do that a good method is one, suggested by Clifford (1965), which follows.

- Data collection about the products behaviour over at least a period of 3-5 years (information to include price, units sold, profit margins and market share)
- Analysis of number of competitors in respect to market share. Also, carry out an analysis of their strategies (production increases, plant upgrade and product promotion)

- Collection of information of life cycles of similar products
- Estimation of sales for 3-5 years from product launch
- Estimation of total costs compared to total sales for 3-5 years after product launch. The estimate should be in the range of 4:1 in the beginning to 7:1 at the stage where the product reaches maturity.

Once the specific stage in the product life cycle is identified a strategy as described below must be adopted (refer to Table 2.1 below).

Table 2.1: Normative PLC Strategies

	Development Stage	**Introduction Stage**	**Growth Stage**	**Maturity Stage**	**Decline Stage**
Strategic Goal	Make your product known and establish a test period	Acquire a strong market position	Maintain your market position and build on it	Defend market position from competitors and improve your product	"Milk" all remaining profits from product
Competition	Almost not there	Early entry of aggressive competitors into the market	Price and distribution channel pressure	Establishment of competitive environment	Some competitors are already withdrawing
Product	Limited number of variations	Introduction of product variations and models	Improvement – upgrade of product	Price decrease	Variations and models not profitable are withdrawn
Price Goal	High sales to middle men	Two options: High to offset costs of product development or Low to increase sales	Re-estimation of price policy Two options are High – skimming or Low – market penetration	Defensive price policy. Low enough to avoid price wars	Low to maintain small profit and reduce risk of unsold inventory
Promotion Goal	Creation of product awareness in the market	High intensity, heavy discounts and focus on early adopters.	Low intensity, reinforcement	Heavy promotion to protect shelf-space and induce brand switching	Gradual decrease, minimum intensity to move inventory
Distribution Goal	Exclusive and selective distribution through certain channels and	Distribution through all channels available	Reinforced distribution with good supply to middle men but with low	Reinforced distribution with good supply to middle men but with low	Withdrawal from most channels of distribution except those used in the

	create high profit margins for them		margins of profit for them	margins of profit for them	development stage
Manufacturing	Test samples	Job process	Batch process	Assembly line	Continuous flow

Adapted from: Avlonitis (2001) & Rowe *et. al.* (1986:156)

A study conducted by Anderson and Zeithaml (1984: 1) empirically examined differences in strategies between the stages of the product life cycle, as well as differences among the determinants of high performance across the stages. They suggested the life cycle concept could be used in two ways:

i) to assume that all products follow the life cycle and develop strategies to sustain sales and profits rather than allowing decline, or

ii) incorporate information on the product position in the life cycle with other information such as market share and profitability.

The findings of Anderson and Zeithaml (1984: 23-24) question the idea that a single set of strategies is preferable at any stage of the product life cycle, particularly in the growth stage. They derived the following major trends from a sample of 1234 industrial manufacturing organisations:

i) Marketing strategies in the introductory stage emphasise a buyer focus, building on advertising and increasing purchase frequency.
ii) In the growth stage there is a movement toward strategic segmentation and building efficiencies in production and marketing.
iii) High performance strategies for the maturity stage are more complex than for the previous two stages. They centre on improving efficiency in process, reducing overall cost in marketing and distribution.
iv) Very little work has been done regarding strategies in the decline stage. Strategy will depend on industry traits, on whether some segments will have enduring demand, on whether barriers impede exit and on the nature of the competition.

Table 2.2 Strategies for each of the PLC Stages

	Introduction Stage	Growth Stage	Maturity Stage	Decline Stage
Concentration of competitors	High; few pioneers, monopoly	Declining as more competition enters	Increasing industry shakeout	"High few players
Product	One	Variety, brand building	Battle of brands	Drop out
Product differentiation	Low, if any	Increasing; imitations and variations	High; increasing market segmentation	Decreasing as competitors leave market
Barriers to entry	High if product can b protected	Decreasing; growth technology transfer	Increasing as capital intensity increases	High capital intensity, low returns
Barriers to exit	Low; little investment	Low, but increasing	High for large company	Decreasing; endgame
Price	Skimming or penetration	Meet competition; price dealing / price cutting	Meet competition; price dealing / price cutting	Meet competition; price dealing / price cutting
Price elasticity of Demand	Inelastic; few customers	Increasingly elastic	Inelastic only in segments	Very elastic; bargaining power of buyers high
Economies of scale	Few; unimportant	Increasing capital intensity	High	High
Experience curve effects	Large early gains	Very high; large production volumes	Decreasing magnitude	Few
Vertical integration	Low	Increasing	High	High
Risks involved in Business	Low	Increasing	Increasing	Declining exit barriers

Adapted from Rowe *et. al.*: (1986:156).

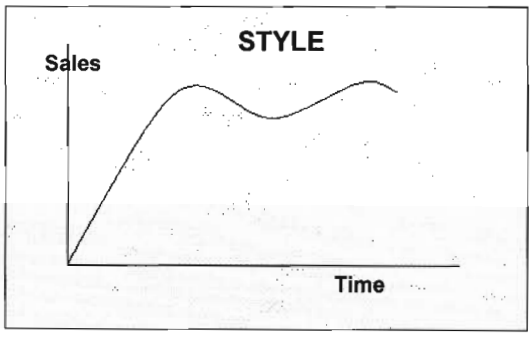
Application of the above strategies is often difficult as the exact stages of the product life cycle are not easily demarcated as different products may behave and respond differently. They do not follow the classical product life cycle curve, and there are numerous product life cycle curves that products could follow. Some products even skip certain stages while others linger in one stage and move rapidly through another.

2.3.3 The different PLC curves

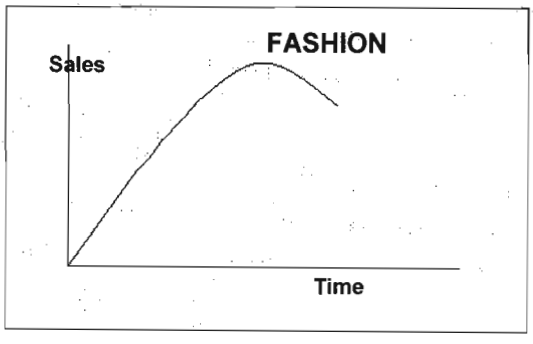
"Many studies have attempted to validate the product life cycle. Their success has been decidedly mixed. While the classic bell-shaped product life cycle discussed earlier has been validated in some industries, it is only

one of many different types of product life cycles," (Bensoussan: 2003: 372). Some researchers have identified as many as a dozen different cycles. Professor Cox was able to identify six different shapes of the product life cycle graph in a research of 256 pharmaceutical products.

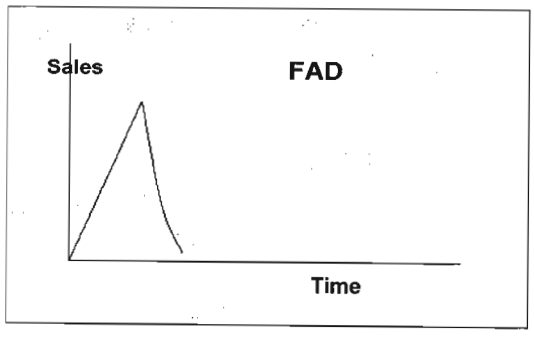
The aim of the empirical part of the study is not to test or question the product life cycle curve, but it is necessary to provide a short description of the various patterns to illustrate the differentiation from the classical curve illustrated in Figure 2.2.



A style is a distinctive mode of expression and once a style is invented, it can last for generations.



A fashion is a currently accepted or popular style in a given field. For example, jeans are a fashion in today's clothing.



A fad is fashion that attracts public awareness, are adopted with great speed, peak early and decline very fast.

Figure 2.4: Style, Fashion & Fad Life Cycles

Adapted from: Kotler (1997: 349)

From the above it is evident that not all products follow the traditional bell-shape as depicted in figure 2.2. Researchers have identified a number of alternate patterns – the growth-slumped maturity pattern, the cycle-recycle pattern and the scalloped pattern are discussed below.

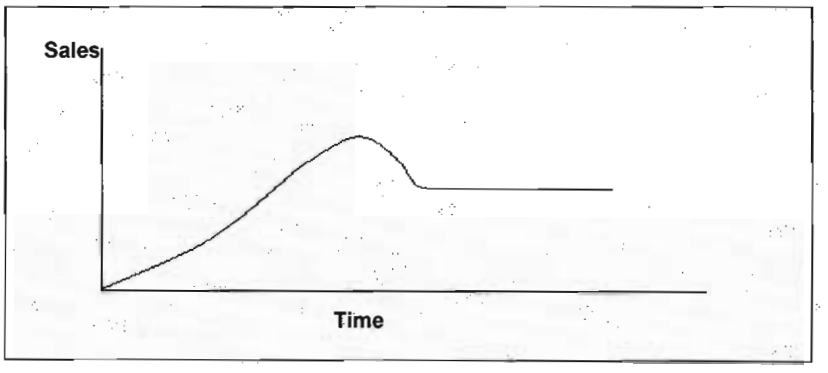


Figure 2.5: Growth-slumped maturity pattern

Late adopters buy the product for the first time and early adopters replacing the product sustain sales levels and prevent decline. This curve is often depicted by small kitchen appliances.

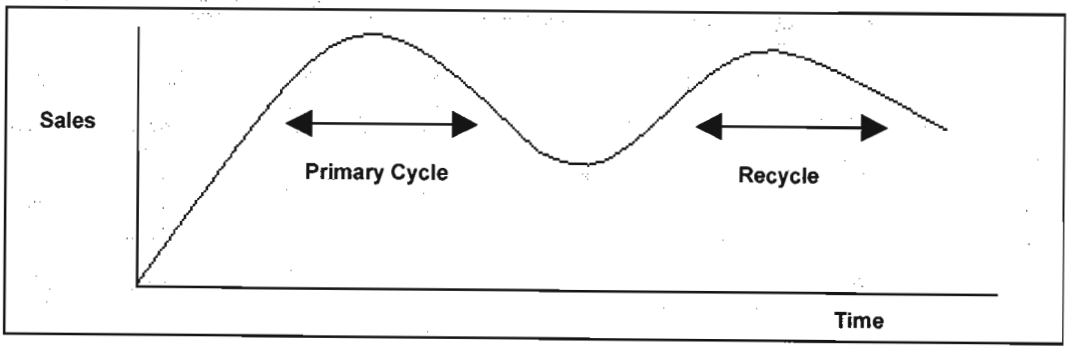


Figure 2.6: Cycle-recycle pattern

This shape is often associated to pharmaceutical products. An example is when companies aggressively promote a new drug, this results in the first cycle. As sales start decreasing the company gives the drug another promotion push and this produces the second cycle.

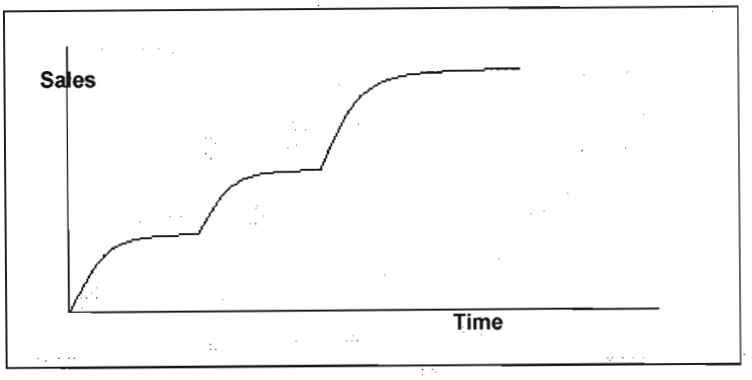


Figure 2.7: Scalloped pattern

As illustrated in figure 2.7 above sales pass through a series of life cycles as new-product characteristics are discovered. An example is nylon sales, which showed a scalloped pattern as new uses were discovered over time.

2.3.4 Criticism and limitations of the PLC

In the mid 1970's the product life cycle model as described in this chapter, came under heavy criticism by numerous authors as mentioned in chapter one, namely Doyle (1976), Grantham (1997) and Midgely (1981). The main reasons behind this criticism are described below.

There are many products that do not follow the classical product life cycle shape, as seen in 2.3.3 above. This makes the typical product life cycle model difficult and complex to use and needs to be adapted in almost all cases.

There can be shift changes in the demand of a product along a period of time and this makes the distinction of the different stages very difficult. The duration of these shift changes are also impossible to predict.

The product life cycle does not entirely depend on time as depicted on figure 2.2, the classical product life cycle graph. It also depends on other parameters such as management policy, company strategic decisions and market trends. These parameters are difficult to identify and so are not included in the product life cycle model.

The model also depends on a particular product. These and the criticisms described in chapter one provide a strong argument against the use of the product life cycle model. Regardless of the problems in the model as discussed above, a company must know how to recognise in which phase of the life cycle their products are in and be able to implement the relevant strategies. They need to make modifications to the classical product life cycle model if necessary.

There are gaps in the product life cycle theory and have been documented by numerous authors, below are the major ones.

The clear value of the life cycle analysis is still to be proven (Sproles, 1981:123). The application of the product life cycle theory for strategic planning across functional areas has been overlooked (Birou, Fawcett and Magnan, 1998:38). The product life cycle on its own is insufficiently uniform to provide a basis for decision-making and therefore planning (Doyle, 1976:3). The product life cycle is empty of empirical generality and positively dangerous if used a guide for action (Grantham, 1997:7).

Other gaps identified by the researcher were that there was lack of evidence of any empirical studies carried out on companies or products in South Africa. All research and studies found were done on large companies abroad. South African decision-makers need more literature on the product life cycle on research being done on companies operating in South Africa, in order for them to use the product life cycle for strategic decision-making more effectively.

2.4 Background to Auto-catalysts and Johnson Matthey

This part of the chapter will be dedicated to catalysts, their purpose and some background to the company, Johnson Matthey, which is the manufacturing concern that is being investigated in this study.

2.4.1 Theory on auto-catalysts

Auto-catalysts are fitted into exhaust systems of motor vehicles and are also referred to as catalytic converters. They are an environmentally friendly product with the aim of reducing the harmful gases emitted from engines. The auto-catalyst is coated with special chemicals, of which precious metals such as platinum are a main component. A reaction occurs within the catalytic converter of the motor vehicle and harmful gases are converted into less harmful environmentally friendly gases. Figure 2.8, illustrates how the auto-catalyst looks and functions.

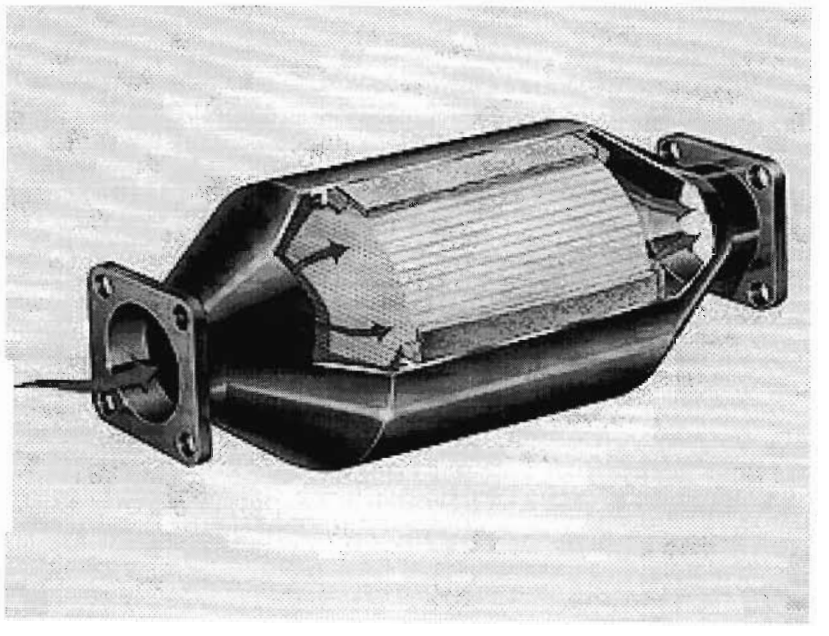


Figure 2.8: An Auto-catalyst

Source: Johnson Matthey Plc. (Internet 6)

The auto-catalyst forms part of the vehicles emission control system. Figure 2.9, shows how it is integrated into this system.

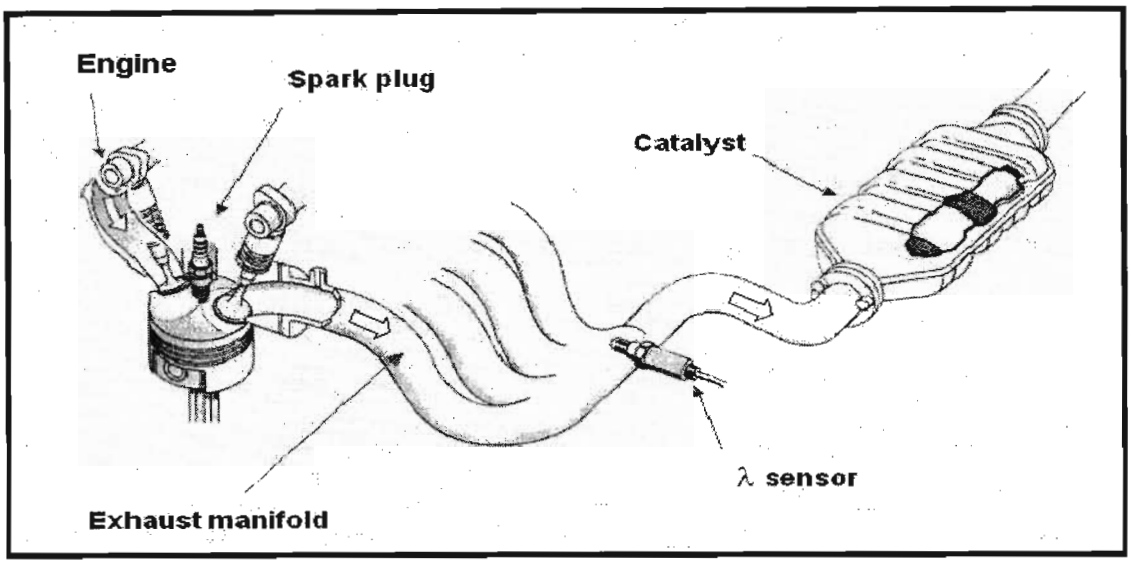


Figure 2.9: Vehicle Emission Control System

Source: Johnson Matthey Plc. (Internet 6)

Catalytic converters are the largest of the auto component groupings being exported from South Africa and now amount to $500 million/year. The growth of the local catalytic converter industry has been spectacular as depicted by figure 2.9. It has since further grown to amount to almost $1.5 billion last year, 2005 (Johnson Matthey (Pty) Ltd: Presentation by Dr David Prest).

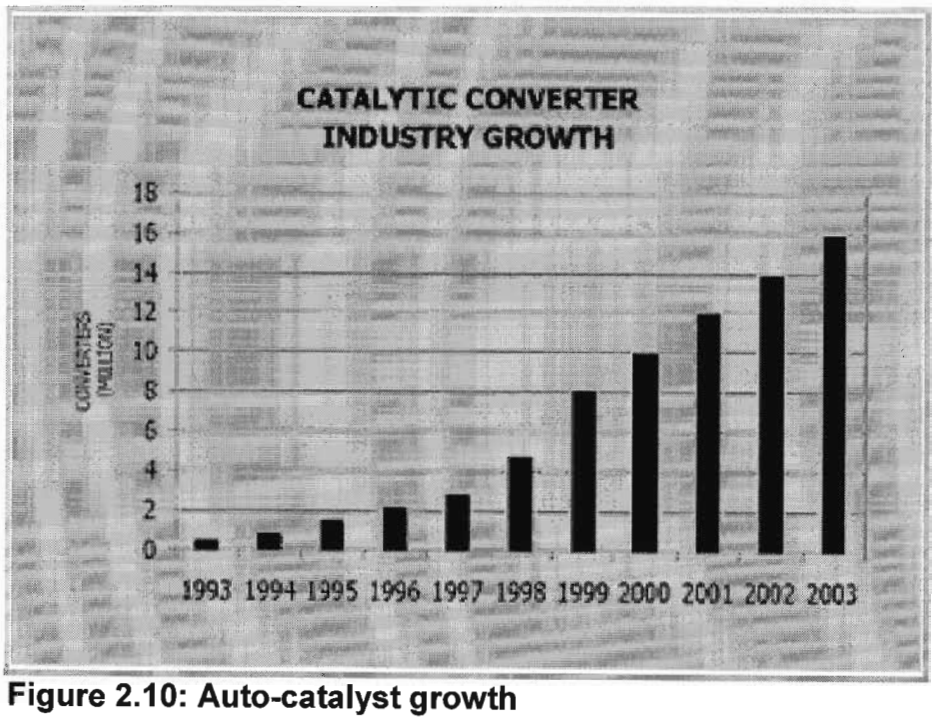


Figure 2.10: Auto-catalyst growth

Source: Internet 6

2.4.2 Advantages of production in South Africa

There are many reasons why the motor industry and specifically the catalytic converter or auto-catalyst industry has been growing at a phenomenal rate and is so successful in South Africa. The major reasons are discussed below.

2.4.2.1 Motor Industry Development Programme

This programme was introduced by the South African government in 1995 and applies exclusively to the motor industry. It allows exporters of motor vehicle components or vehicles to claim a rebate duty on any components or vehicles that they need to import. It is basically an import duty tax incentive that exporters can claim to offset duties on what they import.

This incentive programme by the South African government has resulted in strong growth in the South African motor industry, and the catalytic converter industry in particular.

2.4.2.2 Platinum Group Metals

South Africa produces in excess of sixty percent of the world's platinum group metals, including platinum, palladium and rhodium, which are the essential raw materials for production of auto-catalysts. Additionally, while South Africa's production levels are high, the country has in excess of eighty percent of the known reserves of these metals, which makes South Africa the long-term strategic supplier of these raw materials.

2.4.2.3 Chromium

South Africa is additionally the home to more than seventy percent of the world's resources of chromium, which is the essential ingredient in the stainless steels used to both house the catalyst and produce modern auto

exhausts. This resource base now produces in excess of fifty percent of the world's ferrochrome and has prompted the development of Columbus Stainless, one of the largest and most modern integrated stainless steel works in the world.

Government incentives and the availability of the main raw materials required in the production of auto-catalysts has resulted in five of the world's leading producers now being situated in South Africa, one of which is Johnson Matthey Plc. (Internet 10)

2.4.3 Background to Johnson Matthey

The firm was founded in 1817 as gold assayer is now the world's leading manufacturer of automotive catalytic converters. The company enjoys approximately forty percent market share in the auto-catalyst industry. Internationally, the company employs around 7,500 people in thirty four countries across the globe (Internet 6).

The South African operation started in 1991 with the manufacture of auto-catalysts and has grown tenfold in the last fifteen years. It employs approximately 750 employees representing ten percent of the company's world-wide work force. It is also, the largest of Johnson Matthey's auto-catalyst production facilities, making the South African operation a major player in the industry.

2.5 Conclusion

This chapter had three broad sections. The first section discussed strategy, its benefits and risks and the strategic management model.

The next section focussed on the product life cycle theory. Here the fundamentals of the product life cycle were discussed. The different strategies relevant to the different product life cycle stages were also examined. Then the criticism and limitations of the product life cycle was looked at and many gaps identified mainly the lack of empirical research on companies in South Africa. These gaps in the product life cycle convinced the researcher to conduct this study on the applicability of the product life cycle theory on a company operating in South Africa. This study is the next step in the development of the literature in the product life cycle theory, testing the product life cycle on a company in South Africa, a developing economy.

Finally, the last section looked at auto-catalysts, the reason the business is so successful in South Africa and a brief background to the company, Johnson Matthey.

The next chapter will be devoted to research process and approach that was used for this study, the research methodology for this study.

CHAPTER THREE – RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research process and approach that was used for this study. The research methodology will be discussed with special emphasis placed on data collection, questionnaire design and statistical procedures that will be used later to analyse the results of the questionnaire. Selecting the appropriate methodology is essential for the effectiveness of any research and particular attention must be paid to the methods used to gather information.

3.2 Data sources

There are basically two types of data, primary or secondary data. Data that has already been collected for some other purpose and could possibly be reanalysed to answer the present research questions are known as secondary data (Saunders *et al.*, 2003). Primary data is original data collected for the specific purpose of answering the research questions. "Most research questions are answered using some combination of secondary and primary data" (Saunders *et al.*, 2003). This study will also use a combination of both primary and secondary data although because of the limited appropriate secondary data available, this study relies mainly on primary data.

3.3 Data collection methods

The nature of research is such that it can be distinctly qualitative or quantitative as many authors state (Easterby-Smith *et al.*, 2002) However, there are others who state that attempts to define the distinctiveness of qualitative research, and therefore the way in which it can be distinguished

from quantitative research, can be problematic (Silverman, 1993). Qualitative research is an unstructured, exploratory research method based on small samples intended to provide insight and understanding of the problem setting (Malhotra, 1996). Quantitative research is one that involves some numerical data or contains data that could be quantified to help answer the research question. There are now numerous computer-based analysis software programmes available for assisting in quantitative data analysis. The analysis of the quantitative data for this study is relatively straight forward and the spreadsheet programme Excel with is statistical functions is used.

This study is a combination of qualitative and quantitative research. This will be executed by means of a questionnaire prepared using Excel forms, and sent out electronically. The data will be stored automatically onto a prepared database. No names are required in the questionnaire and the data cannot be traced back to individuals, thus ensuring that total anonymity and confidentiality of the participants are maintained throughout the research and data analysis process.

The questionnaire would be tested on a supervisor and a company director to ensure all the questions are clear and unambiguous and that all the important aspects have been included in the questionnaire. The user friendliness of the questionnaire would also be tested and refined to ensure that it is as easy to use as possible.

Various methods of collecting primary data exist. These were normally post mail based; telephone interviews, personal interviews (face-to-face), focus groups and now more recently electronic mail based self-administered questionnaires.

Dillon *et al* (1993) provide a number of factors that the researcher can consider during selection of the best survey method. These factors are depicted in Table 3.1.

Table 3.1 Summary of the data collection methods

	Postal survey	Telephone survey	Personal interview
Cost	Often lowest	Usually in-between	Usually highest
Ability to probe	No personal contact or observation	Some chance for gathering additional data	Greatest opportunity for additional probing
Respondent ability to complete at own convenience	Yes	Perhaps, but usually no	Perhaps, but usually no
Interview bias	No chance	Some, perhaps due to voice inflection	Greatest chance
Ability to decide who actually responds to the questions	Least	Some	Greatest
Time lag between soliciting and receiving response	Greatest	Least	May be considerable if a large area involved
Suitable types of questions	Simple, mostly dichotomous (yes/no) and multiple choice	Some opportunity for open-ended questions	Greatest opportunity for open-ended questions
Response rate	Low	Usually high	High

Adapted from Dillon *et al.*: (1993:173).

The table does not consider an electronic questionnaire, which was the chosen survey method for this study, however the factors are important and where considered during the decision-making process.

Versatility refers to the extent to which the survey method can handle different question formats and scenarios. In this study this would not be of concern as a set questionnaire would be formulated and there would only be one format sent out to whole sample.

The quantity of data would not to be very large and therefore the chosen method would be suitable.

Sample control would also not be problematic as the electronic questionnaire would only be sent out to the specific sample.

Quality of data, as seen from the table above is better without the presence of an interviewer as more honest and accurate responses are more prominent. This was one of the factors that favoured the electronic based questionnaire method.

Historical response rate's for electronic based survey method was not known as this was a fairly new method. It was decided to continue with this method as the sample size was small and the questionnaire easy to answer. The researcher was even willing to send out the electronic questionnaire more than once, as this would be fairly easy to do.

Speed on electronic questionnaires was also unknown, but the assumption was made that it would be very quick as all it required was a push of a button on the keyboard.

Cost was also another motivating factor for choosing the electronic questionnaire method as it was inexpensive and this research was not being funded.

Another factor that was not included in the table above is convenience to the candidate. An electronic based questionnaire could be answered by the candidate in their own spare time and in a very busy work environment, the electronic questionnaire method also met this criterion.

Taking into account all of the above criteria, the electronic questionnaire survey method was the method that would be chosen.

3.4 Potential sources of errors in the research design

Various errors can occur in the research design and will have an impact on the collected data and the usefulness thereof. Figure 3.1 below outlines the different types of errors that can affect the research design.

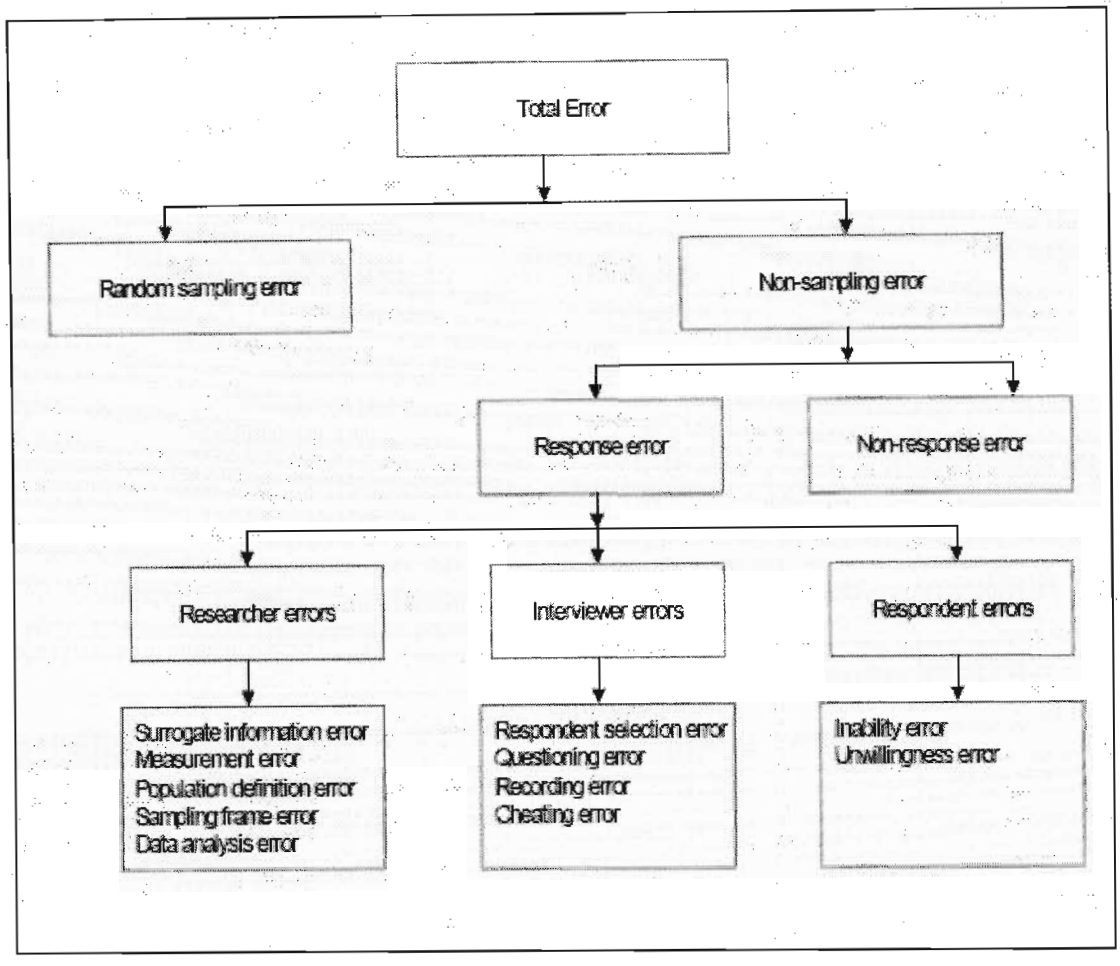


Figure 3.1: Errors in Research design
Adapted form: Malhotra (1996:100)

According to Malhotra the total error over the whole research project can be divided into a random sampling error and a non-sampling error. The random sampling error occurs when the selected sample is an imperfect representation of the population of interest. In this research project the entire population formed the sample, thus eliminating the random sampling error. In the case of this research the population size is sufficiently small for the

questionnaire to be sent out to the whole population, in most other studies this is not possible.

Non-sampling errors (all errors not attributed to sampling) consist of response errors and non-response errors. Malhotra (1996) defines a response error as a non-sampling error arising from respondents who do respond but give inaccurate answers or whose answers are misreported or incorrectly analysed. In the case of this research the questionnaire was an electronic version with a selection from options given where possible in order to eliminate answering errors. There would be no interviewer and the answers would be immediately captured and stored on an Excel spreadsheet data base thus eliminating reporting and recording errors.

The other non-sampling error is the non-response error which occurs when some respondents included in the sample do not respond, causing the obtained sample to be different in size and composition from the original sample. According to Sudman and Blair (1999) there has been a disturbing trend of a steady decline in sample co-operation in the past quarter of the century. Unfortunately, this cannot be controlled. On the basis of the above trend this study will attempt the following possibilities in order to increase the chances of getting most of the chosen sample to respond. Firstly, the questionnaire is an easy, user friendly electronic format with drop down options for most of the answers, thus making answering the questionnaire very simple and fast (no more than 10 minutes). The researcher will also make an appeal, providing a clear account of the purpose of the questionnaire and resend the questionnaire to those who do not respond the first time. This will be done for as many times as is required to get a high enough response/realisation rate (> 30 %). This is also subject to time constraints as the more times the questionnaire is sent out the longer the whole research study would take.

3.5 Sampling

"For some research questions it is possible to survey an entire population as it is of a manageable size," (Saunders *et al.*, 2003). This is exactly the case in this research study; the population consists of decision makers in a catalysis manufacturing subsidiary in Gauteng. The total number of supervisors, managers and directors at this company is seventy two and is known as the population.

Following the guidelines set out by Saunders *et al.*, (2003), there are series of decisions to be made in order to select a suitable sampling technique. Part of the process is displayed below in figure 3.2

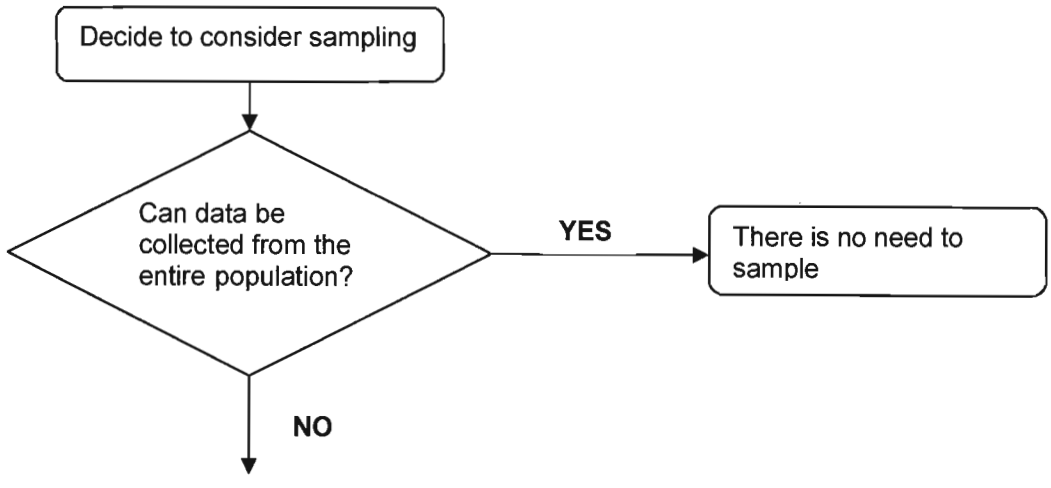


Figure 3.2: Selecting a sampling technique
Adapted from Saunders *et al.*, (2003: 171)

When the above process was carried out, the answer to the first question was a yes, and that implied that there was no need to sample. Therefore this study attempted to collect data from every member of the selected population and this is termed a census.

3.6 Survey method: Electronic mail questionnaire

The self-administered questionnaire which is completed by the respondent was chosen for this study. The questionnaire was delivered and returned electronically using email. This decision was achieved only after careful consideration was given to the recommendations by Saunders *et al.* (2003), and the following main attributes were considered:

i) Population's characteristics: they were computer-literate and could be easily contacted by email.

ii) Confidence that the right person has responded: very high because of the use of email.

iii) Likelihood of contamination or distortion of respondents answer: very low for on line or email based questionnaire

iv) Financial implications: email was easily available, therefore there were no costs incurred.

v) Data input: electronic questionnaire forms enabled data to be automatically stored onto database.

vi) Response rate: email based questionnaire is very easy and inexpensive to resend and this is the most reliable solution to non-responses, making call-backs.

There are disadvantages to this type of questionnaire. The major limitation is that the there is no interviewer present to enable flexibility to improve the quality of information received and to probe for additional information and gather more information through observation. However, interviewing is very costly and professional interviewer's salaries are typically high (Cooper and Schindler, 1998) reiterates that interviewing is costly and they continue to rise. Therefore, the self-administered email based questionnaire method was chosen.

3.7 Questionnaire design and testing

The research problem together with the research objectives have been formulated and discussed in chapter one and will be considered when designing the questionnaire. "The validity and reliability of the data collected and the response rate achieved depend, to a large extent, on the design of the questions, the structure o the questions and the rigor of the pilot testing," Saunders *et al.*, (2003). The questionnaire design will be discussed in this section under three activities – initial considerations, construction of the questionnaire and the pre-testing of the questionnaire.

The initial considerations of what information is required, who the target respondents are and the type of data collection method to use have been addressed in chapter one. The other special consideration was what electronic format to use to construct the questionnaire in. The researcher chose Microsoft Excel because it is easy to use. Therefore the initial pre-testing questionnaire was done in Microsoft Excel (refer to Appendix A). After the initial pre-testing it was found that this did not satisfy all criteria. Important criteria for the questionnaire was that it had to be user friendly, easy to fill in and the data automatically stored. It was for this reason that the user forms from Visual Basic for Excel was used to construct the final questionnaire.

The researcher attended a two day advanced Visual Basic Course at the Keybase Computer Training Institute in order to obtain the necessary computer literacy skills in order to be able to use the Visual Basic programme for designing the questionnaire. The programme allowed the data to be captured on a real time basis onto a Microsoft Excel database. This means that as soon as the respondent answered the questionnaire the data (answers) were being immediately saved onto the database.

The construction of the questionnaire entailed extensive Visual Basic programming. Visual Basic Forms were developed and links to the data base

were created. The questionnaire was divided into three forms, which were three distinct sections as can be observed in the final questionnaire in Appendix B:

- Section A: Introduction, qualification and screening questions. Brief explanation and summary of the product cycle concept.
- Section B: Specific product life cycle questions based on the manufacturing concern and its products under investigation.
- Section C: Questions on whether or not the respondent uses the product life cycle concept in strategic decision making or will in the future.

A very brief covering letter, explaining the purpose of the survey, followed by instructions on how to open up and save the programme was sent on an email to the respective potential respondents with the questionnaire as an Excel attachment. The instructions were in a step-by-step easy to follow arrangement. The product life cycle curve formed the background and there was a five second delay betweens forms. The respondent had the option to abort the answering of the questionnaire at any time by clicking on the 'cancel' button on any of the pages or forms. Once the candidate completed a section he could click on the 'next' button to continue. Once the respondent has completed the entire questionnaire the programme will automatically request to save by means of a pop-up and all the respondent has to do is click on the 'yes' button and the questionnaire data will then be automatically stored.

For any research project there is a temptation to skip the pilot or pre-testing of the questionnaire due to time constraints. The advice from Saunders *et al.*, (2003) was heeded "however pressed for time you are, do your best to give the questionnaire a trial run, as without a trial run, you have no way of knowing your questionnaire will succeed." Two respondents from two different categories were used for the initial pilot testing (refer to Appendix A); one was a company director and other a departmental supervisor. It was decided that this would be sufficient testing as the sample group was small and the test group would be sufficient to address any major variations. After the

suggestions and recommendations from that first round of pilot testing was taken into account and the final adjustments were made to the questionnaire it was then tested by the managing director. There were essential changes that were made to the questionnaire after the pilot testing and this proved that this type of pre-testing is necessary. The changes are discussed below.

The testing helped establish the validity and reliability of the questionnaire and a preliminary analysis of the test data, ensured that the data being collected would indeed answer the research questions. Each completed test questionnaire was checked and it was found that the respondents had no problems understanding or answering the questions and had no problems with following the instructions. Refer to Appendix A for the initial pre-testing questionnaire and Appendix B for the final questionnaire.

The initial questionnaire was an Excel spreadsheet that was to be printed out, answered and then posted back to the researcher by the respondent. The researcher sent this initial questionnaire out to the pilot test group and received no reply. This was a clear sign that too much was being asked of the respondents with no reward being offered. This is then when it was decided to go the fully electronic questionnaire route and the researcher went for training on Visual Basic programming to create a simpler, faster and more user friendly questionnaire format. The detailed programme can be found in Appendix C.

Once this was done and sent out via email to the pilot test group, electronic feedback and a positive response was sent back. The major changes made were:

- The database was behind the questionnaire forms and the respondent could view the previous answers that had already been saved to the database. An appropriate background was created, which was decided to be the product life cycle graph, refer to Appendix B1, and this blocked out the answers in the database.

- The explanation of the product life cycle concept was part of the email and made the email long and complicated. Therefore it was decided to display this information on the second form, refer to Appendix B3.
- The Excel database and the Visual Basic programme was password protected to maintain the integrity of the data captured.

The final testing stage with the managing director resulted in a smooth flowing questionnaire with no more changes recommended and the go ahead was given for the questionnaire to be sent out to the decision makers in the company. These are all the seventy two possible candidates and comprise of the six company directors, twenty four managers, ten superintendents and thirty one supervisors.

3.7 Data manipulation and statistical testing

Once the data is collected and transported in the database it becomes very easy to manipulate the data and run tests. The data can be very easily sorted into many different categories very rapidly. Statistical calculations such as means, averages, frequency and percentages are all done by the program at high-speed. One of the built in functions of Microsoft Excel was used to carryout a statistical t-distributed test to determine whether or not there is a significant difference groups. The p-value which is the probability of just rejecting the null hypothesis is calculated. If the p-value is less than 0.05 (or 5%) then that signals a strong difference between the two groups, 0.05 to 0.1 a moderate difference and greater than 0.1 signifies little or no difference. This was a major advantage of using electronic medium as data could be manipulated without much time being lost as would have been the case with a manual system.

3.8 Conclusion

This chapter focused on the research methodology used in this study. Selecting the correct methodology was crucial for this study to be effective. Traditional data collections methods did not satisfy all the required criteria, especially speed and cost factors. Therefore, the self administered electronic questionnaire was the chosen data collection method mainly because of its convenience, speed and low cost. This was a very new concept and had to be developed by the researcher. The researcher also had to learn a new computer programming language in order to programme the questionnaire on electronic format.

The design, development and pre-testing of this questionnaire was discussed in detail in this chapter. The questionnaire was initially designed in Excel and then pilot tested. This pre-testing proved invaluable in identifying short comings. After the initial pre-testing the questionnaire had to be re-designed in Visual Basic programming language in order to ensuring that the questionnaire successfully met all the required criteria.

This approach also enabled the researcher to resend the questionnaire out quickly and easily in order to increase the chances of achieving the required response rate of >30%. This type of format had another advantage in that the data could be manipulated at high speed and results immediately analysed. The program also had built in statistical functions that made interpretation of the results fast and efficient.

In the next chapter the data that was collected using this methodology with the electronic questionnaire will be presented and analysed.

CHAPTER FOUR – REPORTING OF DATA

4.1 Introduction

The previous chapter dealt with the research methodology and focused on data collection, questionnaire design and statistical procedures that will be used in this chapter to report on the results of the questionnaire and also to analyse these results. This will be done on a question-by-question basis, and results will be presented in tabular and graphic format. Refer to Appendix B for the final questionnaire. The collected data can be found in Appendix D.

4.2 Response rate

Table 4.1: Response rate

Total number of candidates	**72**
Number of respondents after **first** time questionnaire was sent out	**15**
Response rate after **first** time as a percentage	**21%**
Number of respondents after **second** time questionnaire was sent out	**6**
Response rate after **second** time as a percentage	**29%**
Number of respondents after **third** time questionnaire was sent out	**7**
Response rate after **third** time as a percentage	**39%**
Number of respondents after **fourth** time questionnaire was sent out	**3**
Total number of respondents	**31**
Total response rate as a percentage	**43%**
Response rate per category	
Directors	**80%**
Managers	**60%**
Superintendents	**33%**
Supervisors	**35%**

The response rate is further discussed in chapter five, under the section heading: Limitations of this study.

4.3 The representativeness, validity and reliability of results

On the issue of the credibility of this research finding, attention has to be paid to validity and reliability. The results achieved in this study are only representative of the industry and area in which it was conducted. As the research design for this study of an exploratory nature the questionnaire was designed from literature and tested in a specific industry. Thus, the validity and reliability could not be proven statistically. However, the validity of the results was checked by determining whether the questions in the questionnaire used, measured the characteristics it was suppose to measure.

4.4 Results on a question by question basis

The results will be reported on a question by question basis, using tables, graphs and statistical analysis to describe the data collected.

4.4.1 Section A

The purpose of Section A of the questionnaire is to obtain background information on the respective respondents for later classification purposes. It also serves to establish the representative ness of the respective sample. The following results provide the necessary information for later cross-tabulation.

(a) Questions 1

Q1: What department or function do you fall into?

The total frequency distribution is depicted in Table 4.2, and indicates that the majority of the respondents come from the three largest departments in Johnson Matthey, namely the Auto-catalyst Production, the Auto-catalyst Salts and Technical Support Departments.

Table 4.2: Classification per Department or Function

Department or Function	Frequency	
	Number	Percentage (%)
Accounts	0	0
Buy/Purchasing	1	3.13
Finance	1	3.13
Human Resources	2	6.25
Information Technology	2	6.25
Logistics	2	6.25
Maintenance	1	3.13
ACP Production	5	**15.63**
ACS Production	7	**21.88**
Sales	3	9.38
Security	1	3.13
Technical Support	4	12.50

The results also show that the Departments with the actual highest number of managers and supervisors (ACS – Auto-catalyst Salts Plant & ACP – Auto-catalyst Production Area) form the highest percentage of the total respondents (37.5%) as illustrated in Table 4.2. This also supports the argument that the sample is indeed representative of the total population.

The main finding was that the largest departments or functions had the highest frequency.

(b) Question 2

Q2: How many employees reporting to you (directly or indirectly)?

The majority of the decision makers, 42% as depicted in Table 4.3, at Johnson Matthey had five or less employees reporting to them. However, 23% of them had more than 50 employees reporting to them.

Table 4.3: Number of employees reporting to position

Number of employees	Frequency	Percentage (%)	Cumulative Percentage (%)
0-5	13	**41.94**	41.94
6-10	4	12.90	54.84
11-15	2	6.45	61.29
16-20	2	6.45	67.74
21-30	2	6.45	74.19
31-40	0	0.00	74.19
41-50	1	3.23	77.42
>50	7	**22.58**	100.00
Total	**N = 31**	**100**	_

A more detailed look into the above is illustrated in Appendix D results sorted by number reporting and shows that most of the ACP Production managers and supervisors have more 50 employees reporting to them and most of the ACS Production supervisors have less than 5 employees reporting to them. This demonstrates that there is inconsistency in the managing of the different departments in Johnson Matthey South Africa.

The main finding is that the majority of the respondents have five or less employees reporting to them. The next highest frequency was respondents with greater than 50 employees.

(c) Question 3

Q3: What is your position?

The majority of the respondents, 45%, were managers, illustrated in Table 4.4. Superintendents and supervisors can be combined for the purposes of this study as there is very little difference in their responsibilities and level. They form the next highest percentage of respondents, 42% in total. As there are very few directors in the company it is expected that form a lower percentage of the respondents at 13%.

Table 4.4: Classification according to position

Position	Respondents	Percentage (%)
Directors	4	12.9
Managers	14	45.2
Superintendents	3	9.7
Supervisors	10	32.3

The above depiction of the respondents according to position, in Table 4.4, gives a very definitive support to this study's claim that the sample is representative of the Johnson Matthey South Africa's decision-makers population.

The main finding is that the majority of the respondents were managers.

(d) Question 4

Q4: Do you know what the product life cycle theory is?

The results for this question are depicted in Table 4.5 and gave an overwhelming 74% of the total sample having some knowledge of the product life cycle theory. These results are unexpected and it shows that the product life cycle concept is widely known.

Table 4.5: Knowledge of the product life cycle theory

PLC knowledge	Respondents	Percentage (%)
Yes	23	74
No	8	26

A comprehensive look at the results reveals that only three managers and five supervisors answered no to the above question. This implies that the majority of the major decision makers at Johnson Matthey South Africa, had knowledge about the product life cycle concept.

The main finding is that the majority of the respondents have knowledge of the product life cycle concept.

4.4.2 Section B

The purpose of Section B was to determine the product life cycle's importance and to test the ability of the decision-makers in Johnson Matthey South Africa on product life cycle phase identification and application. The following results provide the necessary information on product life cycle importance and application ability.

(a) Question 5

Q5: Name three aspects that, in your opinion, provide our organisation with a competitive advantage?

This question resulted into 9 main reasons for achieving competitive advantage and these reasons are shown in Table 4.6.

Table 4.6: Factors providing Johnson Matthey South Africa with a competitive advantage

Aspect	Number	Percentage of total Number (%)	Percentage of total respondents (%)
1. Advanced Technology	23	25	74
2. Customer Service	15	16	48
3. Adaptability & flexibility	15	16	48
4. Quality of products	11	12	35
5. Human resources & training	9	10	29
6. Advanced production techniques	7	8	23
7. Marketing & market share	6	7	19
8. Low cost	3	3	10
9. Innovation	3	3	10
Total*	**N = 92**	**100**	–

* The total reflects more than the total sample because of multiple mentions

The aspect, which is regarded as most important by the respondents, in giving Johnson Matthey a competitive advantage is its superior and more advanced technology, as illustrated in Table 4.6. 74% of all respondents chose this aspect as one of their top three aspects and it turned out to be 25% of the total number. Table 4.6 lists all the factors from most important down to lest important. It is evident from Table 4.6 that the decision-makers at Johnson Matthey South Africa can identify aspects providing the organisation with competitive advantage.

The product life cycle concept as such is not mentioned as one of the aspects responsible for creating competitive advantage. It is summarised that the decision-makers (respondents) know of and apply the product life cycle but focused on the results of using the product life cycle and not the product life cycle as a means in decision-making to create an advantage.

The main finding is that advanced technology is the major aspect that is responsible for Johnson Matthey South Africa's competitive advantage.

(b) Question 6

Q6: In what phase of the product life cycle would you position each one of the following of our products?

Johnson Matthey South Africa produces four main products, the flow through catalysts for petrol and diesel cars, heavy duty diesel catalysts and catalytic soot filters also used on diesel vehicles. The primary products at present are the flow through catalysts which form 80-90% of total sales. Both the petrol and diesel flow through catalysts are almost equally important in terms of sales. This can be verified by the latest survey by Pricewaterhouse Coopers and eurocarprice.com that revealed that diesel cars accounted for 49% of the total European car market (Internet 11).

Q6.1: Flow through catalysts (for Petrol engines)?

The majority of the respondents (84%) placed the flow through catalysts for petrol engines in the **mature phase** of its product life cycle as depicted in figure 4.1. The remaining 16% placing the petrol flow through catalyst in the declining phase of its life cycle.

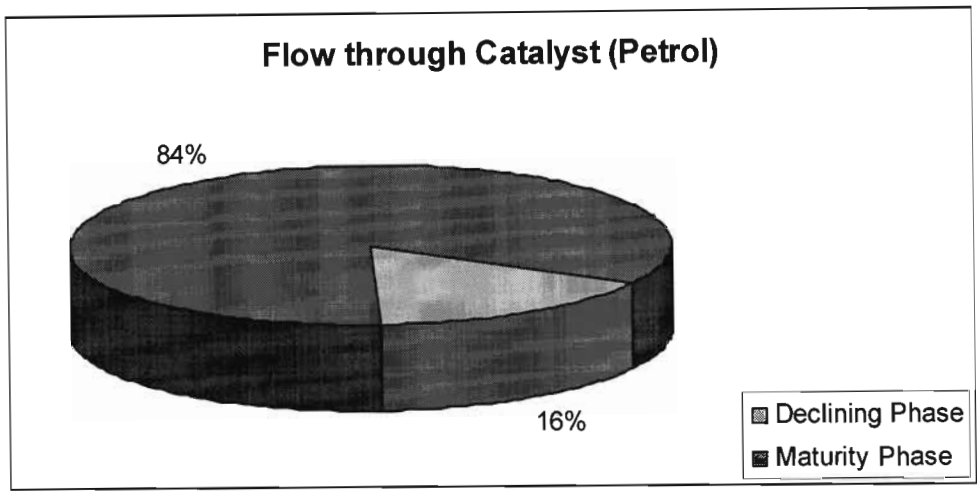


Figure 4.1: Flow through catalyst (Petrol)

The main finding is that one of Johnson Matthey's primary products, the petrol flow through catalyst is in the mature phase of its product life cycle.

Q6.2: Flow through catalysts (for Diesel engines)?

There is much more variation to this question with 62% of the respondents placing the diesel flow through catalyst in the growth phase, 35% placing it in the mature phase and only 3% placing it in the introductory phase as depicted in figure 4.2. It could be deduced from the findings for this question that the diesel flow through catalyst was somewhere between the growth phase and the mature phase of its product life cycle. Alternately, it could be presumed that the diesel flow through is at the end of its growth phase and at the start of its mature phase.

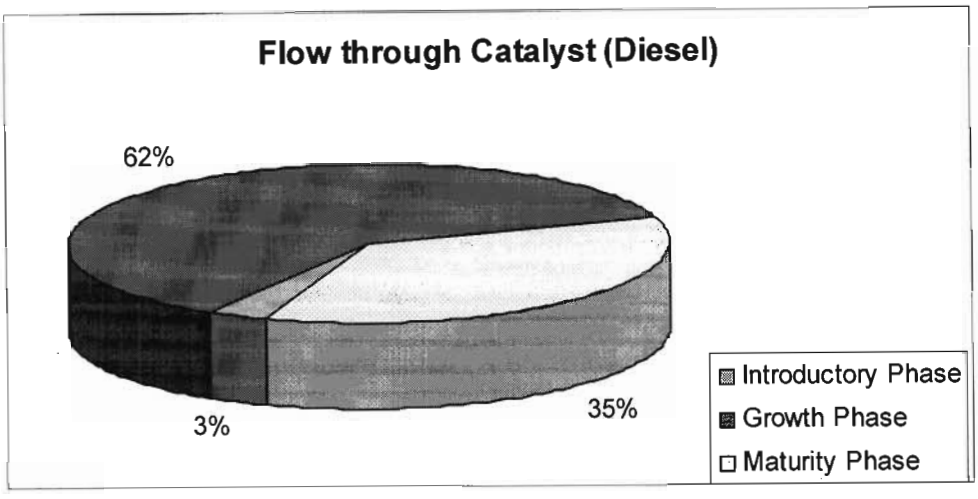


Figure 4.2: Flow through catalyst (Diesel)

The main finding is that the other one of Johnson Matthey's primary products, the diesel flow through catalyst is towards the end of its growth phase of its product life cycle.

Q6.3: Heavy duty diesel catalysts?

Here the results showed that almost half (48%) placed the heavy duty diesel catalyst in the introductory phase and the other half (52%) placed it in the growth phase. The heavy duty diesel catalyst has been developed and sold to only one customer at present. It accounts for approximately 5% of total sales. Therefore, it can be presumed that this product is nearing the end of the introductory phase and is entering the growth phase of its life cycle.

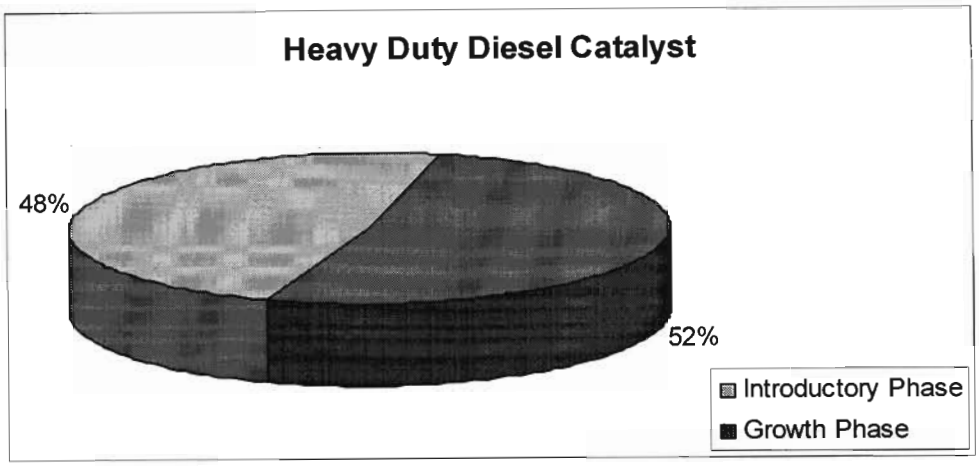


Figure 4.3: Heavy duty diesel catalyst

The main finding is that the heavy duty diesel catalyst is towards the end of the introductory phase and entering the growth phase of its product life cycle.

Q6.4: Catalytic soot filters?

The majority of the respondents (68%) placed catalytic soot filters in the **introductory phase** of its product life cycle. The rest of the respondents (32%) placed it in the growth phase. Catalytic soot filters account for less than 5% of total sales and is still very new to the market. Johnson Matthey is still promoting the product. The catalytic soot filters are in their introductory phase.

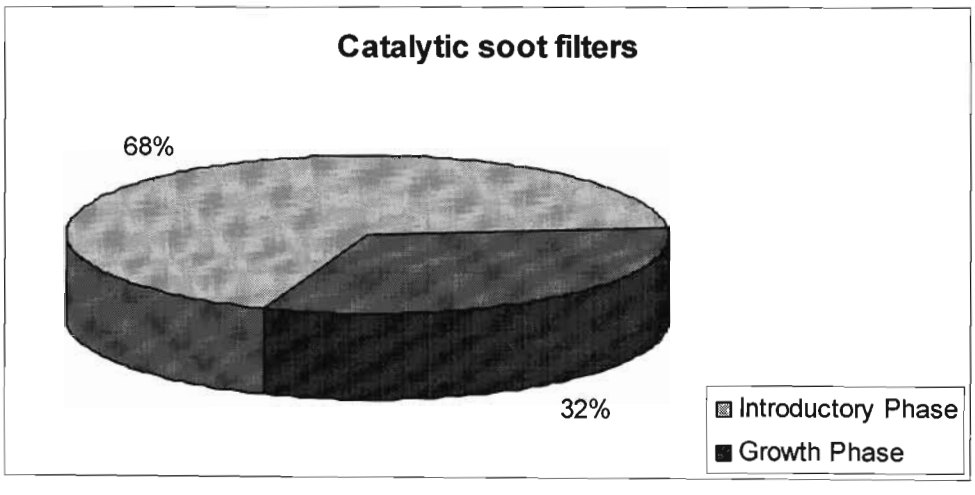


Figure 4.4: Catalytic soot filters

The main finding is that the catalytic soot filters is in the introductory phase of its product life cycle.

Summary of Question 6 results

The results of all four parts of question six is summarised in figure 4.5, which illustrates the product life cycle curve and in which phase the various products at Johnson Matthey were placed by the respondents.

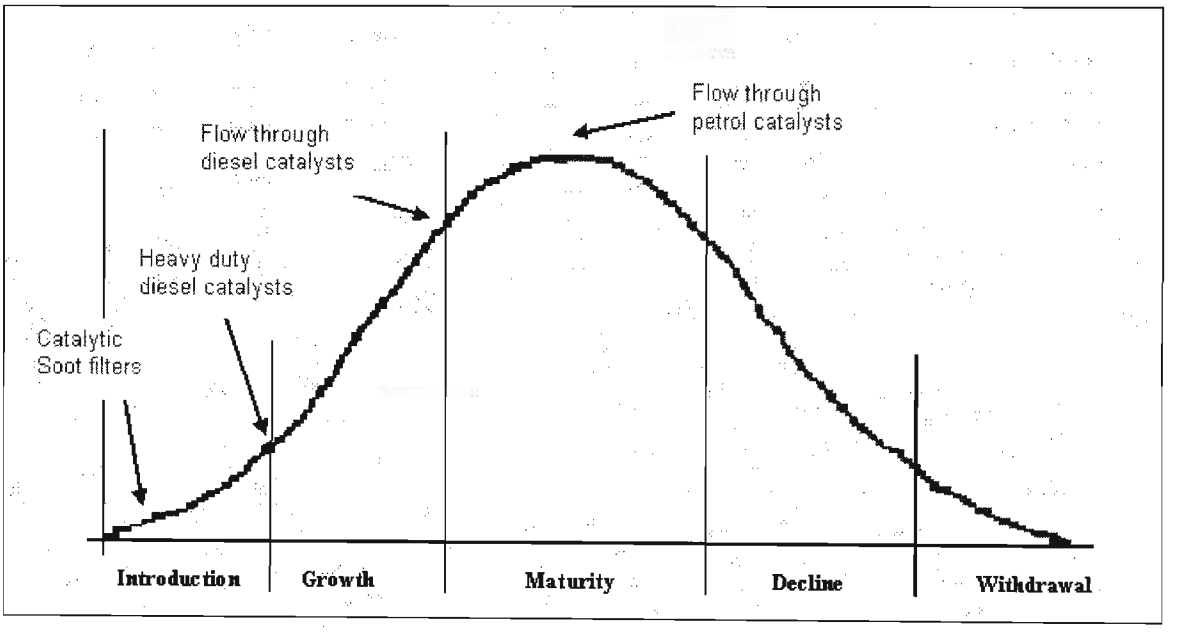


Figure 4.5: Product Life Cycle Curve

Figure 4.5 shows where all the four Johnson Matthey products lie on the product life cycle curve. It shows that the company is in an excellent position as its products are spread over the introduction, growth and mature phases of the PLC. No products are in the decline or withdrawal stages. It also shows that as the products move through it life cycle towards maturity, there is always new products following behind it in the previous stage.

Other findings and implications:

- Questions 5 and 6 revealed the ability of the decision-makers at Johnson Matthey to identify the product life cycle phases and into which phase their products fall into.
- It also reveals their ability to identify what gives their organisation a competitive advantage.
- Johnson Matthey has products well positioned along the product life cycle curve.

(c) Question 7

Q7: In what phase of the product life cycle would you position our organisation (Johnson Matthey South Africa)?

The results for this question were split between the growth and mature phases. All of the respondents in the sample placed the organisation in either of these two phases. 45% placed the organisation in the growth phase and 55% placed the organisation in the mature phase as depicted in figure 4.6.

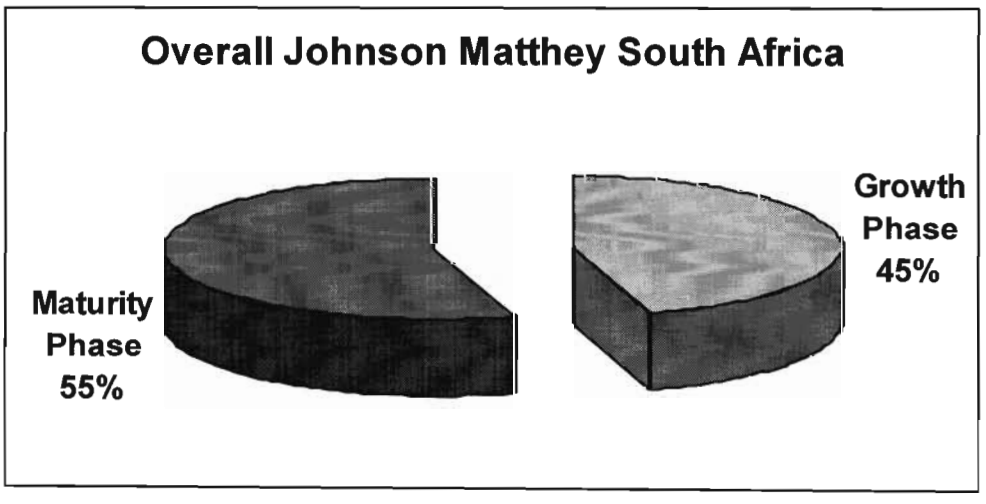


Figure 4.6: Overall organisation

Johnson Matthey South Africa is still expanding its production facility with the installation of new production lines. However, the pace of expansion

has slowed down signifying that the organisation although still in the growth phase is nearing the end of this phase and will soon be entering the next phase of its life cycle.

The main finding is that more than half the respondents (55%) place the organisation in the mature phase, while the rest (45%) place the organisation in the growth phase.

4.4.3 Section C

The purpose of Section C was to mainly focus on how, and how often decision makers at Johnson Matthey South Africa engage in strategic decision-making and planning. This section furthermore wanted to reveal the extent to which these decision makers use the product life cycle concept and if they would in future and the extent thereof. The following results provide the necessary information.

(a) Question 8

Q8: Do you engage in strategic decision-making and planning, using the product life cycle stages?

Almost half the respondents (52%) use the product life cycle concept in strategic decision-making and planning as depicted in Table 4.7.

Table 4.7: Use of the product life cycle concept in strategic decision-making and planning

Decision making using the PLC	Frequency	Percentage (%)
Yes	16	52
No	15	48
TOTAL	**N = 31**	**100**

The main finding is that more than half the respondents make use of the product life cycle in strategic decision-making and planning.

(b) Question 9

Q9: If yes on Question 8, how often do you engage in strategic decision-making and planning?

Decision-makers at Johnson Matthey engage in strategic decision-making and planning on a monthly basis in **37.5%** of all cases as depicted in Table 4.8. The result in Table 4.8, also shows that the decision-makers at Johnson Matthey engage in strategic decision-making and planning on a six monthly basis or less in **62.5%** of all cases and on an annually basis or less in **87.5%** of all cases as indicated by the cumulative percentage.

Table 4.8: Engagement in strategic decision-making and planning engagement

Engagement occurrence	Frequency	Percentage (%)	Cumulative Percentage (%)
Monthly	6	**37.5**	37.5
Six monthly	4	25	62.5
Annually	4	25	**87.5**
Other (more than 12 months)	2	12.5	100
TOTAL	**N = 16**	**100**	–

It can be deduced that the decision-makers at Johnson Matthey realise the importance of adapting to the fast pace of developments in the external environment as described in the theory.

The main finding is that the majority of respondents engage in strategic decision-making and planning on an annual basis or less frequently (87.5% of sample).

(c) Question 10

Q10: To what extent does the product life cycle concept influence your strategic decisions and planning? (Please use the scale in such a way that **"1" would indicate very low influence and "5" would indicate very high influence)**

The extent of influence by the product life cycle concept on strategic decision-making and planning is illustrated in Table 4.9.

Table 4.9: Influence of the product life cycle concept on decision-making and planning for the total sample

Extent of Influence	Frequency	Percentage (%)	Cumulative Percentage (%)
1	14	**45**	45
2	3	10	55
3	9	29	84
4	4	13	97
5	1	3	100
TOTAL	**N = 31**	**100**	–

Mean from the total sample = 2.19

From Table 4.9 it can be seen that **45%** of the respondents indicated a very low influence of the product life cycle concept on strategic decision-making and planning.

The strategic decision-making and planning at Johnson Matthey is to a low extent influenced by the product life cycle concept as indicated by a low mean score of **2.19** for the total sample as reported in Table 4.9. However, a high percentage **(45%)** of the decision-makers indicated an average (a scale value of 3) to above average extent of influence by the product life cycle on strategic decision-making and planning. This 45% is calculated by

finding the cumulative percentage of those respondents that answered 3 or higher to the question.

The main finding is that 45% of respondents indicated that the product life cycle concept influences strategic decision-making and planning from an average to an above average extent. The majority of the respondents, however, indicated that it influence was low to a very low extent.

(d) Question 11

Q11: What is the likelihood that you will continue or start using the product life cycle concept in future for general management or strategic decision-making? (Please use the scale in such a way that **"1" would indicate very unlikely and "5" would indicate extremely likely)**

The likelihood that decision-makers in the organisation will continue or start using the product life cycle concept for strategic decision-making and planning is an important indicator of the utilisation potential and value of the product life cycle concept. Table 4.10 and Table 4.11 will provide an indication of the likelihood that decision-makers at Johnson Matthey in the sample will continue or start using the product life cycle in future for general management and strategic decision-making purposes respectively.

Table 4.10: Significance test of the likelihood of continuing or starting to use the product life cycle concept for general management decision-making

Extent of Influence	Frequency	Percentage (%)	Cumulative Frequency	Cumulative Percentage (%)
1	4	13	4	13
2	10	32	14	45
3	8	26	22	71
4	7	23	29	94
5	2	6	31	100
TOTAL	**N = 31**	**100**	–	–

Mean from the total sample = 2.77

The mean value of **2.77** indicates an average (2.77 is approximately equal to a scale value of 3) likelihood of continuing or starting to use the product life cycle for general management decision-making.

A majority of **55%** of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continued or starting to use the product life cycle for general decision-making in future as depicted in Table 4.10. *(55% = 26% + 23% + 6%).*

The result provides a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for general management purposes in future.

Table 4.11 illustrates the likelihood of continuing or starting to use of the product life cycle concept for strategic decision-making purposes in future.

A majority of **74%** of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continuing or starting to use the product life cycle for strategic decision-making in future as depicted in Table 4.11. *(55% = 29% + 29% + 16%)*. This also confirmed by the above average mean score of **3.23**.

The result provides a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for strategic decision-making purposes in future.

Table 4.11: Significance test of the likelihood of continuing or starting to use the product life cycle concept for strategic decision-making

Extent of Influence	Frequency	Percentage (%)	Cumulative Frequency	Cumulative Percentage (%)
1	4	13	4	13
2	4	13	8	26
3	9	29	17	55
4	9	29	26	84
5	5	16	31	100
TOTAL	**N = 31**	**100**	–	–

Mean from the total sample = 3.23

It can be deduced from Tables 4.11 and 4.12 there is not a large difference between the mean scores of the likelihood of continued or starting to use the product life cycle for general management and for strategic decision-making purposes in future. Table 4.13 will however reveal whether the differences in the mean scores are significant or not.

Table 4.12: Significance test of the likelihood of continuing or starting to use the product life cycle concept for general management and strategic decision-making

Likelihood of using or starting to use the PLC for	Frequency	Mean	p-value
General management decision-making	31	2.77	
Strategic decision-making	31	3.23	**0.327**

The difference between the mean values is small. The ***t*-distributed test statistic** to determine differences between paired samples was used and a **p-value of 0,327** resulted from the calculation, (Albright *et. al*, 2003: 479-546). Special functions in excel were used for the calculations, as explained in the research methodology chapter of this study. If the decision rules that a p-value less than 0.05 signals a strong difference and a p-value of between 0.05 to 0.1 signals a moderate difference, and a p-value of greater than 0.1 signifies little to no difference, (Albright *et. al*, 2003: 485). Then the p-value of 0.327 indicates that the difference in mean values is not significant.

The main finding is that there is no significant difference between general management and strategic decision-making with regard to the likelihood of continuing or starting to us the product life cycle in future.

(e) Question 12

Q12: Any other comments or recommendations?

Forty two percent of the respondents opted to answer this question. This opened questioned revealed some very important findings. Listed below is summary of those findings from the results to this question.

Main findings to Question 12

- Product Life cycle theory is more applicable to higher management involved in strategic decision making. On lower managerial level and day to day decision making PLC is not always that easy to apply.
- The product life cycle is/would only be used at Johnson Matthey South Africa for decisions with respect to product obsolescence as the major decisions with regard to PLC would be made in Europe.
- The current life cycle of Johnson Matthey's existing products is highly dependent upon the availability of oil at an economic price in conjunction with the development of alternative fuels.
- If there was a better vision of the PLC at a departmental level, it would make decisions regarding CAPEX, plant upgrade and budgeting a lot more accurate and easier.
- Therefore, PLC is used and required for the products (the products required are done upstream) manufactured, but not as much for the process. It can to some extent be used for continuous improvement to the process in identifying where our systems have reached maturity and are in need for an upgrade.
- From a human resource viewpoint, the product life cycle is particularly relevant when evaluating current and future initiatives such as training and development, payroll processing etc.
- PLC is a general outline. There should be intermittent phases added such that there is greater flexibility in decision making as well as getting products through its life cycle.

- More effective use of the PLC theory could help Johnson Matthey better utilise it's resources and it would focus on the growing products instead of wasting resources on products in the decline stage.
- Most decisions based on the PLC concept is made at a higher level in the organisation

The main findings here are that the product life cycle is more applicable to higher level decision-makers and that practical application is very difficult at operational or plant level of an organisation.

4.5 The Major Findings

The results obtained in this study were analysed and yielded the following major findings which are representative of a catalyst manufacturing plant in South Africa.

The following major findings are reported:

The largest departments or functions had the highest frequency rates as depicted on Table 4.2, *p. 53.* The frequency pattern indicates that the respondents are representative of the total candidates. The majority of the respondents have five or less employees reporting to them. The next highest frequency was respondents with greater than 50 employees reporting to them and this is depicted on Table 4.3, *p. 54.* The majority (45.2%) of the respondents were managers and is depicted on Table 4.4, *p. 55*, which was collated from data to response to question three on the questionnaire. The majority of the respondents (74%) claim to have some knowledge of the product life cycle concept *[refer to Question 4 – Table 4.5, p.55].*

Tabulating the data obtained from question 5 of the questionnaire, showed that advanced technology is the main factor that is responsible for Johnson Matthey South Africa's competitive advantage *[refer to Table 4.6, p.56].* Question 6 of the questionnaire probed into the life cycle of the

specific products at Johnson Matthey. From the results it can be seen that petrol flow through catalyst is in the mature phase of its product life cycle as 84% of the respondents placed it in that phase *[refer to Figure 4.1, p. 58].* Diesel flow through catalyst is towards the end of its growth phase of its product life cycle with 62% of the respondents placing it in this phase; however 35% of the respondents did place it in the mature phase as depicted in Figure 4.2, *p. 59.* Heavy duty diesel catalyst is towards the end of the introductory phase and now entering the growth phase of its product life cycle *[refers to figure 4.3, p. 60].* Due to this transition most respondents would have found it difficult to place this product, therefore the figure shows 48% placing it in the introductory phase and 52% placing this product in the growth phase of it life cycle. The most recent product, the catalytic soot filters, is in the introductory phase of its product life cycle. The majority of the respondents, 68%, placed it in this phase *[refer to Figure 4.4, p. 60].* The results of question 6 of the questionnaire prove that the decision-makers at Johnson Matthey are able to identify the product life cycle phases and into which phase their products fall into and are also able to identify what gives their organisation a competitive advantage.

More than half the respondents (55%) place the organisation in the mature phase, while the rest (45%) place the organisation in the growth phase, this is according to the results of question 7 *[refer to figure 4.6, p. 62].* Moving onto section C of the questionnaire it is found that slightly more than half the respondents (52%) make use of the product life cycle in strategic decision-making and planning *[shown on Table 4.7, p. 63].* The majority of the respondents (37.5%) state that they engage in strategic decision-making and planning on monthly basis. Cumulatively, 87.5% of the respondents claim to engage in strategic decision making on an annual, six monthly or monthly basis *[refer to Table 4.8, p. 64].*

For question 10 of the questionnaire, 45% of respondents indicated that the product life cycle concept influences strategic decision-making and planning from an average to an above average extent. The majority of the respondents, the remaining 55% however, indicated that its influence was low to a very low extent *[refer to Table 4.9, p. 65].*

For question 11, a majority of 74% of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continuing or starting to use the product life cycle for strategic decision-making in future *[refer to Table 4.10, p.67]*. Also, the results depicted on Table 4.11, p. 68, provide a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for general management and strategic decision-making purposes in future. The *t*-distributed test carried out on the results of the last part of question 11 showed that there is no significant difference between general management and strategic decision-making with regard to the likelihood of continuing or starting to use the product life cycle in future.

Lastly, a synopsis of the results of question 12 of the questionnaire is that the product life cycle is more applicable to higher level decision-makers. The existing product life cycle model is inadequate and needs to be expanded. Practical application of the product life cycle model is difficult. However, the product life cycle concept can be applied in many facets of the organisation and assist in strategic decision making.

4.6 Conclusion

This chapter provided results on a question-by-question basis for the total sample of decision-makers at the auto-catalyst manufacturing facility in Gauteng, South Africa. These results were first analysed, then interpreted and the major findings were reported.

The electronic format, with the database made data manipulation quick and easy. Tables could be set up and data exported directly from the database and put in a presentable form very rapidly and ready for analysis.

The results showed that there is a general awareness of the product life cycle theory and that the respondents can place their products in the correct phases. However the data does not show conclusion evidence that the product life is used in strategic decision-making. Almost half the respondents indicated that they do use the product life cycle while the other half indicated that they do not use the product life cycle model in decision-making. The results also indicated that the product life cycle is more applicable to very high level decision makers, implying a level similar to that of the board of directors of Johnson Matthey. At this level the product life cycle can be used to assist in strategic decision-making. Practical application at plant level is difficult and the product life would have to be expanded in order to be effective at this lower level.

In the next chapter these results will be interpreted, various propositions evaluated and the major findings reported. The chapter will conclude with a discussion on the limitations of this study and recommendations for future research on the product life cycle theory.

CHAPTER FIVE – RECOMMEDATIONS AND CONCLUSIONS

5.1 Introduction

In the previous chapter the research results were presented. This final chapter is dedicated to the analysis, interpretation and explanation of the results. It will also focus on the main conclusions, recommendations for future research and the limitations of this exploratory study. Conclusions will be drawn on the use and application of the product life cycle concept as an instrument for strategic decision-making.

5.2 Research propositions

The research propositions as formulated in chapter one will be discussed and evidence from the research results and main research findings would be used to support or nullify those propositions. This study will attempt to, as far possible, use more than one result to draw on a conclusion.

5.2.1 Proposition 1

Decision makers at a catalyst manufacturing plant in South Africa, apply and use the product life cycle concept for strategic decision-making and planning purposes.

Proposition 1 was tested by questions 8, 9 and 11. It can be concluded that the findings cannot support proposition 1.

The support from the empirical results on this proposition should be viewed against the results of thirty one decision-makers, making up the sample, on their application and use of the product life cycle concept.

(1) More than half the decision-makers (52%), use the product life cycle concept in strategic decision-making and planning *[refer to Major Findings 4.5, p. 72].*

(2) The majority of the decision makers indicated that the product life cycle concept had a low to very low influence on their strategic decision-making and planning *[refer to major findings 4.5, p. 72].*

(3) However, 45% of the decision makers indicated that the product life cycle concept had an average to very high influence on their strategic decision-making and planning *[refer to major findings 4.5, p. 72].*

(4) A majority of **74%** of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continuing or starting to use the product life cycle for strategic decision-making in future *[refer to major findings 4.5, p. 73].*

If the results above are collectively viewed then this proposition cannot conclusively be supported or not supported due to mixed results.

5.2.2 Proposition 2

Decision makers at a catalyst manufacturing plant in South Africa, can identify in which phase of the product life cycle their products fall into.

Proposition 2 can be supported by the results from questions 6.

(1) Petrol flow through catalyst is in the mature phase of its product life cycle *[refer to major findings 4.5, p. 72].*

(2) Diesel flow through catalyst is towards the end of its growth phase of its product life cycle *[refer to major findings 4.5, p. 72].*

(3) Heavy duty diesel catalyst is towards the end of the introductory phase and entering the growth phase of its product life cycle *[refer to major findings 4.5, p. 72].*

(4) Catalytic soot filters is in the introductory phase of its product life cycle *[refer to major findings 4.5, p. 72].*

(5) More than half the respondents (55%) place the organisation in the mature phase; while the rest (45%) place the organisation in the growth phase *[refer to major findings 4.5, p. 72].*

(6) The decision-makers at Johnson Matthey are able to identify the product life cycle phases and into which phase their products fall into and are also able to identify what gives their organisation a competitive advantage *[refer to major findings 4.5, p. 72].*

The overall results support proposition 2.

5.2.3 Proposition 3

The product life cycle concept for decision-making within the manufacturing concern has a high usage potential.

Proposition 3 can be supported by the results from questions 8, 10, 11 & 12.

(1) More than half the respondents make use of the product life cycle in strategic decision-making and planning *[refer to major findings 4.5, p. 72].*

(2) The majority of the respondents engage in strategic decision-making and planning on an annual basis or less frequently (87.5% of sample) *[refer to major findings 4.5, p. 72].*

(3) 45% of respondents indicated that the product life cycle concept influences strategic decision-making and planning from an average to an above average extent. The majority of the respondents, however, indicated that it influence was low to a very low extent *[refer to major findings 4.5, p. 73].*

(4) The results provide a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for general management and strategic decision-making purposes in future *[refer to major findings 4.5, p. 73].*

(5) The product life cycle concept can be applied in many facets of the organisation and assist in strategic decision making *[refer to major findings 4.5, p. 73].*

A holistic view of the results is sufficiently convincing in support of proposition 3.

5.2.4 Proposition 4

Decision makers at a catalyst manufacturing plant in South Africa, will continue or start using the product life cycle concept for strategic decision-making and planning in future.

Proposition 4 can be supported by the results of question 11.

(1) A majority of 74% of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continuing or starting to use the product life cycle for strategic decision-making in future *[refer to major findings 4.5, p. 73].*

(2) The results provide a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for general management and strategic decision-making purposes in future *[refer to major findings 4.5, p. 73].*

The results support proposition 4.

5.2.5 Proposition 5

Use of the product life cycle concept is significantly higher for strategic decision-making than for general management purposes.

Proposition 5 cannot be supported in view of question 11 results.

(1) There is no significant difference between general management and strategic decision-making with regard to the likelihood of continuing or starting to use the product life cycle in future *[refer to question 11, p. 66].*

This result does not support proposition 5, that the use of the product life cycle is higher for strategic decision-making than for general management purposes.

5.3 Main conclusions and implications

The conclusions and implications are based on the results provided in this study and the major findings listed at the beginning of this chapter and cannot be generalised beyond the circumstances and conditions in which they occurred. The results are only representative of a catalyst manufacturing facility in South Africa.
It is furthermore important to iterate that the objectives of this study did not include the questioning of the product life cycle's s-shape and or bell shape curves.

The main purpose of this study was to investigate the use and application of the product life cycle concept as a strategic decision-making instrument. The main findings set out to clarify the results of this study.

(a) Major finding 1

The product life cycle concept theory has application potential as a strategic tool and there is high likelihood for its use as a decision-making instrument in future.

When the product life cycle concept is applied by decision-makers at a catalyst manufacturing facility in Gauteng, South Africa, it seems that the concept has great application potential and incidence rate of use as a decision-making instrument.

- More than half the respondents make use of the product life cycle in strategic decision-making and planning as discussed under the major findings 4.5, p. 73.

- The majority of the respondents engage in strategic decision-making and planning on an annual basis or less frequently (87.5% of sample) as listed in major findings 4.5, p. 72.

- A majority of 74% of the decision-makers in the sample indicated an average to very high likelihood (scale value of 3 – 5) of continuing or starting to use the product life cycle for strategic decision-making in future as listed in major findings 4.5, p. 73.

- The results provide a positive indication that the product life cycle concept has a usage potential among decision-makers at Johnson Matthey for general management and strategic decision-making purposes in future as listed in major findings 4.5, p. 73.

- More effective use of the PLC theory could help with better utilisation of resources and enable Johnson Matthey to focus on the growing products instead of wasting resources on products in the decline stage as listed in the main findings to question 12, in chapter four, p.70-71.

The main conclusion is that the decision-makers at a catalyst manufacturing facility in Gauteng, South Africa do realise the application value of the product life cycle concept.

The implication from major finding 5.2(12) is that the other half of the decision-makers of this organisation should be made aware of the product life cycle and its potential for strategic decision-making as reported by the findings.

(b) <u>Major finding 2</u>

The decision-makers in the sample tended to display a good knowledge of product life cycle concept, displayed by their ability to place their products into the different stages.

The main finding is that decision-makers at a catalyst manufacturing facility in Gauteng, South Africa were able to place their products into the correct stage in its product life cycle, thus displaying a good understanding of the concept.

- The majority of the respondents have knowledge of the product life cycle concept as listed in major findings 4.5, p.71.

- Petrol flow through catalyst is in the mature phase of its product life cycle as listed in major findings 4.5, p. 72.

- Diesel flow through catalyst is towards the end of its growth phase of its product life cycle as listed in major findings 4.5, p. 72.

- Heavy duty diesel catalyst is towards the end of the introductory phase and entering the growth phase of its product life cycle as listed in major findings 4.5, p. 72.

- Catalytic soot filters is in the introductory phase of its product life cycle as listed in major findings 4.5, p. 72.

- The decision-makers at Johnson Matthey are able to identify the product life cycle phases and into which phase their products fall into and are also able to identify what gives their organisation a competitive advantage as listed in the major findings 5.2, p. 72.

The implication is that due to nature of their products, catalyst manufacturers should know where their product is on its product life cycle. As their products are of high technology and they could become less competitive in the future if they do not have any products in the development and introduction stages.

(c) Major finding 3

There are still many unanswered questions and doubt about the product life cycle concept as a decision-making instrument

The theory indicates that the product life cycle has recently become a dominant element of strategy theory. There are however, many unanswered questions and criticism about the practical application of the product life cycle as a strategic decision-making instrument. The following criticisms listed in chapter one is still pertinent:

- There is still no evidence in this study of the effectiveness of the of the product life cycle as an instrument to predict strategy.

- It is still difficult for decision-makers to determine in which stage of the product life cycle a product or service is.

The following are from the main findings from chapter five:

- Practical application of the product life cycle model is difficult as listed in the main findings to question 12, p. 70-71.

- The product life cycle theory provides a general outline of a products position and suggestion possible generic strategies. It should be used in conjunction with other models for strategic decision making.

The implications is that more experiential evidence is still needed to address some of the criticisms and to provide further conclusive justification on the value and use of the product life cycle theory as a strategic decision-making instrument. This study did address certain criticisms in terms of the South African environment which is lacking in the theory of the product life cycle concept.

5.4 Limitations

This dissertation is the result of an exploratory investigation into application and use of the product life cycle as a decision-making instrument in an auto-catalyst manufacturing plant, (a subsidiary of a multinational corporation), in Gauteng, South Africa. Specific limitations originated in the literature review and during the experiential part of the study.

The major limitation of this study is that it only focused on a single auto-catalyst manufacturing plant in South Africa, in order to test and validate the findings of this research, similar research should be carried out on other auto-catalyst manufacturing plants in South Africa, and to be further extended to other sites around the world.

5.4.1 Response rate

The response rate to the questionnaire was much lower than anticipated and could have affected the validity of the results. The reason for the overall response rate of 43 % even after four requests to answer the questionnaire is one or a combination of the following:

- That the decision makers have no knowledge and do not apply the product life cycle concept.
- They do not have the time available to answer the questionnaire.
- They do not feel that will benefit in any way from answering the questionnaire.

Lower response rates are being realised in recent years as questionnaires are viewed as a waste of time if there are no incentives.

All the questionnaires received were completely answered and all of the thirty one answered questionnaires were taken into account in the statistical analysis.

Due to the questionnaire taking approximately five to ten minutes to answer, a fair assumption is that not having time to answer the questionnaire may not have been the main reason for the poor response rate. If the assumption is made that the reason why those respondents did not answer the questionnaire was due to them not knowing nor applying the product life cycle concept then the response would show that ~57% of the employees who enact strategy in this company have no knowledge of what the product life cycle concept is.

Eight out of the thirty one respondents that answered the questionnaire stated that they did not know what the product life cycle theory was. If the assumption above is correct that would mean that a very large number, approximately 68% of the total number of employees who enact strategy in the company have no knowledge of the product life cycle theory.

The response rate would have been much lower had the researcher used the traditional questionnaire format. The electronic questionnaire format sent out by e-mail allowed the researcher to send out the questionnaire more than one time. This type of questionnaire was efficient and cost effective. The respondents also could answer the questionnaire in their own time and the answers were captured directly into a database, and it was not necessary to send back the completed questionnaires.

5.4.2 Limitations in the literature

Based on the literature used the following limitations have been formulated:

- The aim of the literature search was to include all relevant literature on the topic. It is possible that some important research on the application of the product life cycle may not have been completed or may have been done but not yet documented and therefore excluded.

- There is limited literature available on the application of the product life cycle concept in manufacturing concerns.

- Due to the limited timeframe and resources for this study, the researcher may not have found all existing literature on the product life cycle theory.
- Better records need to be kept and made available which demonstrate the application of the product life cycle concept in South African organisations.

5.4.3 Limitations in the research study

Based on the experiential research and the reporting of the results, the following limitations have been identified:

- The major limitation in this study is the lack of understanding about strategy by most of the respondents. This had not been anticipated by the researcher and only later emerged as this exploratory study proceeded. The management team of this South African operation (a subsidiary of a multinational corporation) merely enact strategy that is devised and passed down from the main board of directors. Therefore, the respondents to this study are not involved in strategic decision making; their responsibility is to ensure that the prescribed strategy is executed. This study has shown that the relationship between multinational corporations and their foreign manufacturing plants needs to be re-defined to show clarity of responsibilities in respect to strategy and strategic direction of the business.

- The nature of the questionnaire did not allow for statistical proof on its validity and reliability in the experiential part of this study.

- The study was limited to only one auto-catalyst manufacturing facility in South Africa. There are many similar organisations in South Africa and internationally, but due to the time constraints this study could not be expanded to include these other organisations.

- The questionnaire was on electronic format, and therefore had to be made simple as there was no interviewer to clarify answers. It also had to be short in order to get a good response rate, and therefore multiple questions on a single aspect were not used.

- The major limitation of this study is that, although the sample was representative, a higher response rate would have given more conclusive results. The response rate was lower than expected.

5.5 Further Research

The recommendations are based on the experiential results obtained from this research study. The following recommendations for possible future research on the application and use of the product life cycle concept was formulated:

- Research studies using the same methodology as this study should be carried out on other auto-catalyst manufacturing concerns in South Africa, to draw possible comparisons and to provide better clarity on the practical application of the product life cycle.

- Research is needed on the use and applicability of the product life cycle concept in South Africa.

- A replication study should be carried out in other third world countries, such as the SADC region, Latin America and Eastern Europe, as well as in other first world countries. Comparisons can be drawn from these studies.

- Current literature should be broadened through more research to assist South African decision-makers to accurately identify in which stage of the product life cycle their products are.

- The current product life cycle theory literature in textbooks is being updated and kept relevant by studies such as this research study and needs to include experiential proof on the strategic value of the product life concept as provided in this study.

- The literature on the product life cycle theory should be treated with greater responsibility in strategy curricula to illustrate whether it can be applied successfully in practice.

5.6 Conclusion

This, the final chapter, started of with a summary of the main findings based on the reported results. Then the various propositions were evaluated against the observed results from the previous chapter. This then led onto the major findings of this study.

The chapter ended with the limitations of this study and recommendations for future research.

This study has tested the applicability of the product life cycle in the South African context, on a high technology product. It has provided experiential evidence on the practical application of the product life cycle. It has also explored the use of the product life cycle in strategic decision-making. Thus, it can be concluded that a comprehensive exploration of the problem statement, as described in chapter one, was undertaken.

The objectives of this study were also clearly defined in chapter one. The primary objective of this exploratory research study was to investigate the product life cycle concept as an instrument for strategic decision-making and planning among decision-makers in an auto-catalyst manufacturing facility in Gauteng, South Africa. This objective was met although the results were not conclusive on whether or not the decision-makers studied, use the product life cycle for strategic decision-making and planning.

This study showed that the decision makers surveyed can evidently identify in which phase of the product life cycle their products fall into. They also displayed a good knowledge of the product life cycle theory and its different stages. This study also showed that the product life cycle has high usage potential as a decision-making tool. Thus, three out of the five secondary objectives were fully addressed.

The primary objective and most of the secondary objectives were met and it can therefore be concluded that the results of this study added value to the body of knowledge on strategy theory in general and in particular the product life cycle concept theory.

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APPENDICES

Appendix A: Initial Questionnaire

QUESTIONNAIRE

Section A

Q 1: Do you know what the product life cycle theory is?

YES	No

Q 2: What **department** or **function** do you fall into?

Accounts	
Buy/Purchasing	
Finance	
Human Resources	
Information Technology	
Logistics	
Maintenance	
Production	
Sales	
Security	
Technical Support	

Q 3. How many employees are reporting to you (directly and indirectly)?

0-5	5-10	11-15	16-20	21-20	31-40	41-50	50 or more

Q 4. What is your position?

Director		Manager		Superintendent		Supervisor	

Section B

Before answering the following questions please refer to the notes on the Product Life Cycle theory

Q 5. Name three aspects that, in your opinion, provide our organisation with a competitive advantage?

5.1 _____
5.2 _____
5.3 _____

Q 6. In what phase of the product life cycle would you position our organisation? ***(Keeping in mind the graph from the PLC Theory sheet)***

Introductory Phase	Growth Phase	Maturity Phase	Declining Phase

Section C

Q 7. Do you engage in strategic decision-making and planning, using the product life cycle stages?

YES	No

Q 8. If yes, how often do you engage in strategic decision-making and planning?

Monthly	6 Monthly	Annually	Other

Q 9. To what extent does the product life cycle concept influence your strategic decisions and planning? *(use the scale as indicated)*

Very low influence				Extremely high influence
1	2	3	4	5

Q 10. How **important** is each of the following aspects when you associate them with the four phases of the product life cycle?
(please use the scale in such a way that a "1" would indicate that the aspect is not important at all and that a "5" would indicate that the aspect is extremely important).

		PHASES IN THE PRODUCT LIFE CYCLE																			
		Introductory Phase					Growth Phase					Maturity Phase					Declining Phase				
People	Training of personnel	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Incentives to personnel	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Skills of personnel	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Commitment of personnel	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Processes	Policies and procedures	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Quality control systems	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Information systems	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Technological progress	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Physical evidence.	Organisation's reputation	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Organisation's profit	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	Organisation's expansion	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

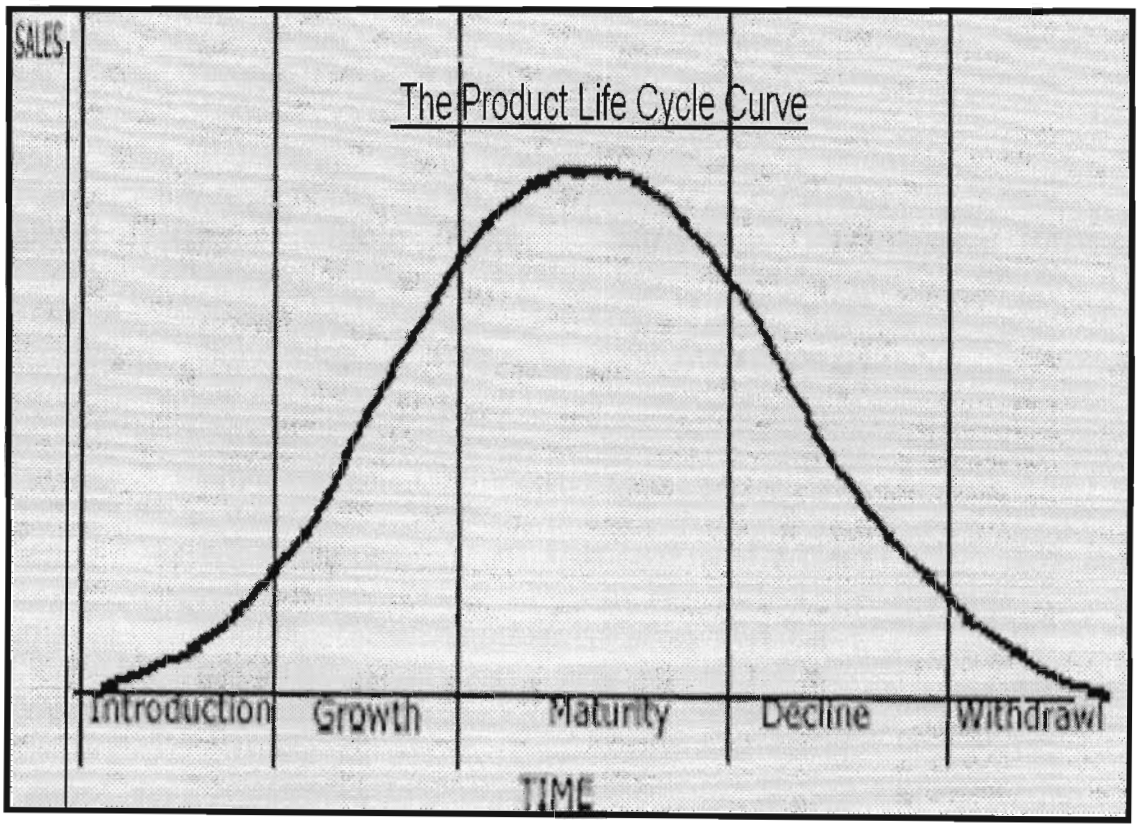
Q 11. What is the **likelihood** that you will **continue or start** using the product life cycle concept in future for general management or strategic decision-making?

	Very unlikely				Extremely likely
	1	2	3	4	5
General management decision-making					
Strategic decision-making					

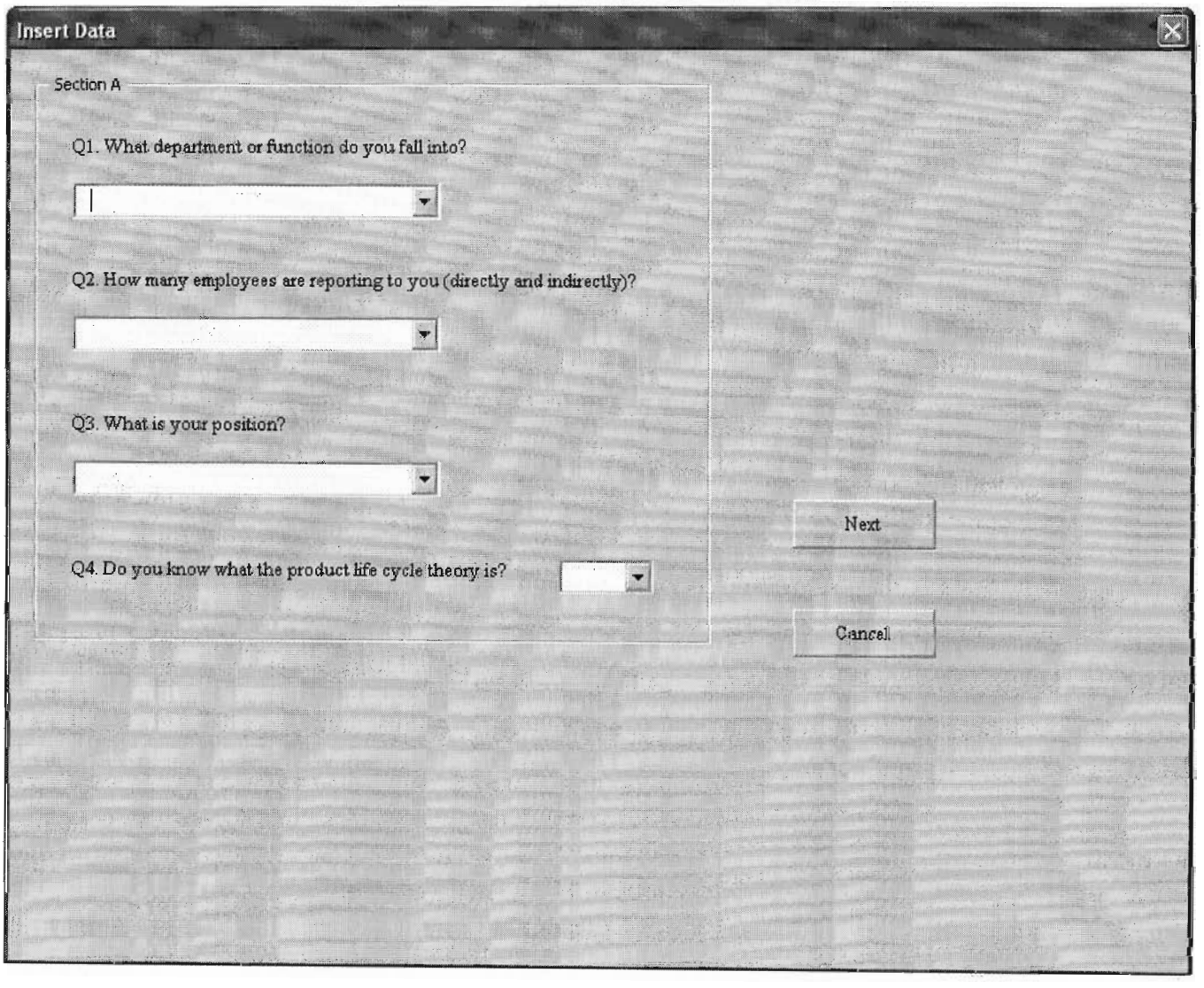
Q 12. Any other comments or recommendations?

Appendix B: Final Questionnaire

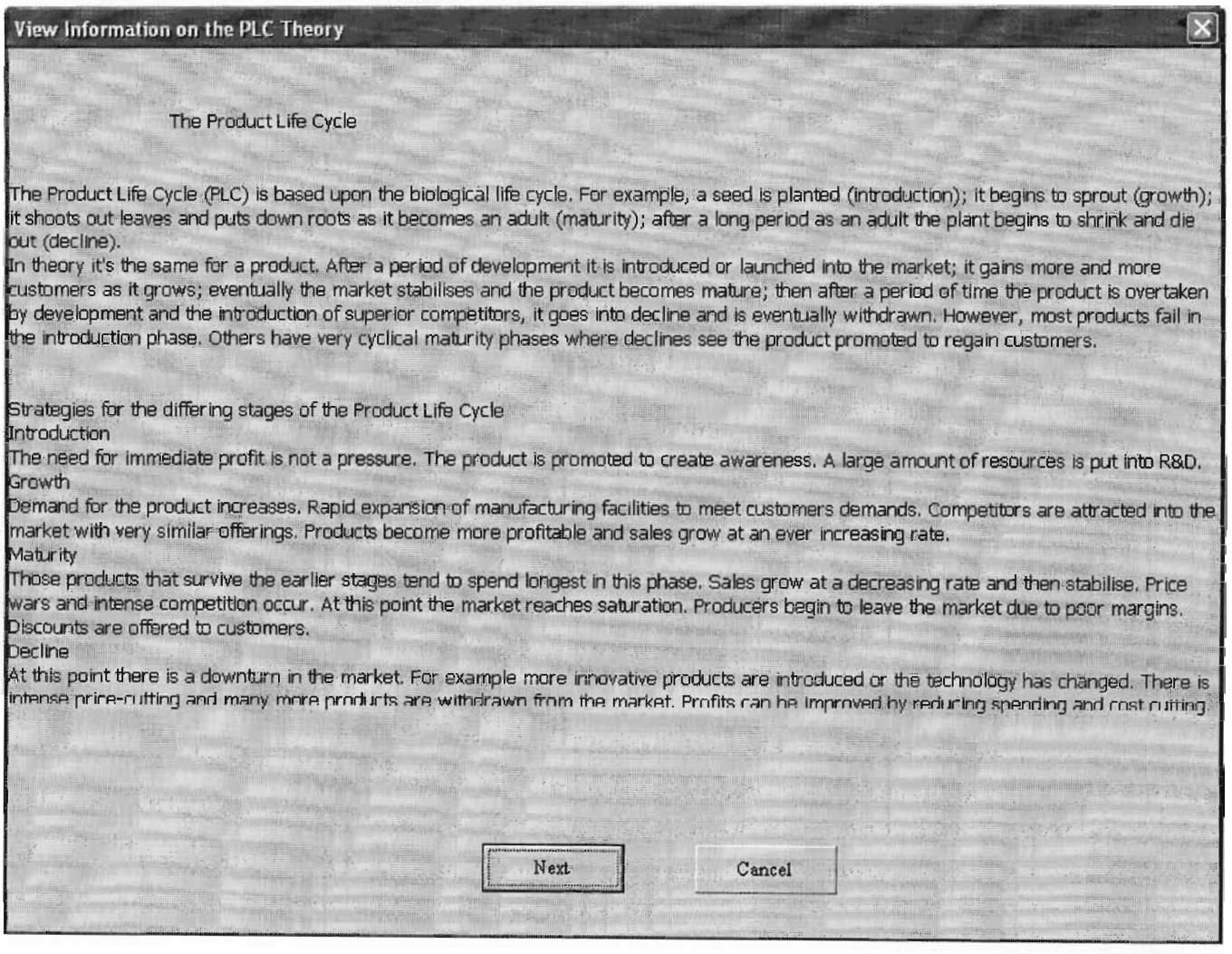
B1. Background between Questionnaire forms screens



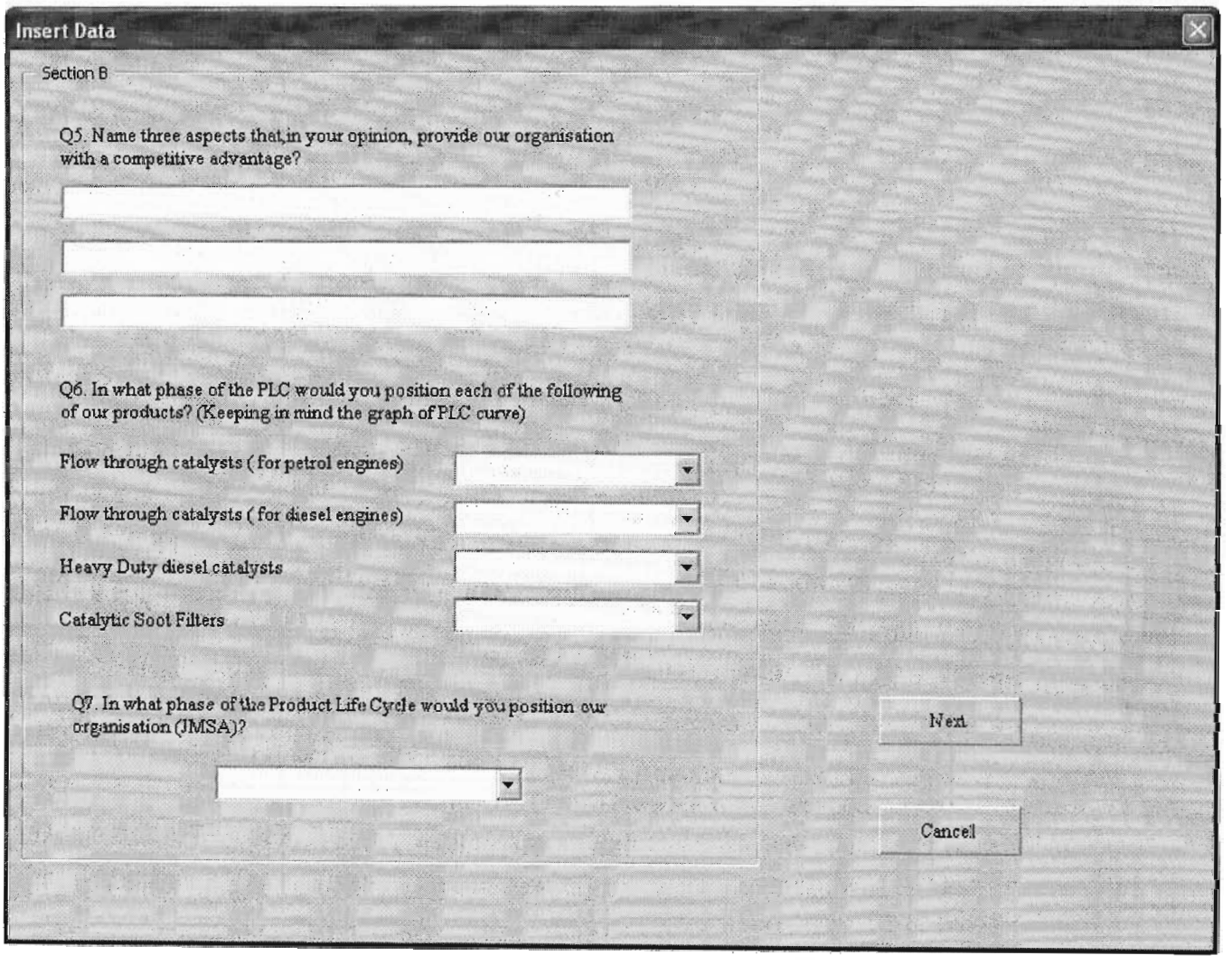
B2. First Questionnaire Form – Screen-shot



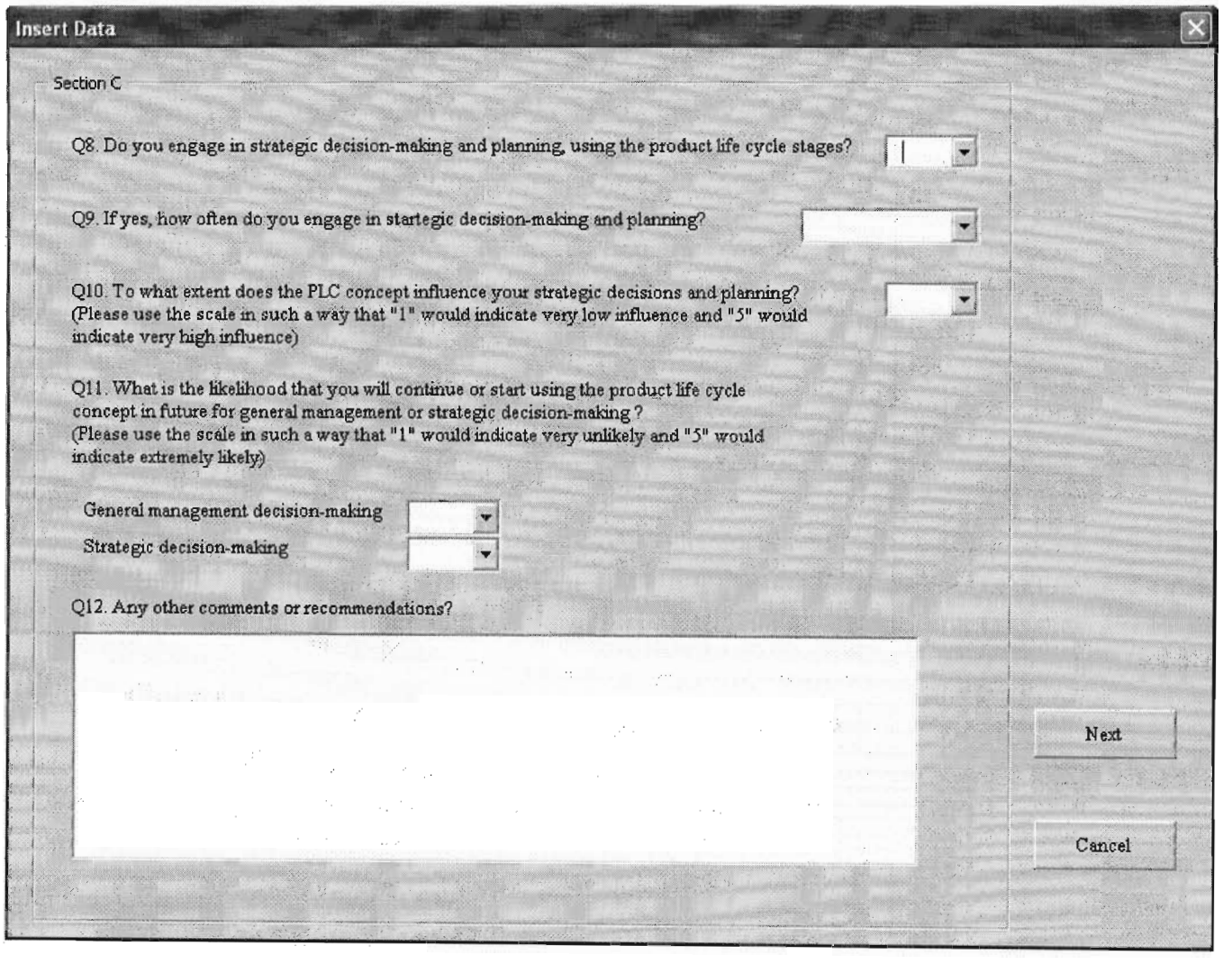
B3. Second Questionnaire Form – Screen-shot



B4. Third Questionnaire Form – Screen-shot



B5. Fourth Questionnaire Form – Screen-shot



Appendix C: Final Questionnaire Visual Basic Program

C1. Start Program

```
Private Sub Workbook_Open()
showform

End Sub
```

C2. Sequencing of questionnaire forms and saving of data to database

```
Sub sortdata()
'
' sortdata Macro
' Macro recorded 15/07/2005 by CHETTR
'

'
    Worksheets(1).Range("A1").Select
ActiveCell.CurrentRegion.Sort Key1:=Range("A2"), Order1:=xlAscending, Key2:=Range( _
        "D2"), Order2:=xlAscending, Key3:=Range("B2"), Order3:=xlAscending, _
        Header:=xlGuess, OrderCustom:=1, MatchCase:=False, Orientation:= _
        xlTopToBottom, DataOption1:=xlSortNormal, DataOption2:=xlSortNormal, _
        DataOption3:=xlSortNormal
End Sub
Sub Hide()
'
' Hide Macro
' Macro recorded 2005/08/19 by CHETTR
'

'
    ActiveWindow.Visible = False
End Sub
Sub save()
'
' save Macro
' Macro recorded 2005/08/19 by CHETTR
```

```
'


'
    ChDir "I:\shared\Questionnaire_Ronald"
    ActiveWorkbook.SaveAs Filename:= _
        "I:\shared\Questionnaire_Ronald\PLC-Questionnaire-Form.xls", FileFormat:= _
        xlNormal, Password:="", WriteResPassword:="", ReadOnlyRecommended:=False _
        , CreateBackup:=False
End Sub
Sub addsubtotals()
'
' addsubtotals Macro
' Macro recorded 15/07/2005 by CHETTR
'


'
    Worksheets(1).Range("A1").Select
    Selection.Subtotal GroupBy:=1, Function:=xlSum, TotalList:=Array(6), _
        Replace:=True, PageBreaks:=False, SummaryBelowData:=True
    Selection.ClearOutline
End Sub
Sub removesubtotals()
'
' removesubtotals Macro
' Macro recorded 15/07/2005 by CHETTR
'


'
    Worksheets(1).Range("A1").Select
    Selection.RemoveSubtotal
End Sub

Sub showform()

frmdata.Show

End Sub

Sub showform2()
```

116086

```
newHour = Hour(Now())
newMinute = Minute(Now())
newSecond = Second(Now()) + 5
waitTime = TimeSerial(newHour, newMinute, newSecond)
Application.Wait waitTime

frmdata2.Show

End Sub

Sub showform3()

newHour = Hour(Now())
newMinute = Minute(Now())
newSecond = Second(Now()) + 5
waitTime = TimeSerial(newHour, newMinute, newSecond)
Application.Wait waitTime


frmdata3.Show

End Sub

Sub showform4()

newHour = Hour(Now())
newMinute = Minute(Now())
newSecond = Second(Now()) + 5
waitTime = TimeSerial(newHour, newMinute, newSecond)
Application.Wait waitTime


frmdata4.Show

End Sub
```

C3. Password protecting saved data

```
Sub save2()
'
' save2 Macro
' Macro recorded 2005/08/19 by CHETTR
'

'
    ActiveWorkbook.SaveAs Filename:= _
        "I:\shared\Questionnaire_Ronald\PLC-Questionnaire-Form.xls", FileFormat:= _
        xlNormal, Password:="", WriteResPassword:="", ReadOnlyRecommended:=False _
        , CreateBackup:=False
End Sub
```

C4. First Questionnaire Form - Programming

```
Private Sub Frame1_Click()

End Sub


Private Sub lbldept_Click()

End Sub

Private Sub UserForm_Initialize()
Set mydata = New DataObject
'Combo box dept list
comdept.AddItem "Accounts"
comdept.AddItem "Buy/Purchasing"
comdept.AddItem "Finance"
comdept.AddItem "Human Resources"
comdept.AddItem "Information Technology"
comdept.AddItem "Logistics"
comdept.AddItem "Maintenance"
comdept.AddItem "ACP Production"
comdept.AddItem "ACS Production"
```

```
comdept.AddItem "Sales"
comdept.AddItem "Security"
comdept.AddItem "Technical Support"


'Combo box reporting list
comreport.AddItem "0-5"
comreport.AddItem "6-10"
comreport.AddItem "11-15"
comreport.AddItem "16-20"
comreport.AddItem "21-30"
comreport.AddItem "31-40"
comreport.AddItem "41-50"
comreport.AddItem ">50"


'Combo box position list
composition.AddItem "Director"
composition.AddItem "Manager"
composition.AddItem "Superintendent"
composition.AddItem "Supervisor"
composition.AddItem "Other"

'Combo box PLC YES or NO
complc.AddItem "Yes"
complc.AddItem "No"


End Sub
```

C5. Second Questionnaire Form – Programming

```
Private Sub btncancel2_Click()
Unload Me
End Sub

Private Sub btnnext2_Click()

On Error Resume Next
Unload Me
showform3

End Sub

Private Sub Label1_Click()

End Sub

Private Sub UserForm_Click()

End Sub
```

C6. Third Questionnaire Form – Programming

```
Private Sub Frame1_Click()

End Sub

Private Sub lblaspects_Click()

End Sub

Private Sub lblphases1_Click()

End Sub

Private Sub txtaspect1_Change()

End Sub

Private Sub txtaspect2_Change()

End Sub

Private Sub txtaspect3_Change()

End Sub



Private Sub UserForm_Initialize()
Set mydata2 = New DataObject
'Combo box Phases 1 list
comphases1.AddItem "Introductory Phase"
comphases1.AddItem "Growth Phase"
comphases1.AddItem "Maturity Phase"
comphases1.AddItem "Declining Phase"

'Combo box Phases 2 list
comphases2.AddItem "Introductory Phase"
comphases2.AddItem "Growth Phase"
comphases2.AddItem "Maturity Phase"
```

```
comphases2.AddItem "Declining Phase"


'Combo box Phases 3 list
comphases3.AddItem "Introductory Phase"
comphases3.AddItem "Growth Phase"
comphases3.AddItem "Maturity Phase"
comphases3.AddItem "Declining Phase"

'Combo box Phases 4 list
comphases4.AddItem "Introductory Phase"
comphases4.AddItem "Growth Phase"
comphases4.AddItem "Maturity Phase"
comphases4.AddItem "Declining Phase"

'Combo box Phases 5 list
comphases5.AddItem "Introductory Phase"
comphases5.AddItem "Growth Phase"
comphases5.AddItem "Maturity Phase"
comphases5.AddItem "Declining Phase"


End Sub
```

C7. Fourth Questionnaire Form – Programming

```
Private Sub Frame1_Click()

End Sub

Private Sub lblq8_Click()

End Sub

Private Sub UserForm_Initialize()
Set mydata3 = New DataObject
'Combo box Q8 list
comq8.AddItem "Yes"
comq8.AddItem "No"

'Combo box Q9 list
comq9.AddItem "Monthly"
comq9.AddItem "Six Monthly"
comq9.AddItem "Annually"
comq9.AddItem "Other"


'Combo box Q10 list
comq10.AddItem "1"
comq10.AddItem "2"
comq10.AddItem "3"
comq10.AddItem "4"
comq10.AddItem "5"

'Combo box Q111 list
comq111.AddItem "1"
comq111.AddItem "2"
comq111.AddItem "3"
comq111.AddItem "4"
comq111.AddItem "5"

'Combo box Q112 list
comq112.AddItem "1"
comq112.AddItem "2"
```

```
comq112.AddItem "3"
comq112.AddItem "4"
comq112.AddItem "5"


End Sub
```

Appendix D: Collected Data

D1. Questions 1-4

Q1. Department	Q2. Number reporting to you	Q3. Position	Q4. PLC Yes/No
ACS Production	16-20	Supervisor	Yes
ACS Production	21-30	Director	Yes
ACP Production	21-30	Director	Yes
Technical Support	>50	Manager	No
ACS Production	16-20	Supervisor	Yes
Information Technology	0-5	Manager	Yes
Technical Support	6-10	Supervisor	No
Projects	>50	Manager	No
Security	41-50	Manager	Yes
Buy/Purchasing	6-10	Manager	Yes
ACP Production	>50	Manager	Yes
ACP Production	>50	Manager	Yes
Technical Support	11-15	Manager	Yes
Projects	>50	Manager	No
ACP Production	>50	Superintendent	Yes
Human Resources	0-5	Manager	Yes
Sales	0-5	Manager	Yes
Logistics	6-10	Supervisor	No
ACS Production	0-5	Supervisor	Yes
ACS Production	0-5	Supervisor	No
ACS Production	0-5	Supervisor	No
Information Technology	0-5	Manager	Yes
ACP Production	>50	Superintendent	Yes
Human Resources	11-15	Manager	Yes
Sales	0-5	Manager	Yes
Sales	0-5	Director	Yes
Finance	0-5	Director	Yes
ACS Production	0-5	Superintendent	Yes
Technical Support	0-5	Supervisor	Yes
Maintenance	6-10	Supervisor	Yes
Logistics	0-5	Supervisor	No

D2. Question 5

Q5. Three aspects #1
Environmental legislation
Superior Technology
Advanced Technology
Innovation
Innovation
Product Technology
Regular new Autocatalyst product development
We are able to respond very quickly to changes in demand
Staff Innovation
Technology & Design
Technology
Customer focus
R&D spend on new catalyst technologies and hence best/better technologies available to compete
We respond rapidly to changing demand
technical
Calibre of employees recruited
Technological Advantage with Catalyst Systems
Advance Technology
Quality
Quality
Size
Innovation
We are very flexible in that we can switch from making one product to another, depending on customer demand
Our superior technology
Technology
Excellent customer service
Proven technology
Advanced production techniques
We are technologically advanced, developing new products
Constantly improving technology to suite new products
Superior customer service

Q5. Three aspects #2
Ability to adapt to flexible customer demands
Customer Service
Customer Service
Capacity
Consistent quality product
Customer Service
High quality of Johnson Matthey autocatalyst
We have good technology
Dedication
Continual Cost Reduction
Quality
Technology
Coating process - can supply with tight tolerences relative to competitors
We deliver products that fulfil customers expectations technically
quality
Investment in research and technology
Inetghrity and Honesty of staff in Customer Contact
Advance Training
Rapid response
Customer care & support
few competitors
Research
Our products are marketed and sold internationally
good customer service (customer comes first)
Quality
Advanced production techniques
Customer satisfaction & reliability
Low cost operation
Our products ar designed to meet Customer needs
Our process is kept ahead by automating and advancing equipment
Quality products

Q5. Three aspects #3
Quality of product and technical expertise
Advanced Manufacturing Techniques
High Quality Standard
Delivery
Customer service of an extremely high level
Real-time Stock Systems
Putting the Customer first all the time
We are prepared and willing to take risks
Product & market knowledge
Customer Focus and Support
The ability to adapt
Employees
As a site - flexible enough to accomodate customer demands
We have been able to rapidly increase capacity to meet rising demand
service
Employee development initiatives
Quality backup for Products
Good Marketing
Flexibility
Employee care
price of raw material
Market share
Currently, we can provide conventional, as well as, PC coatings
People involvement
Support
Better technology than competitors
Reputation
Ability to meet increasing customer demands
We are flexible and customer orientated
We are dynamic and constantly responding to product changes
Advanced production processes

D3. Questions 6-11

Q6. FC (petrol) #1	Q6. FC (diesel) #2	Q6. HDD #3	Q6. CSF #4	Q7. Overall JMSA	Q8	Q9	Q10	Q11.1	Q11.2
Maturity Phase	Growth Phase	Growth Phase	Introductory Phase	Growth Phase	No	No	2	3	3
Declining Phase	Maturity Phase	Introductory Phase	Introductory Phase	Maturity Phase	No	No	2	2	2
Maturity Phase	Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Yes	Monthly	4	4	5
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	Yes	Other	3	2	3
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Maturity Phase	Yes	Annually	4	3	4
Maturity Phase	Maturity Phase	Growth Phase	Introductory Phase	Growth Phase	No	No	1	1	1
Declining Phase	Maturity Phase	Growth Phase	Introductory Phase	Maturity Phase	Yes	Monthly	3	4	4
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	No	No	1	5	5
Declining Phase	Maturity Phase	Growth Phase	Introductory Phase	Maturity Phase	Yes	Monthly	1	1	4
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	Yes	Monthly	3	4	4
Maturity Phase	Maturity Phase	Introductory Phase	Introductory Phase	Maturity Phase	No	Other	3	2	4
Declining Phase	Growth Phase	Growth Phase	Introductory Phase	Maturity Phase	Yes	Six Monthly	3	3	5
Maturity Phase	Maturity Phase	Growth Phase	Growth Phase	Maturity Phase	Yes	Annually	1	2	1
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	No	No	1	3	3
Declining Phase	Growth Phase	Introductory Phase	Introductory Phase	Maturity Phase	No	No	1	3	3
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Growth Phase	Yes	Annually	4	4	4
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Maturity Phase	Yes	Monthly	5	4	5
Maturity Phase	Introductory Phase	Introductory Phase	Introductory Phase	Growth Phase	Yes	Six Monthly	1	1	1
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	No	Other	3	5	5
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Growth Phase	No	Other	1	3	3
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Maturity Phase	No	No	1	3	3
Maturity Phase	Maturity Phase	Growth Phase	Growth Phase	Maturity Phase	Yes	Six Monthly	3	2	3
Maturity Phase	Maturity Phase	Introductory Phase	Introductory Phase	Maturity Phase	Yes	Six Monthly	1	4	4
Maturity Phase	Maturity Phase	Growth Phase	Introductory Phase	Maturity Phase	Yes	Monthly	4	4	4
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Growth Phase	No	No	1	2	2
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	Yes	Annually	3	2	3
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Maturity Phase	Yes	Other	3	1	4
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Growth Phase	No	No	1	2	1
Maturity Phase	Growth Phase	Growth Phase	Growth Phase	Maturity Phase	No	Other	2	3	3
Maturity Phase	Maturity Phase	Growth Phase	Growth Phase	Maturity Phase	No	Other	1	2	2
Maturity Phase	Growth Phase	Introductory Phase	Introductory Phase	Maturity Phase	No	Other	1	2	2

D4. Question 12

Q12
Product Life cycle theory is more applicable to higher management involved in strategic decision making. On lower managerial level and day to day desicion making PLC is not always that
The PLC is/would only be used at JMSA for decisions with respect to product obsolesence as the major decisions with regard to PLC would be made in Europe.
The current life cycle of our current products is highly dependent upon the availability of oil at an economic price in conjunction with the development of alternative fuels.
None
If there was a better vision of the PLC at a departmental level, it would make decisions regarding Capex, plant upgrade and budgeting a lot more accurate and easier.
It is interesting to note that the PLC concept is similar to that of the Software LifeCycle, whereby a newly implemented system experiences a similar set of 5 stages.
This is a very good system to understand the life-span of our business in order to improve the quality of our product. This will help us to diversify and monitor growth for our business. In view of
None
None
I would suggest that more focus is given by departments with regard the purchasing decision, too many staff members are just directly ingaging with suppliers without using the purchasing
None
None
As a manufacturing facility, the PLC concept is not necessarily applicable to the manufacturing process, but rather the product being manufactured. We on average introduce 6-8 new products a month of which say ~ 70% are replacing existing parts and the rest new technologies. The process itself remains more or less the same, only the raw materials and coating recipes change. Therefore, PLC is used and required for the products (the products required are done upstream) we manufactuere, but not as much for our process. It can to some extent be used for
None
None
From a human resource viewpoint, the product life cycle is particularly relevant when evaluating current and future initiativeness such as training and development, payroll processing etc.
PLC is a general outline. There should be intermittent phases added such that there is greater flexibility in decision making as well as getting products through its life cycle.
None
None so far
None
The demand for an alternate fuel source due to the increasing fuel price and demand for oil, will make the long term prospectives for catalysts in jeoprady. We will become obsolete due to the fact that we focus only on catalysts at JMSA, making JMSA future not too bright. This may explain the high staff turnover due to the fact we only are worried for the short term while the
None
None
None
None
More effective use of the PLC theory could help us better utilise our resources and we would focus on the grwing products instead of wasting resources on products in the decline stage.
None
Most decisions based on the PLC concept is made at a higher level in the organisation
None
None
None

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UNIVERSITY OF
KWAZULU-NATAL

27 NOVEMBER 2006

MR. D CHETTY (203517465)
GRADUATE SCHOOL OF BUSINESS

Dear Mr. Chetty

ETHICAL CLEARANCE APPROVAL NUMBER: HSS/06747A

I wish to confirm that ethical clearance has been granted for the following project:

"An exploration into the Product Life Cycle concept as a strategic decision-making tool in an auto-catalyst manufacturing plant (a subsidy of a multinational corporation situated in Gauteng – South Africa)"

Yours faithfully

.....
MS. PHUMELELE XIMBA
RESEARCH OFFICE

cc. Faculty Office (Christel Haddon)
cc. Supervisor (Mr. M Challenor)