

IMPROVING COMPETITIVENESS IN BUSINESSES
THROUGH THE APPLICATION OF PRODUCT DESIGN
AS A KNOWLEDGE CREATION MANAGEMENT TOOL

Jurie Groenewald

CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY
Library and Information Services

Dewey No. 658.314 GRD

CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY



8011773

CPT ARC 658.314 GRO
(BLUE)

UNIVERSITY OF
CAPE PENINSULA
LIBRARY

**Improving competitiveness in businesses
through the application of Product Design
as a Knowledge Creation Management Tool**

Jurie Groenewald

**Dissertation submitted in
partial fulfilment of the requirements for the degree
Doctor Technologiae in Marketing**

**In the Faculty of Business
at the Cape Peninsula University of Technology**

Promotor: Prof A Slabbert

February 2009

Table of Contents

List of Tables	vi
List of Figures	x
List of Annexures	xi
Synopsis	xii
Chapter One: Introduction	
1.1 Introduction	1
1.2 Background to and rationale for the research	2
1.3 Problem statement	3
1.4 Overall research aim	3
1.5 Research methodology	3
1.6 Expected results	5
1.7 Delimitations of the study	6
1.8 Clarification of key concepts	6
1.9 Structure of the thesis	10
1.10 Summary	10
Chapter Two: Evidence in the literature on the contribution of Product Design	
2.1 Introduction	11
Part One: Contribution of design	
2.2 Contribution of design in history	13
2.3 Contribution of design in general: Innovation and competitive edge	14
2.4 Contribution of design in product development	29
2.5 Contribution of design in service development	35
2.6 Contribution of design in economic terms	39
2.7 Contribution of design: summary	46

Part two: Design Management	
2.8 Introduction to Design Management	47
2.9 The need for Design Management	47
2.10 Functional Design Management	48
2.11 Strategic Design Management	60
2.12 Indifference towards Design Management	67
2.13 Design Management: summary	72

Chapter Three: Product Design as Knowledge Creation Management (Framework)

3.1 Introduction	73
3.2 Globalisation	73
3.3 Boundaryless organisations	86
3.4 Knowledge Management	98
3.5 Knowledge Management as a means to increase competitiveness	112
3.6 Product design as Knowledge Creation Management	120
3.7 Product design as a Knowledge Creation Management Tool (Framework)	146
3.8 Conclusion and research question	150

Chapter Four: Research methodology

4.1 Introduction	152
4.2 Scientific research	153
4.3 Questionnaire survey	156
4.4 Qualitative research	167
4.5 Focus group discussion	171
4.6 Course content analysis	173
4.7 Summary	174

Chapter Five: Results and analysis of data

5.1 Introduction	175
5.2 Results of the questionnaire	175
5.3 Results of the first focus group discussion: Product designers	180
5.4 Results of the second focus group discussion: Marketing managers	187
5.5 Results of the two focus group discussions summarised	192
5.6 Results of the content survey	193
5.7 Results of the testing of the framework	195

5.8 Summary	199
-------------	-----

Chapter Six: Conclusions and recommendations

6.1 Introduction	200
6.2 Summary of findings	200
6.3 General conclusions	209
6.4 Recommendations	209
6.5 Application to the industry	215
6.6 Contribution to theory	216
6.7 Application of the framework	219
6.8 Further research	220
6.9 Summary	220

References	221
-------------------	-----

Annexures	257
------------------	-----

List of Tables

Chapter One

Table 1.1 Patent co-operation treaty applications for 2002	2
--	---

Chapter Two

Table 2.1 The influence of design	18
Table 2.2 Market pull vs technology push	19
Table 2.3 Comparative market share of world manufacturing exports	26
Table 2.4 The percentage of total company sales and profits generated by new products	29
Table 2.5 Calculating the return on investment	41
Table 2.6 Input of design expertise and output categories	43
Table 2.7 Results of design input	43
Table 2.8 Non-implementation of design	45
Table 2.9 Strategic role of design	64

Chapter Three

Table 3.1 Differences between the ages of Horus and of Seth	76
Table 3.2 Contrasting features of old and new organisational structure	95
Table 3.3 Kind of enterprises and employment in South Africa	97
Table 3.4 A hierarchy from data to wisdom	102
Table 3.5 Descriptions of data, information, knowledge, wisdom	103
Table 3.6 Distinction between information and knowledge	104
Table 3.7 Four nodes of knowledge conversion	106
Table 3.8 Business and knowledge strategy drivers	113
Table 3.9 Modes of learning in the product creation processes	125
Table 3.10 Domains of design skill and knowledge: a taxonomy	134
Table 3.11 Composite typology of knowledge used in innovation	138

Chapter Four

Table 4.1 Summary of research methods used	152
--	-----

Chapter Five

Table 5.1	Results of the background information of the attendees of the first focus group discussion	181
Table 5.2	Results of the background information of the attendees of the second focus group discussion	188
Table 5.3	Levels of involvement of marketing managers at the various product design stages	190

List of Figures**Chapter Two**

Figure 2.1	The rugby approach	51
Figure 2.2	Integrating design in an organisation's management structure	59
Figure 2.3	Early stage conceptualisation driven by the innovation engine	63

Chapter Three

Figure 3.1	New transformation model	115
Figure 3.2	Model of the fields of design	136
Figure 3.3	Product Design as a Knowledge Creation Management Tool (Conceptual Model)	147

Chapter Six

Figure 6.1	Proposed curriculum	212
Figure 6.2	Summary of the need for a curriculum on Product Design for Managers	218

List of Annexures

Annexure A: Questionnaire	257
Annexure B: Questionnaire coding	262
Annexure C: Questionnaire with summary of the results	264
Annexure D: Excel spreadsheet indicating calculations	270
Annexure E: Statistical analyses of questionnaire responses	283
Annexure F: Content Analysis	323
Annexure G: Summary of students' design projects	341

Synopsis

Many South African businesses experience a lack of competitiveness against a background of increasing globalised competition. One of the reasons for the lack of competitiveness in South African businesses is as a result of a lack of innovation. In response, many scholars have concluded that design can contribute to the competitiveness of a company. Distinguished and refereed business journals have published articles that claim design can have value.

One of the causes of the lack of innovation could be that managers do not use design as widely as it might be. Some say that it is mainly as a result of a poor understanding of the benefits of design. This prompted the research question: *How can the competitiveness of businesses be improved through the application of product design as a knowledge creation management tool?* This question was investigated by a combination of a literature survey, construction of a conceptual model, a questionnaire survey, a focus group discussion and a curriculum content analysis.

Through a literature study evidence was presented that design could contribute to innovation, which could add a competitive edge and could lead to commercial success, provided it is managed properly. Unfortunately, managers do not use design as widely as it might be as a result of a poor understanding of the contribution of design. This raises the question, how can the understanding of design be improved? An alternative to the traditional views was presented whereby product design can be used as a knowledge creation management tool. In this regard, a framework was proposed, which indicated product design as both a user and a producer of knowledge. This framework could assist managers to acquire a sufficient understanding of design. The next step is to ask what managers should understand about design in order to use it as a knowledge creation management tool.

A questionnaire survey managed to distinguish, in a statistically significant manner, between certain items that were indicated by the respondents as important for managers to understand and other items that the respondents felt were unimportant. In general, the items that were design specific, such as conceptualisation and the psychology of creativity, were indicated as unimportant and the items close to managing a business, such as the writing of a creative brief and the risk factors, were indicated as important for managers to know. Two focus group discussions agreed in the main with the results of the questionnaire survey, but with one exception. One group felt that managers should have a basic understanding of the whole design process. Another aspect of importance was that the manager should trust the designer. The groups also suggested a number of topics that should be included in a curriculum on a basic understanding of product design for management students.

The next question is whether management students were educated to have a basic understanding of product design. A content survey was undertaken of the offerings to management students. Based on the information received, it was concluded that the offerings to management students at South African universities or universities of technology do not put sufficient emphasis on creativity and innovation, while the design discipline is totally ignored. The proposed framework was then successfully tested in practice as a vehicle to assist managers to acquire a sufficient understanding of product design.

In response to the research results, a curriculum was developed which could provide managers with a sufficient basic understanding of product design in order to increase a company's competitiveness by managing design as part of the knowledge creation management of a company. This then answered the research question of how the competitiveness of a business could be improved through the application of product design as a knowledge creation management tool.

Chapter One

Introduction

1.1 Introduction

In a survey [on competitiveness] South Africa was ranked 42nd out of 47 countries, placing it at the bottom of the pile.... These findings are cause for concern especially as there is growing awareness that an inability to compete in a fiercely competitive international economy spells ruin (Wasserman, 2001: 6). In 2004 South Africa improved one position to number 41 in the World Economic Forum's global competitiveness rankings (Msiza, 2004: 1). In a recent survey on competitiveness in the Travel and Tourism Industry, an area counted on to contribute significantly to the South African economy, the country were ranked 62nd (Slabbert, 2007: S1).

Many South African businesses experience a lack of competitiveness (Marcus, 2003: 16). This problem is a special example of a global problem, for example Britain's loss of competitiveness as described by Walsh *et al.* (1992), Fox (1993), Roy and Potter (1997) and Cooper and Press (1998)¹. One of the main reasons for the lack of competitiveness is not developing new products or services. According to Kotler (2003: 349) companies that fail to develop new products or services are putting themselves at great risk. Their existing products or services are always vulnerable to, amongst others, increased domestic and international competition. While all the functions of a company should work together to increase its competitiveness, the marketing function, or new product development in particular, is traditionally being considered to spearhead the drive to increase competitiveness. The reason for this is that marketing can be defined as the task of creating, promoting, and delivering goods and services to consumers and businesses (Kotler, 2003: 5).

In response to the problem of lack of competitiveness, there is good reason to believe that Product Design, as a part of the marketing function, can contribute to improve the competitiveness of businesses based on previous research. Distinguished and refereed business journals have published articles and many scholars have concluded that product development can contribute to the competitiveness of a company. A few examples are Hollins and Pugh (1990), Peters (1996), Kristensen (1998), Bruce and Cooper (2000), Danzig (2002), Zaccai (2002) and Kotler (2003).

¹ Wherever possible, references will refer to the specific pages. In exceptional cases, where the overarching argument of a source is being referred to, references will refer to the source in general. Similarly, in the case of websites, specific page numbers can not be cited if they are not indicated.

One reason for the lack of competitiveness in South African businesses could thus be seen as a result of a lack of new product development. This can be demonstrated by South Africa's poor performance in the field of innovation. If international patent registration is a barometer of innovation and future growth, the figures in Table 1.1 provide cause for concern (pctgazette, no page). Low spending on research and development has meant South Africa has not fared well in international patent registration. The list in Table 1.1 reflects the number of patent co-operation treaty (PCT) applications for individual countries for 2002. PCT is the process that allows inventors to file patent applications in all major countries through one application. It is a better gauge of innovation levels than in-country applications, where up to 70% of patent applications are invalid. One of the causes of the lack of innovation could be that managers do not use design as widely as it might be. Some say that it is mainly as a result of a poor understanding of the benefits of design (Bruce & Cooper, 1997b; Thackara, 1997; Jevnaker, 1998; Von Stamm, 2006). This raised the question, what do managers need to know in order to manage the design resource as part of the strategic management of a company. This question was investigated by a literature review in Chapter Two and Three. The research methodology described in Chapter Four was adopted for the field research. The data was analysed in Chapter Five and discussed with recommendations in Chapter Six.

United States	39 529
Germany	13 746
United Kingdom	5 908
Israel	1 132
Australia	1 685
India	566
South Africa	390
Egypt	4
Nigeria	1
Ghana	0
Kenya	0

1.2 Background to and rationale for the research

The business environment in South Africa, as everywhere in the world, is becoming more competitive. Today's commercial world offers more goods and services than consumers have ever known before. Only 25 years ago there were shortages of many products and waiting lists for consumer durables such as cars and hi-fi equipment. Too many customers chased too few products. This situation has changed in the meantime: worldwide there is an overproduction of cars, steel and many electrical and electronic goods. The customer now has a wide choice of almost every product within a price range.

With this increased choice, consumers have become more aware of the good and bad features of a product. As a result they select the product that most closely fulfils their opinion of being the best value for money. This includes not just price, but a wide range of non-price factors such as quality, reliability, aesthetics, delivery, after sales service, ease of operation, performance, safety and status. Nearly all these price and non-price factors can be related to Product Design (Hollins & Pugh, 1990: 9).

With the increase in product offerings resulting in increased consumer choice, continuous innovation is needed in order to be competitive. Differentiation through product development has become essential

to beat the competition. Research done especially in the United Kingdom (e.g. Walsh *et al.*, 1992 and Cooper & Press, 1998), showed how the influence of design, on a strategic level, can increase a business's commercial success. A report by Pearlfisher (Nicholas, 2000: 9) concluded that design must be at the centre of marketing strategies for brands that want to attract the young, and, equally important, the young at heart. This ability of design to provide innovation was, however, not always utilised or understood by marketing managers.

1.3 Problem statement

This study will investigate the problem within the realm of the marketing discipline, and more specifically new product development. The problem to address is that, despite the fact that the benefits of innovative Product Design have been researched and published, not all marketing managers are aware of the contribution that the design discipline could make. A study by Borja de Mozota concluded that managers have a poor understanding and perception of how the design discipline can influence a company's results (Cooper & Press, 1998: 58 – 59). This poor understanding led to the design discipline not being managed properly and not being integrated with other key business activities as well as it could have been. For business managers to manage any function, for example human resources, they must have a sufficient understanding of the most important issues and the vocabulary of that discipline (Hands, 2005). Such a functional knowledge of different business functions is at the heart of many management training programmes, such as the MBA. This need of a functional knowledge of the design discipline led to the formulation of the overall research aim.

1.4 Overall research aim

Given the need to increase the competitiveness of businesses, the fact that the benefits of the design discipline were published, but that design was not being used as widely as it might be, the general aim of the research was to investigate how business managers can obtain a functional knowledge of the design discipline so that they can integrate design into the marketing function and use it as a Knowledge Creation Management tool in order to increase the competitiveness of the business.

1.5 Research methodology

This section provides a brief overview of the methodology used to investigate the general aim of the research as stated above. The investigation was a combination of a literature survey, construction of a conceptual model, a questionnaire survey, two focus group discussions and a curriculum content analysis.

- 1.5.1 The first objective was to indicate that in lieu of the published benefits of the contribution of the Product Design discipline, it was not used sufficiently by marketing managers. This objective was reached by a literature survey and representation of the knowledge in the field to date. It provided an overview of the published benefits of the contribution of the Product Design discipline to the competitiveness of a business, as well as the lack of understanding thereof by marketing managers. This objective also investigated previous attempts to resolve the problem, especially the advances made by design management.
- 1.5.2 The second objective was to demonstrate an alternative theoretical solution for marketing managers, through the use of Knowledge Creation Management. This objective was reached by providing an overview of management practices in the twenty-first century, emphasising outsourcing, networking and the resultant need for Knowledge Management. This objective also investigated how Knowledge Creation Management can improve competitiveness. As a result, a framework of how Product Design can be understood as a Knowledge Creation Management tool was developed.
- 1.5.3 The third objective was to indicate certain areas of Product Design that managers should have a basic understanding of. This objective was reached by investigating what managers should understand about Product Design through a questionnaire survey in which designers and managers, knowledgeable about design, could express their opinions. The results of this survey were discussed by two focus groups: one consisting of qualified Product Designers and the other consisting of marketing managers.
- 1.5.4 The fourth objective was to demonstrate that marketing managers are not educated by tertiary institutions in South Africa to use the Product Design discipline as a source of creativity. This objective was reached by investigating whether future managers are educated by tertiary institutions to apply the Product Design discipline as a source of creativity to increase competitiveness. A content analysis of the offerings of tertiary institutions in South Africa in the areas of management, marketing and entrepreneurship was undertaken.
- 1.5.5 The fifth objective was to test the framework developed in the second objective. The process proposed in the framework was followed by the fourth year Product Design students at the Cape Peninsula University of Technology. This objective was reached by an evaluation of the design projects against the processes indicated in the framework.
- 1.5.6 The sixth objective was to indicate the contribution to theory and practice. This objective was reached by constructing a model that indicates how a curriculum for Business or Marketing Managers can fit into the current thinking of Business Management. In this objective the theoretical framework proposed in the second objective, was integrated with the results of the third objective.

The attainment of all these objectives led to a new approach in the understanding by managers of Product Design. A proposal was developed whereby Marketing Managers, who did not know much about the actual Product Design process, could be educated in how Product Design could improve the competitiveness of their businesses if it is being used as a Knowledge Creation Management tool. A curriculum was developed based on the framework that was proposed and tested. Such a curriculum met the general aim of this research study.

1.6 Expected results

It was expected that the *first objective* would be reached by presenting evidence of the published benefits of the contribution of the Product Design to the competitiveness of a business, as well as the lack of understanding of the Product Design discipline by managers. It was also expected that previous attempts to solve the problem through design management did not quite meet the expectations.

It was expected that the *second objective* would be reached by demonstrating an alternative theoretical solution. It was expected that Knowledge Creation Management could be used to improve competitiveness and as a result a conceptual model, of how managers could better understand how to use Product Design as a Knowledge Creation Management tool, would be developed.

It was expected that the *third objective* would be reached by indicating certain areas of Product Design that managers should understand. It was also expected that the two focus group discussions would agree with these results.

It was expected that the *fourth objective* would be reached by demonstrating that managers were not educated by tertiary institutions in South Africa to understand how to apply the Product Design discipline as a source of creativity in order to increase competitiveness. In fact, it was expected that management students did not receive much education on creativity in general.

It was expected that the *fifth objective* would be reached by presenting evidence from design projects of eighteen students. The evidence will indicate that the framework can be used to foster an understanding of Product Design with managers.

It was expected that the *sixth objective* will be reaching by constructing a model that indicates the contribution to theory. Such a model will indicate the place of a curriculum on Product Design for Business Managers in the current thinking on Business Management.

As a result of the above, it was expected that a curriculum could be drawn up, which will enable management students to understand the new approach depicted in the framework and as a result how Product Design could become a source of creativity and thus be used as a Knowledge Creation Management tool.

1.7 Delimitations of the study

The main subject of the research was how competitiveness in business could be improved through the application of Product Design as a Knowledge Creation Management tool. The main argument is supplemented by secondary-level arguments on the economic contribution of the Product Design discipline, Design Management, globalisation and Knowledge Management. These topics are discussed in sufficient detail to support the main argument, but are not discussed in depth.

The research focused on the integration of the Product Design discipline into the marketing discipline. The discussion therefore concentrated on the *application* of the Product Design discipline and was not directed at the Product Design discipline itself. Nor will the discussion focus on the design discipline in general. It will merely allude to the benefits of the Product Design discipline to the marketing discipline.

The study used Product Design as a specific example of creativity and innovation. Creativity is a very wide concept and although innovation is a somewhat narrower form of creativity, it is still much wider than design. There are many other sources of creativity and/or innovation apart from Product Design, but they fall outside the scope of this study.

1.8 Clarification of key concepts

This section provides definitions for the key concepts, namely design, applications of design, design management, as well as the use of the term managers. These concepts appear through the whole research report. Other concepts, such as creativity and innovation, appear in very specific locations and their definitions are discussed at the relevant location.

1.8.1 A definition of design

Design in general, and Product Design in particular, started two-and-a-half million years ago when *homo habilis* manufactured the first tools. Human beings were designing well before they began to walk upright. Spears were manufactured 400 000 years ago and specialised tools were crafted 40 000 years ago. Urban design, architecture and furniture design were developed in Mesopotamia about 10 000 years ago. Graphic design and typography came into being in Sumeria 5 000 years ago with

the development of cuneiform (Friedman, 2000a: 5 – 6). Cuneiform was wedge-shaped or arrow-headed characters of the ancient inscriptions of Persia, Assyria (*OED*, 1978: 472).

Design as an academic discipline was, however, relatively new. Design was first defined as a verb in 1548. According to *Merriam-Webster's Collegiate Dictionary* (1993: 343), design (v) was to conceive and plan out in the mind, to have as a specific purpose, to devise for a specific function or end. Since those early days the process of design involved the drawing of plans or to execute or construct according to plan. Creativity, although implied, was not specifically mentioned in Merriam-Webster's definition. The *Oxford English Dictionary* mentioned creativity when, in one of its usage, it defined design as fashioning with artistic skill or decorative device. In another example of usage, it defined design as to trace the outline of a figure or form; to put a graphic representation on paper, canvas, etc. or to draw a sketch (*OED*, 1978: 244).

Only in 1588 was design described as a noun. *Merriam-Webster's Collegiate Dictionary* (1993: 343) defined design (n) as a particular purpose held in view by an individual or group, purposeful planning or a mental project or scheme. The art of drawing was again included, as design (n) also referred to a preliminary sketch or outline showing the main features of something to be executed; a plan or protocol for carrying out or accomplishing something; the arrangement of elements of detail in a product or work of art. The *Oxford English Dictionary* placed more emphasis on the abstract thinking process when it defined design as the preliminary conception of an idea that was to be carried into effect later by action. (*OED*, 1978: 244)

The use of the word evolved and in the present age design is a broad field covering many different disciplines. According to Von Stamm (2006) there are currently three definitions of the word "design", namely

- (a) A design is a tangible outcome, i.e. the end product of the design process, for example a camera, a car or a dishwashing machine, etc.
- (b) Design is a creative activity.
- (c) Design is the process by which information is transformed into a tangible outcome.

Different people see design differently. Designers may see their work in terms of creativity, problem solving or art. Marketing managers may see design as providing distinction from other similar products, so that consumers will choose their items rather than competing ones. To consumers, the function of design may be the creation of new styles, fashions and images, or the improvement of products so that they are easier to use, longer-lasting or energy-saving.

When many definitions are compared, design can mean either an activity (the design or innovation process), or the outcome of that activity (a design referring to the idea or plan from which a service can be provided, an object made, a new product or industrial process).

In this research, **design refers** to the conception of an idea and then the conversion of that idea into information from which a plan can be executed. The primary purpose of design is thus to create something new (Lockwood, 2004: 38). **Designers** in this thesis refer to full time designers as trained at a design institution, which is often found at universities of technology, technikons, politechniques or colleges.

1.8.2 Applications of design

The term *design* has developed, and a proliferation of design disciplines has been established, as the original process is applied in many ways. The following are some the different applications of the design discipline:

- *Industrial design* refers to the creation of products that are utilisable to the consumer or to industry. Typical examples are the design of a domestic iron or motor car. Both need to function effectively, be comfortable, as well as have some aesthetic appeal.
- *Interior design* (termed Interior Architecture in many countries) refers to the design of spaces within an architectural framework. These spaces might include homes, offices, restaurants, shops or hotels.
- *Communications design* includes all forms of visual communication such as print (advertisements, packaging, books and magazines), or on film, video and computer (e.g. illustrations or animations).
- *Jewellery design* refers to the designing, manufacture and marketing of creative and commercial jewellery.
- *Fashion and clothing design* refers to the creation, adaptation and interpretation of clothing styles and accessories for each season.
- *Textile design* refers to the creation of knitted, woven or printed textiles suitable for fashion wear or interiors.
- *Ceramic design* refers to the creations of a professional studio potter, a sculptor in ceramics, a ceramic designer or a production manager in a ceramic factory.
- *Information design* refers to the gathering and presentation of information in organisations.
- *Systems design* refers to the conceptualisation and implementation of various integrated systems.
- *Design leadership* refers to leading a team of designers. Projects are often too big for a single designer. Sometimes the skills of more than one designer must be combined.

The above list is endless. Many disciplines can be combined with the design process to form another application in that particular field, e.g., engineering design or transport design.

As is often the case after a period of proliferation, a period of reconciliation follows. Owens (2000: no page) mentioned that the practice of design had become highly interdisciplinary. Design teams increasingly engaged industrial designers, engineers and social scientists in collaborative and creative problem solving. In the new vision of design, the focus was not on product-centred innovations but on user-centred innovations, and was aimed at enriching the totality of the user experience with a

product. Gornick referred to an integrated design process where product, communication and environmental design, as *the three major disciplines*, contribute to corporate success (Gornick, 2001: no page). This categorising of various design disciplines was evident of a notion to integrate the variety of design disciplines in a synergistic manner.

1.8.3 *The management of design*

The design process found so many applications in such a variety of disciplines, that it had become necessary to manage the process (McArdle, 2005). As an integrative discipline, design addressed problems across many ranges of complexity. In a complex environment a designer should do many things, from identifying problems, to finding and realizing solutions. In this process a designer often had to assemble and lead a team (Friedman, 1999: 7 – 11). This was a very involved process, and with the increasing level of complexity of the solutions needed, as well as economic pressures to do it more cost effectively, it had become necessary to manage the process.

As the crucial contribution of design started to gain recognition in the global business community, the place of design management within the organisation was growing. Design management could therefore be described as the integration of the process of management and the process of design (Cooper & Press, 1998: 5).

Strategic Management was defined by David (2001:5) as the art and science of formulating, implementing, and evaluating cross functional-decisions that enable an organisation to achieve its objectives. This definition implied that strategic management focuses on integrating the various business functions, such as marketing, finance, production or operations, research and development. *Design as a strategic resource* therefore focused on integrating design into strategic management.

Strategic Design Management then focuses on integrating design as one of the business functions with the other traditional business functions in order to reach the objectives of the business. *Operational Design Management* referred to managing design projects, which was an integrative process, starting with the design idea and following it through to the finished product. It also involved an understanding of the integration of design and business activities.

Managers, in the context of this study, refer to anybody that has the ability to make decisions where design is concerned. It can be a project manager, head of department, such as marketing, or a senior manager, deciding on the strategic direction of a company. Traditionally design was accommodated in the marketing department, with a marketing manager as head of the department. The design function can, however, also be accommodated on its own, or in its own department, which then resorts under a general or senior manager.

1.9 Structure of the Thesis

In order to attain the general aim of the research, the thesis was structured as follows: Chapter one provides the introduction, background of the research, as well as the general aim, objectives and an overview of how they were reached. Chapter two provides the evidence in the literature on the contribution of Product Design towards increasing competitiveness in a business. The first part of this chapter concentrates on the contribution that design can make to a business. The second part concentrates on how this contribution can be made through Product Design Management. It ends with the position that previous attempts to integrate design into a business through Product Design Management were not always very successful in. As a result, chapter three proposes a new direction, and then develops a conceptual model of how Product Design could be used as a Knowledge Creation Management tool. This chapter ends with the field research question.

Chapter four explains the research methodology used to investigate the research question. As this is exploratory research, a combination of qualitative and quantitative methods was used. Chapter five presents objectively the results and analysis of the data. The thesis ends with chapter six, which deals with the discussion of the results, conclusions and recommendations. It also highlights the contribution to theory, namely a model indicating how a course in Design Management could fit conceptually in the training of business or marketing managers.

1.10 Summary

This introductory chapter provided the background and rationale for the research. That led to the problem statement, which was broken down into five objectives. These objectives were formulated and methodologies used to investigate and attain these objectives were indicated. The decisions taken with regard to the delimitation of the study were explained, the key concepts used in the study were clarified, and finally a breakdown of the chapters was provided. The next chapter will initiate the investigation and address the first objective with a literature review.

Chapter Two

Evidence in the literature on the contribution of Product Design

2.1 Introduction

Against the background of the overall research aim, how the competitiveness of businesses can be improved through the application of new Product Design as a Knowledge Management creation tool, Chapter Two shows evidence in the literature that new Product Design can improve competitiveness.

Design has become important for any business. As the world becomes more competitive, customers are having an increased choice and have thus become more aware of the features of a product. This encompasses not just price, but a wide range of non-price factors such as quality, reliability, aesthetics, status, etc. Nearly all price and non-price factors can be related to Product Design. Therefore good design matters.

Design becomes even more important as the economy becomes more information based and needs a system of creativity to consistently increase their information. The information based economy dawned when Microsoft stock market value surpassed that of General Motors in 1992. Soon thereafter Disney's stock market value became greater than Ford's. The providers of professional services had become the engine room of the economy. That led to the Age of *Information* Intensification, while the Age of *Creativity* Intensification is in the ascendant. Creation Intensification is what will set any company apart (Peters, 1996: 20 – 21). Design can be fundamental to creation intensification, not only in the narrow sense of new products, but also in terms of new ways of doing things. In order to do this, a system of creativity is much needed. If one went into a corporation twenty-five years ago and said, *What is your system for strategic planning?* the response would have been, *Huh?* Systems for strategic planning are common these days. If you went into a similar corporation recently and said, *What is your system for creativity?* the answer would probably be, *Huh?* (Kao, 1996: 10).

By providing such a system of creativity, design and business goals complement one another. Both commerce and design may be used creatively for problem finding or problem solving. They differ, however, in the use of creativity. Companies are primarily concerned with finding new opportunities for their businesses, and earning a profit by offering a product to a market. Design is concerned with finding needs and designing and improving products. Although the goals of design include profit, it is not limited to profit. It also encompasses utility, aesthetics and other qualities of artefacts as experienced by individual users (Kristensen, 1998: 221). Design has been described as the Trojan horse for bringing a renewed spirit of creativity into a corporation. Designers understand methodologies for using creativity and think differently and more broadly about business issues (Kao, 1996: 13).

The importance of design to businesses, providing creativity in a complementary role, can be demonstrated by the example of the Czech Republic and a substantial survey. When the Czech Republic was transforming their economy after the so-called velvet revolution in 1989, design was given a certain prominence. Firstly, because their domestic market was full of foreign goods and they wanted to bring their own products to a level at which they can compete. And secondly, the Czech Republic realized that design can play a crucial role as a tool to increase the quality of their industrial products and thus their competitiveness in the world marketplace (Vokrouhlicky, 2001: 79). That design can provide commercial success when managers had a positive disposition towards design, was also shown by a survey of 369 companies. The University of Strathclyde, examined managerial attitudes to design and Design Management practices, correlating them against sales performance and comparing them with major competitors. The study concluded that firms, who were committed to New Product Design and ensured that it was properly managed, had the greatest success in the market (Cooper & Press, 1998: 59).

In providing creativity, design will play a complementary role in business and can add to its commercial success, especially in the information-based economy. The rest of this chapter will elaborate on the importance of design in history and in innovation, and all the while providing a competitive edge in product development and in service development. This will be done in two parts. The *first part* provides an overview of the knowledge in the field to date and presents a theoretical background of the contribution of design to the strategic management of a business. Newly designed or redesigned products can contribute to a company's competitiveness in an increasingly global competitive environment. Design can contribute innovation to products resulting in increased economic activity for the company. This contribution, however, is subject to design's being properly managed. Put differently, the benefits of design are not used as widely as they should be, mainly as a result of lack of proper management.

The *second part* of the chapter provides an overview of past attempts to examine or solve the problem, and focuses attention on Design Management. Current research in Design Management is presented, starting with the need for design to be managed. Thereafter Functional Design Management is discussed, followed by Strategic Design Management. The section concludes that despite efforts made in the past to highlight the benefit of design, there is still much ignorance of the role design can play in a business. Design is not used as widely as it might be. Further research is necessary to improve managers' knowledge of the proven contribution of design for the benefit of businesses. This new way is then addressed in Chapter Three.

Part One: Contribution of Design

2.2 Contribution of design in history

The importance of design for business can briefly be demonstrated by a short historical overview. This section shows that especially since the late 1950s, Industrial Design has played a crucial role in providing well-designed products. This resulted in, *inter alia*, that Britain and America lost market share in favour of Germany and Japan, because the latter supplied products of excellent design. Despite efforts by the UK government to reverse this trend, Britain lost its competitive edge and at the same time the design industry shrank. The main reason for this decline in the design industry was due to design not being sufficiently integrated into the other business processes.

While Industrial Design can be associated with Product Design in the late 1920s, for example Kenwood food processors, Braun electric shavers and Gillette razors, it was only during the late 1950s, that well-designed products became important. In this period, industrialised economies had to adapt to a situation in which international competition has grown steadily and customers were presented with an ever-widening choice of products and suppliers. At the same time, greater affluence increased the demand for well-designed goods of high quality and technical sophistication. As a result British and American firms soon lost market share to competitors from countries such as Germany and Japan, which recognised the need for advanced Industrial Design. Interestingly, successful firms placed their emphasis not only on innovation, but also on improving the design of their own or competitors' products, designing and redesigning these products to augment reliability, quality and economic manufacturing (Walsh *et al.*, 1992: 4 – 5).

This economic importance of design was officially recognised in Britain in the mid 1980s when the UK government, in response to the decline in competitiveness, launched several government initiatives promoting the benefits of good design. One initiative was the design summit, chaired by the then Prime Minister, Margaret Thatcher. Following that was the Funded Consultancy Scheme (FCS) which enabled small and medium sized manufacturing firms to engage a professional design consultant to help with the development of new or improved products. The FCS was succeeded by Support for Design (SFD), which extended the scheme to the service sector with a reduced level of individual subsidy (Roy & Potter, 1997: 176 – 177). These initiatives led to fast growth in the design industry in Britain as state funding for design topped £25 million in 1988 and the UK design industry turnover was £2 billion. This growth can, to a large extent, also be ascribed to the consumer boom, to which the design industry ultimately fell victim with the onset of the economic recession in the 1990s. Between 1990 and 1992, Britain's 100 largest design consultancies lost over half the 10 200 jobs they accounted for. In five years' time the design industry grew to twice its size, and then halved again (Cooper & Press, 1998: 29 – 35).

Despite the government's efforts to stimulate the design industry, Britain was slowly losing its competitive position. For the first time since the Industrial Revolution, the country became a net importer of manufactured goods in 1983 (Toy & Potter, 1997: 175). According to Fox (1993: vii), the British have become uncompetitive in Product Design, because the manufacturing industry attempted to address the uncompetitiveness by concentrating largely on looking for solutions downstream in the manufacturing process: robotics, quality control, and improvements to manufacturing process control. The problem was that one cannot put manufacturing quality into a design that does not have quality originally designed in it.

In the late 1980s and early 1990s design consultancies showed poor financial results. In Denmark and Sweden, profitability for design companies fell starkly, along with a rise in the number of companies making a loss in the same period (Kristensen, 1998: 264 – 265). In the UK income from total turnover for design consultancies was £5.9bn in 2002, down from £6.7bn in 2001. Correspondingly, fees have also declined, down 22 per cent from £5bn in 2001 to £3.9 billion in 2002. Although the collapse of Britain's design industry can largely be accounted for by the recession, other factors have also been identified. Essentially a cottage industry, design failed to develop the strong management and effective financial controls. In addition, design became style. The design decade was more about selling goods (advertising, corporate identity, etc.) than producing goods (manufacturing) (Cooper & Press, 1998: 29 – 35). The biggest problem was that design was viewed as an add-on commodity rather than an integral strategic resource. Design failed to integrate itself as an essential element of managing a business. From a business's perspective, managers failed to realise the contribution design could make, especially in the area of innovation.

It can thus be concluded that design had influenced economies in the past, providing a bigger market share to Germany and Japan. Design has grown as an industry in Britain, because of stimulation from the government, but when the recession came it shrank just as fast. The reason was not only the recession, but also the inadequate integration of design into the other business processes. To address the question of design's integration successfully, one first needs to look at what design can contribute to business.

2.3 Contribution of design in general: Innovation and a competitive edge

In general terms, design can contribute innovation which can lead to or improve a competitive advantage. While any company that would like to renew its products needs innovation, product innovation is recognised more in Japan, because innovation is seen as the heart of a company. This section will demonstrate that innovation can come from design's ability to create something new. Design's impact on price, as well as non-price factors will be demonstrated. The source of such innovation may be based on market conditions (pull strategy) or a new development (push strategy). Whether a radical product innovation or an incremental product innovation, the new product should be well accepted by the market. Innovations should therefore be able to be commercialised for example

in the case of Xootr. Continuous innovation, however, is necessary for a sustainable competitive advantage.

2.3.1 Importance of innovation

This section will indicate the importance of innovation. Although innovation can happen by accident, a managed process is required to increase the frequency of innovation. This section will also indicate that Design, as a source of innovation, is recognised by Korea and the European Union. Design is not only a part of research and development, it's influence can stretch much wider.

Products are the lifeblood of companies, but they become outdated and obsolete. Companies that fail to develop new products are putting themselves at great risk. Over time, existing products are vulnerable to changing consumer needs and tastes, new technologies, shortened product life cycles, and increased competition (Kotler, 2003: 189). As a result, many companies follow a product development strategy that will create new offerings (Kerin & Peterson, 2004: 9). Innovation is then necessary to replace and update existing products, to diversify into new markets and to create new opportunities.

Innovation, according to the Shorter Oxford English Dictionary (1993: 1373) comes from the Latin *novare* meaning *to make new*, which comes from the root *novus* meaning *new*. Merriam-Webster (2001: 736) describes innovate as *to renew; to introduce new methods*. A similar concept, creativity, is described by the SOED (1993: 544) as from the Latin *creativus*, meaning imaginative. Merriam-Webster (2001: 340) describes creativity as artistic or intellectual inventiveness. Management writers, such as Stoner *et al.* (1995: 426) describe *creativity* as the generation of a new idea and *innovation* as the translation of a new idea into a new company (Apple Computer), a new product (Sony Walkman), a new service (Federal Express's overnight delivery), a new process (one waiting line for multiple services at a bank), or a new method of production (computer-aided design and manufacturing). In Product Design, *innovation* is frequently used to describe the whole range of activities from invention to the point of first commercial or social use, which includes research, design, development, market research and testing, manufacturing, engineering, etc. A commonly used definition of *innovation*, which is also used in this study, is that innovation is the commercially successful use of a creative idea. Successful innovation is about creating value (Von Stamm, 2006: 13).

Innovation can be an important source of success in the market economy, especially in today's changing and competitive environment (Tseng, 2006: 120). A study, commissioned by the German Industry Chamber on innovation excellence found that an increase in innovation capacity is the most important tool to improve profitability and income (Media Tenor & idea engineers, 2004: 2). Research undertaken by a London Business School revealed that 70 percent of organisations with a positive attitude toward innovation outperformed their competitors. These companies had seen an increase in profits over past years and had a larger market share than their closest competitors (Cooper & Press, 1998:124). According to Rollins (2004: 20), innovation is the mere cost of entry for US businesses.

Other authors are also convinced that success in the twenty-first century can only come from competing through continuous innovation (Raward, 2005: 18; Von Stamm, 2006: 5). Philips would not have been fighting for its survival had it not been for the Sony Walkmans, Hitachi videos, Sharp televisions and other Japanese goods that flooded Western markets from the 1960s onwards (Cooper & Press, 1998:124).

Many innovations occurred by accident such as the example of the discovery of antibiotics in 1928 by Alexander Fleming. A more recent example happened in the Sony Corporation's Tape Recorder Division where personnel tried to redesign a small portable tape recorder. They failed to reduce the size sufficiently and ended up with a prototype that could not record anything. So the engineers used it to play their favourite music cassettes while they worked. Mr Ibukam, an honorary chairman, popped into the room, saw this and remembered a project on lightweight portable headphones going on elsewhere in the building. Combining the two projects led to one of the most successful innovations – the Walkman (Pearson, 1991: 19).

Some innovations, although occurring as the result of a specific research process, can still be regarded as accidental. One example is that of the polyethylene terephthalate (PET) plastic bottle, which was developed at Du Pont by Wyeth. He thought that if one could orientate molecules in yarn or film – just as Wallace Caruthers did when he invented nylon in the same company in the 1930s – why could one not apply the same technique to plastic bottles to make them stronger? He did succeed eventually. In the second example, Chester Carlson noticed how difficult and expensive it was to make copies of documents. In the New York public library, he read about the photoconductor. Working on this idea for many years he obtained his first crude image in 1938. In the mid-1940s, Batelle took an interest and later on the idea was exploited through the Haloid Corporation (Pearson, 1991: 19). While these two innovations were the result of a specific process, both can be called accidental or *ad hoc*. The solution just happens to be innovative. Innovation was not the original intention.

The problem is that innovation often appears in an *ad hoc* accidental pattern. With the current level of competition, that is no longer good enough. Establishing a climate for organisational creativity and innovation will go a long way towards generating new ideas, as suggested by many authors (Rosenfield & Servo, 1991: 28 – 39; Ekvall, 1991: 73 – 79; Stoner *et al.*, 1995: 428 – 429). Many brilliant ideas have been discovered in this way. The problem is that managers, who must execute a strategic plan, cannot be dependent on the occasional bright idea from an employee. This need for consistency was later captured when Raward (2005: 19) defined innovation capability as the capacities that enable a firm to be innovative on a sustained basis, rather than producing one-off product or process innovations from time to time.

Design can be a source of such innovation. A study of Norwegian companies found that companies using design consciously have (a) higher levels of innovation activity, (b) generate more revenue from innovation, and (c) are overall more profitable than companies that do not use design (Von Stamm,

2006:14). Designers with a structured approach, aimed at innovation, have a better chance of increasing the frequency of new or improved products. It is not a wait-and-hope approach. One of the biggest differences is that for designers finding a creative solution to problems is a full-time occupation, while for managers it is only a part of their responsibility. Many managers solve problems as part of their daily task; some even do it with a measure of creativity. Very few are, however, trained to apply creativity consistently as design thinking does. The importance of designers thus lies in the fact that they specialise in generating creative solutions.

An example of the high regard of design's innovation capability was in Korea where the government declared a Design Era in 1994 to recognise the importance of design as a competitive edge for the nation (Hardy, 2000: 65). Another example of design's importance to innovation was the European Design Prize (EDP). The EDP is an initiative of the European Union's Innovation Programme, which was launched to help the European industry become more competitive. The aim of the EDP is to stimulate the use of design as an instrument of innovation and quality. Countries such as Ireland, Canada, Denmark, Finland, Sweden, Estonia and the State of Victoria in Australia developed national design policies. Germany also has design strategies in place – a growing recognition of how design needs to be integrated into national growth and development strategies (Thackara, 1997: 437 – 441).

Design can thus be an important source of consistent innovation. By providing such innovation, Design can have an influence on both price and non-price factors of a product.

2.3.2 Price and non-price factors in innovation

Price and non-price factors contribute in various ways to differentiating products. The design and the price of a product have an importance relative to each other. Customers will pay more for a better-designed product only if it represents, in their perception, better value for money.

An emphasis on price will always be important. Design decisions affect price factors, through their influence on how economical the product is to manufacture. Cooper and Press (1998: 56 – 60) maintains that design can determine up to 86 per cent of all costs of a product. That is because the designer specifies the material to be used, the component configurations and the manufacturing processes involved. For example, *value analysis* is a design strategy which reduces cost by identifying the cheapest means of performing each essential function in a product, and it can lead to a total cost savings of up to 20 per cent. Another cost saving approach is called *design for manufacturability and assembly* (DFMA). The DFMA process has cut the assembly time of IBM printers by 90 per cent and reduced Ford's manufacturing costs by \$1.2 billion. According to Ford, design decisions are ten times more effective than production planning decisions and one hundred times more effective than production changes in reducing costs and improving quality (Roy & Potter, 1990: 44).

In addition to reducing the price as much as possible, non-price factors are also important. Only one business can be the cheapest. The rest must use design. The poor competitive performance of the British manufacturing industry since the 1960s has for three decades been related to issues of productivity, prices, and exchange rates. In the 1990s, however, there has been an understanding of the growing role of non-price factors, such as product quality, prompt delivery, marketing effort and increasingly environmental impact. It was realised that one of the most important non-price factors in competition is how well a company's products are designed (Roy & Potter, 1997: 175).

The importance of non-price factors can be seen in the responses given to a survey by British furniture, heating and electronic business equipment firms and their leading overseas competitors. Only 16 per cent of British managers and a mere 11 per cent of their overseas competitors cited price as the key factor. The main difference between British firms and their major competitors in other countries

was that the latter tended to attribute product competitiveness to an increased number of factors, such as technical performance, product quality, delivery and after-sales service. Similarly the most successful plastics product firms offered well-designed, high-quality products, not at the lowest prices, but at a price that many consumers felt provided value for money (Walsh *et al.*, 1992: 79 – 80). Cooper and Press (1998: 61) concluded that one third of firms mentioned *value for money* as a key factor in giving their products a competitive edge. The design of a product helps to determine the consumer's perception of value-for-money, which is itself a crucial purchasing factor. Design's contribution to both price and non-price factors is summarised in table 2.1.

It can thus be concluded that in purchasing decisions consumers will consider price and non-price factors. Design can play an important role in both. Various techniques can assist in reducing the prices, while properly designed products will always differentiate themselves on non-price factors. The relationship between design and market conditions in differentiating products needs to be explored further.

2.3.3 Market conditions and innovation

In differentiating products, design may or may not be related to market conditions. These relationships correspond with a push or pull marketing strategy and can also be associated with radical and

Table 2.1: The influence of design (Cooper & Press, 1998: 61).

Factor	Influence of design
Price	
	Can reduce cost of use and maintenance
	Can reduce manufacturing costs
Non-price	
(a) Quality	Product performance Uniqueness Reliability Ease of use Durability
(b) Company image	Product presentation Display Packaging Promotion
(c) Delivery time	Design for ease of manufacture
(d) After-sales service	Design for ease of service and repair

incremental designs. The difference between these approaches is whether market conditions lead design or whether design leads the market.

An innovative design can be based on market conditions when a product is designed as a result of a gap or a need in the market, such as the ageing population or poor existing products. This source of design is then akin to a pull marketing strategy. That is when customers ask for a product, the retailer places an order with the manufacturer who in turn will ask a designer to develop such a product (Doole & Lowe, 2004: 304). In this approach designers adhere closely to market research reports and it is usually found in such industries as small appliances.

An innovation can also be found when a product is created with no relation to market conditions. This source of innovation is akin to a push marketing system. The designer conceives an idea without any market data and develops a product. A manufacturer decides to produce the product, convinces the retailer to stock it, who then convinces customers to buy the product. This philosophy is usually found in such industries as apparel and furniture.

An intermediate position is that designs need not be market sourced but should at least be market tested. Consumers should be asked to react to any proposed design because often consumers have views that are not apparent to designers and marketers. Most companies espouse the philosophy that designs should be market-tested (Kotler & Rath, 1997: 212).

In a market driven economy, the market leads design as designers respond to customers' requirements. Such a product is certain to be well accepted by the market, but if the designer is confined to the demands of the market a lack of creativity can result. It may also mean a missed opportunity to lead the market as traditional market research is unlikely to reveal demands for something really new. It remains a fact, however, that the majority of successful innovations arise in response to the recognition of a need (need pull), as opposed to the use of a new technical potential (technology push). Sometimes a new technical potential becomes available first and results in a technology push, for example in the case of the more radical innovations. Although a high degree of creativity can be exercised by the designer, it is uncertain whether the product

Table 2.2 Market pull vs technology push (Groenewald, 2000:131)

	Advantage	Disadvantage
Market pull	High possibility of sales Reduced uncertainty	Low creativity Missed opportunities to lead the market
Technology push	High creativity	Sales uncertain

will be accepted by the market. An extensive descriptive study of 567 successful innovations showed that most successes were market pull ventures and that only 21 per cent were technology push (Cooper & Kleinschmidt, 1991: 128).

In certain instances, design based on the pull strategy can lead to a really innovative product. One of the British consumer electronics company Amstrad's most successful products in the mid-1980s was designed to fill a market gap by providing a complete package of hardware and software for word processing and other office tasks (Walsh *et al.*, 1992: 172 – 173).

Design based on the push strategy can sometimes fail or at other times be a roaring success. An example where design based on the push strategy fail badly is that of the Sinclair C5, an electrically assisted tricycle. Clive Sinclair's trike was an open-topped three-wheeler with no reverse gear. Its top speed was 24 kilometres per hour, it needed pedals to go up hills and it had room for just one person. But it was inexpensive and Sinclair thought he had a winner. The C5, however, failed to create the market demand expected by its planners and designers. Production was stopped after five thousand of an estimated one hundred thousand units and Sinclair conceded that he had misjudged the market (Davis, 1991b: 164).

In another example, design based on the push strategy can be a roaring success. The Sony Walkman was the first personal stereo and this innovation opened up a market that did not previously exist. Sony's approach is to lead the public with new products rather than ask them what kind of products they want. Instead of doing a lot of market research, they develop a new product and try to create a market for it (Morita, 1991: 188). A similar approach was followed by Soichiro Honda. When he set out to design and manufacture his first real motorcycle, there was not yet a market for such a machine. He said later: *We do not make something because the demand, the market is there. With our technology we can create demand, we can create the market* (Davis, 1991e: 150).

It can therefore be concluded that some innovations may be grounded in market conditions; while others may be grounded in a new technology or a completely new creative idea. These two approaches can also be associated with radical innovations and incremental innovations.

(a) **Radical product innovation** refers to something that is significantly different from anything that has existed before. It uses advances in technology to offer customers a new line of products, for example companies involved in high technology and R&D-intensive sectors. Radical, or breakthrough innovations, are novel, unique or technology advances in a product category that significantly alter the consumption patterns of a market (Zhou, Yim & Tse, 2005: 42). Radical innovations often caused an upset in the market. Steam ships replaced sailing ships and the transistor radio replaced large console radios (Cooper, 2000). Another example is that of the compact disk, which uses a new technological platform (laser optics) to write and read data when the prior technology used magnetism (Sood & Tellis, 2005: 153). Radical product innovation is based on discontinuous change as the new product is completely different from the old one

(b) **Incremental product innovation**, based on continuous change, involves using existing technology to extend an established product line. The sum of quite minor modifications can often have as

great an overall impact as did the original breakthrough, for example the role of re-innovation in the television set. Following the initial technological breakthrough, the television was characterised by a small screen, and poor quality. Through incremental design improvements, modern television sets now have large screens, are of far better quality, and are available at a much reduced real price. According to Sood and Tellis (2005:153) incremental innovation happens when products are based on the same technological platform, for example the floppy disks were decreased from 18 to 14 inches in 1978, to 5.25 inches in 1980, to 3.5 inches in 1985 and to 2.5 inches in 1989, though each was based on magnetic recording (Sood & Tellis, 2005:153).

An interesting example of incremental design is the motor car. Although the basic car design has been static for some years, from 1966 onwards car companies concentrated more of their efforts on the way in which a car is manufactured, rather than on its actual design. The Japanese led the way, producing cars effectively and at a lower cost than that of their competitors. Having a static Product Design, they maximised on the other design disciplines to produce more efficiently.

Some studies indicate that the commercially more successful firms were those with an evolutionary approach to design and product development. Walsh et. al. (1992: 30) concluded that successful companies were those who improve their products in response to user needs and continuously modify and adapt their designs in response to new technologies and competing products. The stream of incrementally improved products coming out of China on the world market is a very typical example. One of the big tests for the success of an innovation is thus whether it can be commercialised.

2.3.4 Commercialisation of innovation

This section indicates that businesses must be able to commercialise the new designs to generate a profit for the firm as well as provide new benefits for their customers. Two examples of the commercialisation of innovation are Microsoft and the Xootr.

The ability to innovate can create substantial value. One of the best examples is that of Microsoft, which became more valuable than General Motors because of its intellectual capital or, put differently, its capability to invent. Rapid innovation in new products then becomes a core competency for a company (Leonard-Barton, 1996: 130).

Another good example of how an innovation can be turned into a commercial success is that of the Xootr. Nova Cruz turned a traditional child's kick scooter into a hip toy for grownups. Within their first year, their annual revenue rate grew to \$10 million and the company reached positive cash flow and profitability. They transformed an old idea – the kick scooter – into a product that could compete in a fast maturing, cost-sensitive category. Priced between \$199 and \$489, Xootr was significantly more expensive than its competitors. To support the price premium, the product variations offered clear advantages with its high-quality design: increased comfort with decks wide and long enough for two

adult feet; 7.1 inch wheels with low rolling resistance that easily enabled speeds of 10 to 12 miles per hour; and a backward-angled front fork, in combination with a front braking system that promoted stability and safety. At the time of writing the article, Xootr had more than 100 distributors worldwide; mostly action sports and specialty retailers (Smith & Ulrich, 2001: 29 – 34).

Nova Cruz, depended for 25 per cent of its sales on Xootr, realised that its biggest challenge was to keep pace with the flow of Xootr orders and prepare the company for the possibility that the demand for kick scooters might ultimately pass. In February 2001, Nova Cruz launched the Xootr eX3. This scooter is the world's smallest, lightest, and most powerful electric scooter. At just 19.8 pounds, it weighs only half as much as its closest competitor, yet offers nearly twice the top speed (17 miles per hour), acceleration (12 miles per hour in five seconds), and hill-climbing ability (10 per cent grade). It can go as far as 16 miles on a single charge and function as an efficient kick scooter when not powered. Again, they were banking on the strategy of combining high performance and strong aesthetics to differentiate their product (Smith & Ulrich, 2001: 28 – 34).

The Xootr is also a good example of how firms need to innovate more than once to keep their competitive edge. It does not necessarily have to be products. Many companies view innovation as the perpetual new frontier and the key to achieving a competitive advantage. Everything is subject to innovation such as political systems, economic policy, ways in which medical research is conducted and even complete user experiences, for example a passenger's journey on an airline. The application of design sensibilities and skills can extend to innovations as varied as online interactions, for example Amazon.com's one click feature, and improved business processes. Design can connect consumers and providers in ways that ultimately contribute to larger industry innovations (Weiss, 2002: 34).

It can thus be concluded that design can provide innovation which sometimes can be commercially successful (e.g. Microsoft and Xootr) and at other times be commercially unsuccessful (C5 tricycle). A sustained long-term approach is needed. A competitive edge may take years to develop. The commercialisation of design must therefore over the long term be translated into a competitive edge on which the business can capitalise.

2.3.5 A competitive advantage based on innovation

With worldwide competition increasing, companies cannot compete if they do not have a competitive advantage. This section demonstrates that through providing innovation, design can contribute to differentiation and ultimately lead to or contribute to a competitive advantage. Differentiation is defined by David (2001: 180) as a strategy aimed at producing products and services considered to be unique and directed at consumers who are relatively price insensitive. A competitive advantage is defined by Stoner *et al.* (1995: 139) as a capability or circumstance that enables a corporation to earn above average profits in a particular industry.

In this era of intensifying global competition, companies are searching for ways to gain a sustainable competitive edge in hope of protecting or improving their market positions. One of the few hopes companies have to stand out from the crowd is to produce superiorly designed products. As a result, designing products needs a new and innovative approach. Products are becoming equal which also means similar. According to Tom Peters (1996: 17): *A jillion new products arriving faster than ever: and the quality of almost all of them these days is good. But do they sparkle; suck the customer for financial services software or toothpaste off the couch? Rarely.* During a seminar in Australia he argued that Toyota's products were not very interesting. After the presentation, the chairman of Toyota Australia denied that there was a major product problem. About fifteen minutes into the lunch the chairman said that when cruising the streets of Sydney or Melbourne, sometimes he could not tell the Toyotas from the Hondas and the Nissans! Another example involved the very prestigious International Contemporary Furniture Fair at the Javits Centre in Manhattan. *Most of the stuff looked just like everything else. Uninspiring, me too-ism galore* (Tom Peters, 1996: 19).

In contrast, Rubbermaid is a good example demonstrating the advantage of innovation that leads to products that are different from the competitors. Rubbermaid, a maker of rubber and plastic products was voted the most innovative company in America by *Fortune* magazine. Rubbermaid generates about four hundred new products each year, and was tied for first place with Microsoft in the number of industrial-design awards won in a prestigious 1994 contest. Ninety-five per cent of Americans recognise the brand name, which puts Rubbermaid in a league with Coke and Disney. If one can differentiate Rubbermaid's products, it can be done with many others. Peters (1996: 19) believes that design mindfulness is clearly the number one route of attack for standing out, for halting, and even reversing inevitable commoditisation.

Design can be instrumental in providing differentiation, which can be used to build a competitive edge. The differentiation that design can provide refers to the tangible products, as well as the intangible company image and positioning.

Differentiation is the best competitive edge design can provide in contrast to, for example, design's contribution to low-cost manufacturing. Design can help to devise a physical form that may have immediate charm and appeal to the consumer. According to Tom Peters (2000: 10) the fundamental purpose of design is to differentiate a product or service, whether through aesthetics or through function. Confirmation of the importance of differentiation as a competitive edge is that even in crowded markets, successful companies tend to compete by making their products different, not by making them cheaper. Europe's 500, the European Union's fastest-growing companies, steer clear of low-cost leadership strategies by a factor of two to one (Thackara, 1997: 37).

When the product or service produced is difficult to differentiate, it is the image of the company that is the competitive factor and therefore the target of differentiation. Most banks or insurance companies provide exactly the same products, based on mathematical calculations involving the same factors for

all competitors. Design is then used to project a distinctive identity for an organisation, using a visual language. Two examples are the cupped hands of the Sanlam logo or the three anchors of the Old Mutual logo. Both offer financial investment opportunities. Sometimes companies and their brands compete with each other on emotional rather than rational grounds. For example, the payoff line for a shock absorber that reads: *You are safe in the arms of Armstrong.*



Sanlam



According to Cooper and Press (1998: 59), the company with the strongest, most consistent, most attractive, best-manifested identity will emerge on top in this race. A well-established corporate identity can lead to long-term cost savings, for example advertising becomes cheaper, greater employee motivation for example increased loyalty and pride, and higher consumer awareness.

Differentiation, however, does not guarantee a competitive edge, especially if standard products sufficiently meet customer needs or rapid imitation by competitors is possible. The best differentiation can be achieved with products protected by barriers to quick copying by imitators. Successful differentiation can mean greater product flexibility, lower costs, improved service, less maintenance, greater convenience or more features (David, 2001: 181). The fundamental principle is that design is one of many elements essential to success. Design alone is not enough. It is, however, a distinguishing feature – one that sets a company, its products, its services and its relationships with customers apart from competitors, in ways that are enduring, valued by customers and profitable. By doing this, design can secure a distinctive niche in the market (Walton, 2002: 6).

2.3.6 Design contributing to a competitive advantage in niche markets

Dominating niche markets is the ideal competitive edge, because products or services can be tailor-made for small homogenous groups of customers. As design and manufacturing become more efficient, it has become more profitable to sell products in lower volumes than in earlier years, making it possible to target smaller niche markets. According to a survey done by the British Design Council, about 80 percent of companies believe that design increases competitiveness and 83 percent believes it helps to increase market share (Von Stamm, 2006: 14).

Changes in the production system allow products to be produced for niche markets. The rise of an individualistic consumer society created a market where people no longer desired a standard product. Stores such as Sainsbury's, which holds over 12 000 product lines, were among the first to realise that the mass consumer was being replaced by diverse market segments. At the same time flexible manufacturing systems were developed. Single-purpose machines were being replaced by general-purpose multi-task robots. Sharp's robotised electronic calculator line can produce up to six different models simultaneously. Whereas car panel presses in the United States recently took nine hours to change their dyes, Toyota's modern presses have reduced this to two minutes. At Panasonic it is claimed that over 11 million variations of bicycle designs according to individual customers' ergonomic and feature requirements can be produced from their flexible factory (Cooper & Press, 1998: 72 – 73).

New production methods have reduced the breakeven for motorcars of a new design from 200 000 units to 50 000 units (Lockwood, 2001: 50). With a large variety possible and short production runs economical; a small niche market can be dominated. While the European consumer electronics industry has generally withered in the face of high volume, globally marketed Japanese products, two relatively small manufacturers have employed design-led strategies to gain a distinctive market presence.

- (a) **Linn Products:** This Scottish manufacturer of top range record turntables had sales of £3 million in 1991. With the advent of the CD age the company decided to invest in design and manufacturing totalling £2.75 million. As a consequence, Linn has grown rapidly and accrued profits of £11 million in 1993. Linn's success derives from using its high quality market profile in turntables as a springboard to launch complete sound systems. With its top end systems retailing for £22 000, Linn has to satisfy the buyer that the product is a lifetime investment. This is, *inter alia*, achieved through the modular design of its products, whereby well designed enhancements can be bought and added to existing equipment.
- (b) **Psion:** This British company has used design to gain a niche in computers. With its new Series 3 pocket computer, Psion is pitched against strong Japanese competition, but the firm used design to give its products a distinctive presence in the market. Psion was the first to open up the hand-held computer market. The Series 3 possesses a new product concept: a pocket computer with a QWERTY keyboard, PC compatibility, a word processor and a distinctive alternative to the matt black aesthetic of most organisers (Cooper & Press, 1998: 114 – 115).

Linn Products and Psion demonstrate the need for flexibility in the fast changing consumer electronic markets. They avoid head-on competition with Japan's mass manufacturers by carefully focused design and marketing strategies at specific niche markets.

- (c) **Bang & Olufsen:** A design-led strategy secured a niche for a family-run Danish firm. With a small domestic market, and thus less opportunity to manufacture on a large scale, Denmark tended to wed its craft traditions to modern technology. One firm that typifies this strategy is Bang & Olufsen. Employing little more than 3 000 people, compared with Sony's 80 000, for example, Bang & Olufsen manufactures a range of hi-fi and television products noted for their distinctive styling and innovative features. Bang & Olufsen's innovation is based on design rather than technological research and development. They implement the newest technology with creativity and inventiveness (Cooper & Press, 1998: 113 – 114).
- (d) **Miyake and Comme des Garçons:** This example demonstrates how design has been used to survive in a mature industry. Leading designer Issey Miyake developed laser-printing techniques and introduced computer-driven looms to craft weavers. Investment in Miyake's design studios by

the Toray Company has accompanied continued innovation by Miyake in new methods of texturing synthetic materials. Comme des Garçons is a Japanese fashion house that has built a presence for itself on the international market. All their fabrics are produced by Hiroshi Matsushita's Textile Research Centre, which co-ordinates a network of producers nationwide. Miyake and Comme des Garçons have in a short time secured positions as leading international fashion houses and as a consequence they have secured new markets for Japanese textiles. Cooper and Press (1998: 118) conclude that both in Britain and Japan, textile producers are finding a niche through greater integration of design as a means of meeting the needs of fashion based markets.

It can therefore be concluded that design's ability to match customer requirements to a product's performance, can lead to developing a product that can dominate a niche market. Design can not only contribute to a product's success in niche markets, but can also make a contribution towards global competitiveness.

2.3.7 Design contributing to a global competitive advantage

Design's ability to innovate can be a key element in a company's endeavour to compete in a global economy. Global competitiveness for individual companies can also make the national economy more competitive. Design's ability to contribute to a competitive edge, can thus make a contribution towards South Africa becoming more competitive in world markets and in so doing expand its economy and increase employment opportunities and wealth creation.

Research shows conclusively that design has been an important factor in a firm's competitiveness in local and export markets, for example in the case of Germany and Japan. From 1950 to 1988 (then West) Germany increased its share of manufacturing exports from 7 per cent to 20 per cent with a peak of 22 per cent in 1973. Japan's share increased from 3 per cent to 18 per cent over the same period, with a peak of 20 per cent in 1984 (Roy & Potter, 1990: 13). (See Table 2.3.)

Table 2.3 Comparative market share of world manufacturing exports (Roy & Potter, 1990: 13).

	Germany	Japan
1950	7%	3%
1988	20%	18%

The relationship between design and global competitiveness is also addressed by Larry Roellig (2001: 40-45). Roellig explores the design challenges corporations must address if their products and services are to have an effective presence around the world. According to him, brand identity and distinct positioning messages are best communicated across all countries through packaging graphics that are as standardised as reasonably possible. The positives and negatives of creating one global design versus localised adaptations, or remaining associated with the country of origin versus embodying cultural differences, must be weighed against one other. However, despite these complications, great brands tap into basic human needs and aspirations. There can be no stronger

global brand platform than one that speaks directly to customers and improves their lives – no matter how small or incremental the improvement (Roellig, 2001: 45).

Understanding the differences in international markets is further stressed by Mario Gagliardi (2001: 32 – 39). He compares the Western emphasis on uniqueness with Eastern interest on synthesis. Novelty and innovation in the West are achieved through contrast – that is, by staking out a position and defending it. In contrast novelty and innovation in the East embrace copying (mimesis) and assimilation. Gagliardi's message is to recognise these cultural options and integrate them into the design process. Gagliardi thus agrees that the key to global design starts by studying human needs and human aspirations.

Selling globally is not just a matter of simply having a presence in a large number of countries, but of positioning products successfully. The basis for the acceptance of Braun products worldwide is a synthesis between the best possible functionality and the best possible aesthetics. People's wishes and expectations differ from region to region and sometimes the differences are quite contradictory. A hair dryer in the Far East, for example, needs to be compact, because the people there tend to have smaller hands, while in the US a product has to be as large as possible to be regarded as representing good value for money. This approach, to positioning products in different markets, has led to greater diversity in the Braun look. Once a product is designed, the goal is to offer feature variations. The stylistic consistency that was such a great feature in the 1960s for Braun is a great way of making the company well known. But when one looks at the practicality of the products, not to mention the ergonomic factors, the new Braun products are clearly better and more highly developed than their 1960s ancestors (Beuker, 2001: 18 – 19).

The challenge then is to design a desirable and economically viable product in markets that are complex and diversely segmented (Walton, 2002: 6). One of the best examples of design's successful contribution to global competitiveness can be seen in the IBM ThinkPad. Sakakibara (1998: 91 – 105) demonstrates how a large and mature high-tech company can combine its best sources of design ideas and expertise for targeted global competitiveness. For years IBM had been failing to keep up with its competitors in the personal computer market. In the portable computers' sector that has all been changed largely due to IBM's successful use of design. In 1993 sales of the ThinkPad series were estimated at \$1.4 billion worldwide, making it the market leader in the portable computer sector. According to a survey in the US, over one third of purchasers bought it because of its design.

For portable computers, design is critical. The ThinkPad 700C was conceived as an adult's electronic business tool which is powerful and easy to use. Its size allows it to be easily carried in a briefcase, stored in a locked drawer, stacked horizontally or vertically on a bookshelf and used on a lap, desk or aeroplane. The TrackPoint device facilitates ease of use in a space-constrained environment. Conceptually, the ThinkPad 700C design reflects the concepts of the traditional Japanese lunch box,

Shoukadoe Bentou, the essence of which is a simple exterior and a rich interior. Once opened, the simple exterior reveals a powerful computer with colour display and exquisite attention to detail.

The ThinkPad product series was the first successful example of IBM's differentiation approach to Product Design. Industrial designers were responsible for the hardware, peripherals, and for design co-ordination. Graphic designers developed the user's manual, nameplate and shipping carton graphics, while the software look and feel was developed by graphic interface designers. The IBM graphic design consultant established the product nameplate, packaging and operator manual guidelines. At IBM, almost all Product Design is created in-house. The company has 15 design centres from Boca Raton, Florida to Yamato, Japan. In Yamato alone, about 70 designers work with engineers to develop new product lines (Sakakibara, 1998: 102).

Important for South Africa, design can also contribute to small and medium companies. The Europe's 500-project concluded a five-year investigation of Europe's *most dynamic entrepreneurs*. It was found that their companies grew by an average of 21 per cent per annum and increased employment levels by almost 160 per cent, during a period of recession (the early 1990s) when the total number of jobs in the economy fell. Product differentiation, rather than cost was indicated as the reasons for their success. They differentiate principally on the basis of the quality of their product (48 per cent), in the superior service they provide to their customers (33 per cent), or on product appearance (14 per cent) (Thackara, 1997: 15 – 18).

Five Scandinavian small and medium-sized firms explored industrial design to create a competitive edge. Sometimes the designer was located entirely outside the firm as an autonomous designer, or a design consultancy was used, or the designer was partly an insider. The results were summarised in terms of five result indicators:

- Unique products*: Distinctive and unique products were created for all five companies.
- Market assets and commercial results*: Four of the five companies obtained increased sales revenue, in particular in export markets. This financial development was mainly attributed to the designed products and their commercialisation.
- New image and relationships*: All the companies achieved new customer relationships based on offering the new product designs.
- Revitalise the firm through design competence*: In all five firms, the designer's collaborating partners tell stories of learning more about design, through the design associates. It is worth noticing that not only the CEOs learned more about design, but many other employees on various other levels also (Jevnaker, 1998a: 113 – 116).

This section has shown that, in the face of increasing global competitiveness design can contribute to making businesses more competitive. Such a competitive edge can be found in differentiation, which can secure a niche market. Not only can design contribute to international companies, for example Braun and IBM, but also to small and medium-companies. Carefully targeted investment in design in

South Africa, should therefore contribute towards increasing global competitiveness. According to Digby Jones, design is not just about design; it is about the importance of using design and innovation to help in the global battle for competitiveness (Design Council (b), 2006).

However, the success of a product, service, company or economy does not rest solely on innovation or design. The success of a company in international competition depends on all-round competence. Business success depends on the synergy reached between many factors. Design, as one of the input factors, can play a major role in achieving that synergy. In addition to synergy in a business, excellence in at least one area is required to achieve a competitive edge. This area could be design, but might be excellent quality, low cost manufacturing or some other strength. While design may provide the innovation that can make the contribution towards achieving a competitive edge, interactions of many other competencies are needed.

The overall contribution of design to a business has been demonstrated. The next step is to illustrate design's specific contribution towards product and service development.

2.4 Contribution of design in product development

One of design's major contributions is in the area of product development. A company, whose main business is selling products, constantly needs new products in order to compete in the market. Product development is therefore vital to its continued existence. Product Design can include both Engineering Design (more technical) and Industrial Design (more aesthetic). Most product developments go through a similar process, given individual adaptations. When products are designed for international markets, a few adjustments might be necessary. The design of the product, however, remains the biggest factor in successfully launched new products.

2.4.1 Importance of product development

Markets for products are reaching maturity and it is becoming increasingly difficult to differentiate products (Doole & Lowe, 2004: 249). The need and importance of new products can clearly be seen by the increasing amount of sales and profits generated by them. The percentage of total company sales generated by new products increased from 33 per cent during the period 1976 – 1980 to 42 per cent in the period 1985 – 1990. At that stage it was projected that it would reach 52 per cent. For the same periods the profits generated by new products increased from 22 per cent to 46 per cent (Baxter, 1996: 2). (See Table 2.4.) In addition, Planting (2004:1) indicates that over the six years following from 2004 onwards, products that currently represents more

Table 2.4 The percentage of total company sales and profits generated by new products (Baxter, 1996: 2).

Year	% total sales	% profits
1976 – 1980	33	22
1981 – 1984	40	33
1985 – 1990	42	*
Projected	52	46
*information not available		

than 70% of companies' sales will be obsolete due to changing customer demand and competitive offers.

The need for product development has increased, as a result of three reasons:

- (a) Competition between market offerings has increased.
- (b) Shortening product life cycle as a result of the increasing pace of technology (Doole & Lowe 2004: 260).
- (c) The new system of manufacturing produces a variety of products in short economical production runs for niche markets (Cooper & Press, 1998: 94).

The success of new or redesigned products can be demonstrated by the increase in sales generated by new products. It can be concluded that new products are needed for a competitive edge as a result of increasing competition, shorter product life cycles and new production systems. When designing products, it is necessary to understand the processes involved in product development.

2.4.2 Processes in product development

The process by which a product is designed always starts with a stimulus. The stimulus may or may not relate to market information as supplied by market research projects, depending on the firm's attitude towards market information.

The factors influencing new product development usually fall into three categories: market stimuli, technological stimuli and company stimuli. Except in the relatively rare cases of radical product innovations, the overwhelming stimulus is *market demand* or opportunity. For example, a firm is aiming to exploit gaps in the market, to move into different market sectors or to meet customer orders. A firm's attitude towards market research is therefore of the utmost importance. According to research done in this regard by Walsh *et al.* (1992:179), furniture and heating companies surveyed had a very negative approach towards market research. They also tended to introduce variants and updates rather than innovative designs. They were rarely at the forefront of changes in the market and reacted to changes in consumer needs and to competitor actions rather than operating in a more challenging and pro-active way.

In contrast, the electronic business equipment firms surveyed generally viewed market research in a more positive light. These firms operated in a market characterised by uncertainty and rapid change. In such a market situation formal market research could provide information about users to assist in product planning and design. Other firms in this sector, however, said that their products were too innovative to attain any meaningful assessment from a market survey. A manager interviewed in the research said that very few people in a market research sample could make the step to evaluate conceptually new designs. This shows the dilemma of those producing radical innovations: can market research ever lead the way? Despite this difficulty, one of the more successful electronic business

equipment suppliers attributed its success to its vigorous approach in gathering marketing intelligence. The company felt that if they did not exploit new market opportunities as these appeared, then others would do so. The need to get the timing right to make the most of new market opportunities seems to be particularly acute in fast moving, high technology product markets (Walsh *et al.*, 1992: 179). In contrast, Akio Morita of Sony often proceeds without the backing of positive market research results. In his words: *I do not believe that any amount of market research could have told us that the Sony Walkman would be successful ...* (Morita, 1991: 190).

It can thus be concluded that market conditions play an important role in the beginning of the design process. It seems that firms who do not have a high regard for market research results also tend not to have very innovative products. Although market research cannot lead the way to innovative products, it can point to the opportunities in the market. In a market-driven economy, the designer should always be very conscious of market research results and their possible impact.

Beyond the initial stimuli, the phases in the actual design process are as varied as there are designers. A general trend, used by most designers can, however, be depicted. A typical example can be the following stages:

- Briefing, a knowledge sharing activity during which the client describes what is required.
- Research into social, economic and technological context to establish market relevance, e.g. study of market research documents.
- Strategic enquiry and orientation to integrate the product development with the strategic thrust of the company.
- Idea generation and innovation during which new ideas are generated
- Concept design is a process whereby ideas with potential are worked through in more detail.
- Concept development involves a tighter focus on a smaller selection of concepts.
- Design development encompasses the drawings and/or a finished model.
- Further phases and liaison could follow for example the development of specifications for parts, prototyping, tooling and involvement in the eventual production.
- Market testing will test the product with a representative sample of the intended target market.
- Business analysis will examine whether the product will be a financial success
- Commercialisation is the final step and includes full scale manufacturing and promotion (Doole & Lowe, 2004: 277 – 278; Powell, 2006: 1 – 4; Kotler 2003: 194 – 196).

In contrast to the highly structured approach, 3M has a very different attitude towards managing the new product development process. A typical procedure will be the following: A 3Mer comes up with an idea for a new product. He or she forms an action team by recruiting full-time members from technical areas, manufacturing, marketing, sales and maybe finance. The team designs the product and decides how to produce and market it. Then it develops new uses and line extensions. All members of the team are promoted and get raises as the project goes from hurdle to hurdle. When sales grow to \$5 million, for instance, the product's originator becomes a project manager, at \$20 million to \$30

million, a department manager, and in the \$75 million range, a division manager. Interestingly, there's a separate track for scientists who do not want to manage (Mitchell, 1991: 174).

It is clear that different processes can be used. Bob Anders (2000: 29 – 37), programme head of Arts and Cultural Management and Design Management at Pratt Institute, New York, regularly asked his students to draw up a visualisation that describes the design process in their view. Different diagrams were shown of how his students saw the design process. Anders cautioned design managers that it is not a matter of choosing, but rather of devising their own route through design that yields the best results (Anders, 2000: 37).

One fact, however, remains constant despite various design processes: the most benefit the company can get from the designers, is if they impose the design discipline as far upstream as possible, i.e., at the product conception stage. In this way designers have the most freedom to come up with a truly innovative product. Kotler and Rath (1997: 212) state that a common management mistake is to bring designers into the new development process too late or bring in the wrong type of designer. They follow eight stages in the new product development process: idea generation, screening, concept development and testing, marketing strategy, business analysis, product development, market testing, and commercialisation. Typically the designer is invited in at stage six (product development) when the prototype product is to be developed.

Designers, however, should be brought in earlier, preferably in the idea generation stage or at least the concept development and testing stage. Designers are capable of producing ideas that no customers would come up with in the normal course of researching customers for ideas. And during the concept development and testing stage, designers might propose intriguing features that deserve investigation before the final concept is chosen. All the functions should be involved in the process (Doole & Lowe, 2004: 278).

It has been demonstrated that the process involved in designing and developing new products differs in different circumstances and designers or design managers often follow their own pattern in developing products. Whatever the process, it is important to introduce the design discipline as far upstream as possible in the product development process. These processes are also used to develop products for international markets. The question is whether products for international markets should follow the same design or should the design adhere to variances in the different markets?

2.4.3 International markets in product development

International offerings can be in the form of different products in different countries or maintaining uniform product profiles in many countries. Value exporters present a uniform product, emphasising their national origin to different countries. Value collectors assimilate local cultural trends.

International offerings sometimes differ. The smallest difference is when product communication on packaging and in media advertising reflects language differences and cultural tastes. In some instances, the design of the product itself can be different. A Nokia in the US does not look, or even work, in the same way as the European or Asian Nokia. In other instances the products are the same. Some companies utilise their national characteristics to retain a single design vision. Companies like Braun capitalise on their European cachet when they are marketed in the United States, and Harley-Davidson motorcycles would not sell nearly as well in other countries without their American outlaw mystique. The natural inclination of any international business is to force everybody into the same size in an attempt to find one design that fits all. Sometimes this is successful, for example, the Ford Focus, a design that sells well in both the US and Europe (Grinyer, 2001: 10).

Whether products are different or the same, design can be a tool to emphasise the same uniqueness worldwide, or it can be a tool for getting closer to local market conditions and different user needs. In following one of these two approaches, global companies selling a brand outside their home countries, can become value exporters or value collectors.

Value exporters: These companies have especially strong values that are often linked to national characteristics and presented as such in other countries. The companies use design as a tool to emphasise either their national origin or the set of values that differentiate them from other products. The best market in which to observe this approach is the automobile sector. Audis and Volvos, for instance, look the same in the US and in Europe and their message is the same. Volvo has always retained a Swedish identity that is associated with safety and protection. Citroen made cars that defined perceptions of French culture. Renault have created innovative cars for decades, establishing the first hatchback, the first small urban car, the first Euro MPV and then the innovative and much copied Scenic, an MPV on a compact car platform that combines the needs of rural and urban driving.

Volvo and Renault are examples of companies whose values, rather than looks, are used to enhance their brands. Companies like Mercedes, Audi and Alfa Romeo emphasise their origins much more through their appearance. Companies such as Jaguar, Aston Martin and hi-fi manufacturer Bang & Olufsen combine both of these attributes by having strong visual identities that refer to traditional craftsmanship or historical design values.

Value collectors: Many companies go to great lengths to study and to react to local cultural trends. Many value collectors are Japanese and Korean companies. Eager to connect with the values and tastes of European and US customers, they work with local designers or set up local design studios. In the UK, for example, there are in-house studios for Sony, Hitachi, Panasonic and Samsung as well as for US brands such as Hoover and Black & Decker. Daewoo has set up a studio in France and so has Motorola in Milan. The aim is to identify values in your users, wherever they are, to find opportunities for innovation and real competitive edge. Local design teams are becoming a vital part of strategic design vision because they add new ingredients with their ability to sense what is around us,

understand the value of products and services and spy out new opportunities that would not be available from a sent-in report (Grinyer, 2001: 11 – 12).

Market-driven innovations have statistically a better chance of being successful, but being market driven is not the only criterion for success in new product development. Cooper and Kleinschmidt (1991: 132 – 135) tested a set of ten hypotheses using 203 actual case studies. Of the ten success factors, three of the hypotheses were found to be significantly and strongly related to new product success. They were:

H1: New product success is positively related to product advantage and benefits.

H6: New product success is positively related to project definition or protocol – how well defined the project strategy is prior to product development.

H7: New product success is positively related to the proficiency of the upfront or predevelopment activities of the new product process.

Cooper and Kleinschmidt (1991: 136 – 137) came to the conclusion that a well designed product is essential and when that is in place, it will beat the competition. They maintain that their research results have the following managerial implications:

Product superiority is the number one factor in success.

Product definition and the up-front activities are vital to success.

Synergy – both marketing and technological – is a key factor in success.

Controllable variables, rather than situational or environment variables, are the dominant factors in success.

This section indicated that product development is necessary for any company to compete successfully. Changes in the production system have increased the demand for new or redesigned products and have led to new ways of developing products. Product development can be done through engineering or industrial design, depending on the emphasis that is needed at a particular point. The process through which these products are designed needs to be well understood and adapted for each designer. Examples of the process generally used are given. When a product is designed for international markets, it can either export the company's culture (embodies the values of the country of origin) or collect value (assimilates the values of the other country). Finally, a study had indicated that the design of the products is the most important factor in successfully launched new products.

The above Product Design process can also be extended to services. The increase in services in the economy has increased the importance of designing the service, but there are, however, certain differences that must be taken into consideration.

2.5 Contribution of design in service development

The economies of the year 2000 and beyond are increasingly relying on services rather than manufacturing for employment and wealth creation. With 70 per cent of the working population in Britain and the USA employed in the service sector according to Hollins and Hollins (1991: 9), the management process behind services has taken on an increasing importance. The value of design to businesses in the service sector will increasingly include efficiencies in the delivery of those services. Quick-service restaurants, for example, are increasingly reliant on good design in order to compete with the quality and speed of their service.

A service is defined as any activity or benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything (Kotler & Armstrong, 1999: 6). Some authors view the design of services in the same light as the design of products. There are, however, certain differences; the most important is the fact that services are intangible. As a result, companies that provide a service need to have a well-designed corporate identity to communicate their values. Although the design process of services is in the main similar to that of products, the early stages of Service Design are different.

2.5.1 Similarities between Product Design and Service Design

A service can be very similar to a product. Some authors take the view that services are similar to products and the imperative for design is therefore the same as for products. Hollins and Hollins (1991: 3) mention that design is a process equally applicable in products or services and that there is no clear distinction between manufactured products and service products. Although some companies are classified as being in the manufacturing sector and others in the service sector, there is not a perfect cut-off point as those classifications suggest merely points on a continuum. All manufacturing organisations have a service element in them. In the manufacturing plant itself, there may be a canteen, fire service or telephone exchange. Also many service organisations will have an element of manufacture in them. This could include cooking food in a restaurant or the actual cutting of clients' hair in a hairdressing salon. Design itself is a very good example of providing a combination of a service (consulting, advising, supervision) and a product (finished drawings, prototypes).

2.5.2 Differences between Product Design and Service Design

There are a number of very important differences between services and products which have an effect on how they are designed. The differences are explained using as a point of departure the four service characteristics from Kotler and Armstrong (1999: 258 – 259).

(a) Intangibility

In its simplest form, a service is an intangible product. This creates uncertainty with clients who then look for signals of service quality. One of the tasks for design is to manage the tangible clues, such as the atmosphere of a restaurant, leaflets, stationery and the overall corporate image and communications. A new banking service such as a premier account has to be given an identity that reflects its status as an executive service – for example the card, literature and chequebook. Whereas product marketers try to add intangibles to their tangible offers, service marketers try to add tangibles to their intangible offers. The designer can thus contribute to making the service more tangible.

(b) Perishability

As a result of its intangibility a service cannot be stored for later sale or use. This inability causes a major design difficulty. An important aspect of designing a service is avoiding bottlenecks that result in queuing at peak times, but also avoiding staff remaining idle at other times. The task of the Service Designer is to balance these apparent opposites as best as possible.

(c) Inseparability

Services are normally produced at the same time they are consumed. This means the client generally has to be present and directly involved in the consumption of the service at the time of its production. The inseparability of services poses a challenge to design an environment that is conducive to the delivery of the service, and includes aspects such as layout of the service provider, comfort of the client, décor, flow of clients and providers. When in combination with (a), these features are often the clues clients use as an indication of quality.

(d) Variability

The quality of a service depends on many variable factors, such as different moods of human beings. It is relatively easy to design the input of raw material in a manufacturing process, which, to a large degree, is constant, than designing the frame of mind of an individual delivering a service. The best design can do is to provide an ambient that can assist in providing a consistent quality.

Apart from the above, which arise from the traditional description of the differences between products and services, there are also two other differences that impact on the designing of a service.

(e) Protection

With a new manufactured product or manufacturing process it is possible to protect the designs from being copied through patents or by registering the design. This is not possible with a service.

Copyrights do not exist to protect a service-based company. The only way to survive with a new Service Design is to make it better suited to potential customers' needs and keep it a secret until the service is ready to be put on the market. If it is launched with a fair degree of publicity it may be possible to surprise your competitors and get a good lead in the market, before they catch up. One of the biggest drawbacks of patents is that competitors can (and some definitely do) scrutinise them regularly and thus obtaining all the details. Patents are a mixed blessing, which those in designing services are fortunate to avoid (Hollins & Hollins, 1991: 14).

(f) Profitability

In a company providing a service, profit margins and return on investment (ROI) are generally higher, because services do not use raw materials and mostly need less investment in physical equipment. The only exception is where expensive equipment is needed to deliver a service (Hollins & Hollins, 1991:15). It must, however, be realised that although the ROI, which is a percentage, will be higher as a result of the smaller base, the order of magnitude of the bottom line might be lower. Hollins and Hollins (1991) do not take into consideration the limitations of a service provider, for example, limited capacity, perishability and limited ability to benefit from economies of scale. Then again, providing a service requires less capital and is therefore easier for start-up entrepreneurs, especially in a developing country such as South Africa.

As services become a bigger part of the economy, the role of Service Design will increase. Although there are similarities between products and services, there are also differences, such as the intangibility, perishability, inseparability and variability of services that pose certain challenges to Service Design. A further difference is that services are more difficult to protect. Profitability seems higher, but the limitations of a service must be remembered. As a result of these differences, and mainly on account of the intangibility of services, a distinguishing corporate identity is required.

2.5.3 Corporate identity as a Service Design

A corporate identity is just as necessary for companies providing services, as it is for companies manufacturing products. In fact, a corporate identity is essential to differentiate service providers in order to portray the tangible clues, of which the image of the company is the most important. The totality of a corporate identity, which is considerably more than just a logo, has today evolved into the complex science of Visual Management (Cooper & Press, 1998: 130).

There are a number of industries in which the product or service itself may be immune to the enhancing powers of design. In such a case it is the image of the company that is the competitive factor (Cooper & Press, 1998: 59). This need for a unique company image has given rise to what has evolved as the sophisticated business of corporate identity design. Therein design is used to project a coherent and distinctive identity for an organisation, using a visual language to communicate its values

and function. Such a distinct corporate identity is aimed at overcoming the lack of any perceivable difference in the values of their services. One example is the oil and petrol industry, where a company may want to associate itself with the colour green in order to foster a link with consumers' increasing environmental concerns. Another example is the financial sector. While there is little differentiation in terms of the products on offer, competition centres mainly on corporate identity.

A corporate identity is also essential for a manufacturing company. While corporate identity is crucial to competitiveness for suppliers of relatively undifferentiated commodities, it is no less important to manufacturers. For firms such as Apple, Bang & Olufsen, Philips, and Sony, whose identity derives from their physical products, corporate identity is vital to the public perception and demand for their branded products. For some manufacturers, the identity of the corporation is of vital importance. In the process of designing these services, a few adjustments should be made.

2.5.4 The early stages of Service Design

On the whole, the Service Design process should be managed similarly to the Product Design process. There are, however, small differences in the early stages of the Service Design process. An overview of the Service Design process is provided by Hollins and Hollins (1991: 119 – 133). It starts with someone being appointed to head the design function at a senior level. The process should then progress through the following six stages:

(a) First stage: Main management guidelines.

The board must state the main management guidelines, which are broad parameters to which any new service or product must conform and limitations to what may be designed.

(b) Second stage: Strategic specification and initial market input.

The strategic specification defines the objective of the service, while the initial market input refers to a broad list of the service requirements that should be drawn up.

(c) Third stage: Relevant innovations and competition analysis.

The identification of possible new innovations that are relevant for this service can become opportunities from which the organisation can benefit. The purpose of competition analysis is to determine what the direct competition is currently doing and to identify trends that may indicate the direction of this design.

(d) Fourth stage: Screening.

The threads, thus far, are drawn together into a feasibility study. If a project is accepted, the service must be defined in detail.

(e) Fifth stage: Service status specification.

The service audit states, in broad terms, the existing capabilities of the organisation. Its purpose is to identify which areas may require additional attention.

(f) Sixth stage: Preliminary technical specification.

The preliminary technical specification can be drawn up. A preliminary market specification will also be required and will be assembled by the marketing department. A full service design specification can then be compiled from the various sub-specifications (Hollins & Hollins, 1991: 119 – 133).

It can be concluded that Service Design will increase as competition between companies providing services increases. Designing a service is largely the same as designing a product. The only differences to be accommodated are the intangibility of services and an adjustment to the early stages of the design process. In the previous two sections it was demonstrated that design could contribute to the development of better products and services. But design is not an end itself, it should be translated into increased economic activity.

2.6 Contribution of design in economic terms

Design has the ability to provide innovation to the product development process, which in turn could lead to a competitive edge. Ideally the competitive edge should be followed through to increased economic activity. *Economic activity* in this instance refers to a very broad range of activities, inclusive of sales, turnover, profit margin, return on investment, capital growth and also indirect indicators, such as awareness and noting. Various scientific studies refer to a varied range of indicators, choosing the indicator that displayed the most dramatic results. *Economic activity* is therefore used as a collective noun, which includes all these various indicators. Increasing profit is the ultimate test and sometimes design can do that by cutting costs or an exclusive positioning. Sometimes design can only increase demand or turnover. Increasing profit from there then becomes a function of good management.

2.6.1 Design awareness and economic activity

A number of studies have indicated the contribution that design can make to increase the economic activity of a business. Research showed that those firms that invest resources and professional expertise in industrial design in both traditional and new industries have been commercially more successful than firms that pay less attention to these aspects of design. (Wallace, 2001: 23 – 26).

When the Queen's Award for Export winners from 1999 – 2001 were surveyed, it was found that there is a concrete link between UK firms' success abroad and their use of design:

- 51% of export sales of award winners can be attributed to their investment in design;
- 82% found that design helps to differentiate their products in the market;

·75% found that design helps to increase the value of their products for export;

·53% indicated that design helps to tailor products to individual export markets.

The conclusion was drawn that these findings provide strong support for the fact that the firms with good design have better financial performance (Hertenstein *et al.*, 2001: 18).

Research by leading US academics related an organisation's focus on design with bottom-line outcomes. The research studied the financial performance of 51 companies over a five year period and concluded that firms who used design more effectively performed better on virtually all measures. The research provided strong evidence that good design boosted firms' operating performance and growth (Von Stamm, 2006: 12). In similar fashion a PricewaterhouseCoopers study showed that the top 5 percent of performers, based on return on capital employed, gave design a high level of strategic importance, as did nearly three-quarters of the top 25 percent. In contrast, 90 percent of the bottom 25 percent of performers said that design had a low level of strategic importance (Von Stamm, 2006: 12).

2.6.2 Investment in packaging

One of the most revealing studies on increased economic activity was done by Wallace (2001: 23 – 26). He summarised a technique for quantifying the returns on investment accruing to improvement in packaging. Based on historical data, this method established a projection of sales and profits, assuming no changes were made to the communications platform. It then used the same measures based on the implementation of an actual, new communications programme. The method measures profit and sales growth against the cost of the overall investment made.

The first example involved packaging and advertising. A sum of \$2.5 million was invested in advertising and \$220 000 was invested in package/brand identity design for a total investment of \$2.72 million. The subsequent increase in sales provided a return of \$7.21 on every dollar invested. The calculation was done as follows: The net contribution with no communications investment was calculated at \$9.765 million. The net contribution after the communications investment was calculated at \$29.365 million, leaving a difference, or incremental gain, of \$19.6 million. This is then divided by the estimated sum of all brand communication efforts, which was \$2.72 million, providing a result of \$7.21. For every dollar invested in communication efforts, therefore, a contribution of \$7.21 was generated. This finding is similar to other case histories in which a combination of advertising and package design was used (See Table 2.5.)

In the second example advertising was not involved. The only variable that changed was an enhanced brand identity expressed through a revitalised package design system. It used the same measures as above. In this instance, the net contribution with no communications investment was calculated at \$156.24 million and the net contribution after the communications investment was calculated at \$287.02 million. The incremental gain of \$130.78 million was thus as the direct result of the package

design project, which had a total budget of \$0.315 million. This shows that, in this instance, the package design change was exclusively responsible for generating \$415.17 of increased sales for every dollar

Table 2.5 Calculating the return on investment (Wallace, 2001: 23 – 26).

	Advertising + Package design	Only Package Design
Net contribution after communications	29.365m	287.02m
Net contribution before communications	<u>9.765m</u>	<u>156.24m</u>
Incremental gain	19.600m	130.78m
Investment in communications	2.720m	0.315m
Ratio	7.21	415.17

invested. That's more than 50 times the ROI of the integrated programme. This finding is similar to other case histories in which only the package design was changed (see table 2.5) (Wallace, 2001: 23 – 26). Design's contribution can thus be quantified. These examples indicate that an investment in design can generate exceptionally high returns.

This second example of Wallace concurs with a South African example where nothing else but the label on wine bottles was changed and it led to increased economic activity. SAD Foods introduced the Cape Safari wines in January 1997 into the highly competitive wine market. They decided to focus exclusively on the Supermarket sector, which made up 35 per cent of the natural wine sales. The wine was targeted at the mass middle market, as a table wine. By 1998 sales of the wine were static and then began to drop. Packaging design, price point and product quality are the main criteria for listing with supermarkets onto their shelves and are strictly applied. SAD Foods complied in only two areas, price point and quality, but not design. The product did not interest consumers and thus the wine received numerous delistings.

A graphic design company was approached to design a new range of labels. These labels were to transform the brand to that of an exciting, colourful and appealing wine brand, but still appealing to the original target market. The new labels were designed in matte black, with dark green bottles creating a distinct upmarket look, which is further enhanced by gold lettering. Rich colours and the use of black in the design also contribute to an aspirational look. People should want to buy the product because it looks expensive and exclusive.

The results were far better than expected. Despite the fact that the South African wine market has shown a steady decline in volume over five years, the following are some of the results:

- 304 new listings in the three supermarket chains.
- Listings in bulk retailers, such as Makro, Hyperama and Metro since relaunch.
- Cape Safari accounted for 68 per cent of SAD's wine sales volume the next year, compared with 54 per cent for the same period of the previous year.
- A 104 per cent increase in sales, with Cape Safari wines constituting the bulk of the growth.

- Owing to its rise in popularity, SAD was able to increase the wholesale price by 14 per cent on average, thus increasing their profit margin. Retailers accepted this increase owing to the brand's popularity. SAD also expected increased profit margins after the next price increase.

- SAD expected a future growth rate of about 150 per cent on a year-on-year basis.

The overall effect of the redesigned label was high shelf impact. This resulted in supermarkets giving the product more prominent shelf position. An immediate upsurge in sales followed without any additional market communication efforts (Groenewald, 2001: 186 – 187).

2.6.3 Effective design and financial performance

That effective design was linked to improved financial performance, was demonstrated by the following facts based on a national survey by the Design Council in the UK (Powell, 2006: 11):

- 48 percent of rapidly growing companies said design contributed to a great/fair extent to creating new products;

- 40 percent of companies that have experienced rapid growth in the last twelve months used design in the idea generation, research and R&D phases.

- 95 percent of rapidly growing businesses said design was used to develop new products.

- 100 percent of rapidly growing businesses agreed design was about products working well to meet clients' needs.

- Rapidly growing companies were three times as likely as companies that have experienced moderate growth to claim that design contributed to an increase in turnover.

In another study, the British Design Council analysed the performance of UK FTSE quoted companies over the ten years between 1994 and 2003. This study offered conclusive evidence for the relationship between the effective use of design by corporates and improved share price performance and therefore greater shareholder returns. The finding of the study was that a group of 63 companies identified to be effective users of design outperformed the FTSE 100 index over the full period by 200 per cent, and also beat their peers in the bull *and* bear markets during that period (Kester, 2006: 2).

A similar study, done by the Danish Centre, concluded that all findings indicated a very clear correlation between the employment of design and the economic success business achieve. The correlation was especially marked for companies that adopt a comprehensive approach to design. This correlation also applied to companies that employ professional designers, as well as purchased design service externally. These companies experience an increase in growth that was statistically significant. Their increase in export share of turnover and their increase in gross revenue performance corresponded to the degree at which a comprehensive approach to design was adopted. However, it was suggested that the nature of this correlation be studied more closely (Kretzschmar, 2003).

2.6.4 Economic benefits of design in SMEs

Design does not only benefit big companies, but small and medium-sized companies can also reap the benefits of design. A survey of 221 small and medium-sized UK manufacturers, which received a government subsidy to employ a professional design consultant to help develop new or improved products or graphics, showed that 60 per cent of all projects and 90 per cent of the implemented ones were commercially successful (Roy & Potter, 1997: 175 – 200). A sample was drawn from businesses participating in the FCS (Funded Consultancy Scheme) and SFD (Support For Design) programme in Britain. The majority (60 per cent) of the firms in the study were classified as small (<100 employees), a third were medium sized (100 – 500 employees) and only 4 per cent had more than 500 employees. Although the British definition of a small business differs from the South African, this study is ideal to see the impact of design in smaller businesses.

Input of design expertise, according to Roy and Potter (1997: 180) was as follows: Product Design 47 per cent, Graphic Design 24 per cent, Engineering and Industrial Design 29 per cent. The output categories were products or components 78 per cent and packaging/graphics 22 per cent. (See Table 2.6.)

Table 2.6 Input of design expertise and output categories (Roy & Potter, 1997: 180).

Input of design expertise		Output categories	
Product design	47%	Products or Components	78%
Graphic design	24%		
Engineering and Industrial design	29%	Packaging or Graphics	22%

In the analysis of the results of the design input, half of the projects (50 per cent) could be considered completely successful: they were commercially successful and also produced indirect benefits, such as the firm's managers learning how to use designers more effectively. A small proportion (10 per cent) of projects was partially successful: they were successful commercially but produced no spin-off benefits. A further 21 per cent might be considered as part successes and part failures: they were projects that made a loss yet produced worthwhile indirect benefits. Almost a fifth (19 per cent) of the projects was definitely failures: they both made a financial loss and produced no indirect benefits. Overall 60 per cent could be considered commercially successful measured in terms of financial returns. For the 120 implemented projects, 89 per cent were commercially successful and 11 per cent made a loss. (See Table 2.7.)

Table 2.7 Results of design input (Roy & Potter, 1997: 180).

Completely successful	50%
Partially successful	10%
Only indirect benefits	21%
Failures	<u>19%</u>
Total	100%

One of the interested findings is that Graphic Design projects are significantly more likely to be profitable (chi-square $p < 0.03$) than projects involving Product Design expertise or projects involving Engineering or Engineering plus Industrial Design. However, once the projects were put into production, the likelihood of product or engineering projects being profitable was almost as great as that for Graphic Design projects. Indeed, the difference in risk is then not statistically significant

(Fischer $p = 0.33$). The main difference was in the payback period, with Graphic Design projects on average paying back somewhat faster than Product or Engineering Design projects.

When payback was analysed, overall, 69 per cent of all the projects and 94 per cent of those that were implemented paid back their total investment within a mean payback period of 14.5 months. These figures indicated a very good case for investing in design projects. Graphic design projects appeared to involve little technical uncertainty or financial risk. Although there was a relatively high risk of failure at the start of a product or engineering project, because most of the failed projects involved exploring ideas that were abandoned before being put into production, the financial loss was likely to be quite small. And once a project has been implemented, the prospect of a rapid return on the investment becomes very good, and the risk of financial loss small, for all types of design.

2.6.5 Implications for South Africa

The impact of these projects on exports is very important for South Africa. There seems to be a link between companies using design and healthy exports.

In the study by Roy & Potter (1997: 179 – 180) 70 per cent of the firms reported exporting their product or design, with the average amount exported being £151 000 a year. The exports represented on average 19 per cent of their total sales. Implemented Engineering and Industrial Design projects on average produce much higher export ratios (41 per cent of annual sales) than Product Design (10 per cent of annual sales) and Graphic Design projects (7 per cent of annual sales). The probable reason for this pattern of export performance was that engineering projects were for capital goods for both home and export, while Product Design projects tended to be consumer goods aimed mainly at the UK market, and most packaging projects were for food and drink products also for the home market

The lesson for South Africa is that export projects are more successful if they are designed for the export market from the beginning, rather than to try to export a product that has done well domestically. One of the main benefits in Roy and Potter's (1997: 187) analysis was that well-designed products enable firms to enter new markets. Over a quarter (28 per cent) of all projects resulted in firms entering a new market with their new or improved designs and a further 30 per cent increased their market share. Import substitution, where domestic sales were captured from foreign competitors, was a major factor in 21 per cent of the implemented projects.

Is it possible that factors other than design could have been responsible for the financial and trade effects? Firms were asked to rate the relative influence of design and other factors, which might have affected the commercial outcome. In only 15 per cent of projects were factors other than design considered to be the main influence on commercial outcomes. These other factors were mainly marketing effort, pricing, technical quality, and market changes (Roy & Potter, 1997: 187). Looking at this information from Roy and Potter, the obvious question must be asked whether a well-designed

product does not inspire a marketing team to put more effort in, or a timely adaptation in a product could better exploit changing marketing conditions. Marketing teams are known to be motivated in direct relation to their belief in the success of a product.

Another important indirect benefit reported by Roy and Potter (1997: 190) was that the projects helped firms to learn how to use professional design consultants. Three-quarters (75 per cent) of firms reported learning some Design Management lessons. The Managing Director of a manufacturer of swimming aids said that the design project of four products, their packaging plus a new logo, gave them impetus and confidence to move ahead.

Non-implementation was also analysed (Roy & Potter: 1997: 195). Firms gave one or more reasons for non-implementation.

Non-implementation in 16 per cent of cases was due to changing market circumstances (e.g. a competitor launched a better design). In a quarter (27 per cent) of non-implemented cases the project were not considered commercially viable (e.g.

Table 2.8 Non-implementation of design (Roy & Potter: 1997: 195).

Changing markets	16%
Not commercially viable	27%
Technical difficulties	27%

the design was considered too expensive for market acceptance) and in another 27 per cent there were technical difficulties in development (e.g. the designer was unable to meet the specifications). Not surprisingly, technical problems and questions of commercial viability affected Engineering and Product Design projects more than Graphic Design projects. (See Table 2.8.)

Two very important conclusions were reached that have an important bearing on the South African situation.

- A disturbing factor was that 14 per cent of firms could not afford to implement the design, even though it was judged to be commercially viable. For such firms, subsidising design was not sufficient, further help was needed for the development and implementation of new products.
- The lack of awareness of the potential commercial returns among small and medium-sized British firms seemed to be a major barrier to this investment. Another barrier was the fact that most of the firms surveyed viewed their projects as a once-off investment rather as a way of incorporating design into their long-term strategy (Roy & Potter: 1997: 196 – 200).

The influence of design is not limited to the individual companies that effectively use it. Design also makes a contribution to the wider economy by affecting the performance of both manufacturing and service firms. Design contributes to manufacturing firms' performance by improving the quality of the products, as well as by improving the efficiency of production methods and the use of materials and energy and hence influences the price of the products. It further improves the marketing of both product and company image via the design of packaging, publicity material, logo and so on. Design contributes to service sector firms' performance by providing an environment that encourages customers to value, and buy, their service or, in the case of retailing, the products of manufacturing

firms. Design also makes a contribution to marketing the service or company image and to prices via the efficient use of materials and energy.

There is, however, always the probability that the better financial performance of firms more effective in design may result not necessarily from effective design but also from many decisions made by judicious senior managers. Then again, the root cause may be that those managers are clever enough to make good business decisions, one of which may be the effective use of design. Design, then, is an indicator of good management, rather than the cause of improved financial results. Whether design is the indicator or the cause, the fact still remains that design is an important part of improved financial performance.

In this section various studies confirmed that a design input could lead to increased economic activity. Companies that are aware of design are positively related with increased economic activity. Advertising and packaging design also lead to an increase in profits and sales. Overall it was proved that firms with effective design are associated with better financial performance. Design also has a positive effect on small and medium-sized companies, which has important implications for South Africa. Finally, design can also have an indirect effect of stimulating the economy.

2.7 Contribution of design: summary

In order to study the contribution of design to businesses, it is necessary to establish a theoretical foundation. The point of departure was that design is important to business, because it can provide a system of creativity. Newly designed or redesigned products are important for a business to compete in an increasingly competitive environment.

With competition worldwide increasing, a company cannot compete if it does not offer something different. Innovation is necessary for such differentiation. Design can be an important source of innovation and in the process can secure niche markets. Design can therefore contribute towards establishing a competitive edge. This can be done through designing products, as well as designing services. The result can lead to increased economic activity, as many studies have proved.

The process through which design is integrated into the rest of a company's business functions is a part of Design Management. The next section describes the role Design Management can play in increasing a company's competitiveness.

Part Two: Design Management

2.8 Introduction to Design Management

This second part of the chapter illustrates past attempts to examine or solve the problem. It has been established that a design input can contribute to innovation and hence to a competitive advantage, which can increase economic activity. This section indicates that this can only happen if the design input is properly managed. It therefore focuses on the area of Design Management. Evidence is presented of existing research in Design Management, starting with the need for design to be managed. Thereafter this section discusses Functional as well as Strategic Design Management. It concludes that problems still exist, because the full potential of design is not used. Research in South Africa is thus necessary to maximise the proven benefit of design to the benefit of our economy.

2.9 The need for Design Management

This section shows the need for design to be managed, illustrated by examples of commercially successful and unsuccessful designs. Today almost everyone is familiar with the now famous statement made in the late 1950s by the then CEO of IBM, Thomas Watson, Jr.: *Good design is good business* (Weiss, 2002: 33). That concept, a breakthrough in the post World War II industrial era, was grounded in the belief that a commitment to design would help a good product reach its full potential, presumably through increased sales of a more functionally robust and aesthetically pleasing object.

That design is good business is not always true. On the one hand, the Polaroid I-Zone made instant photography relevant to a whole new generation of users and became the number one selling camera within months of its introduction. Similarly, the Palm V made high-tech functionality appealing to a much wider and more mainstream audience. Both products are strong examples of design making a difference to a company's top-line growth. On the other hand, there is an Apple Power Mac G4 Cube or 3Com Audrey – products whose design boldness failed to save them from marketplace failure owing to an inadequate understanding of target users, a poor business plan, or both (Weiss, 2002: 33). Good design, it seems, is not always good business if it is not pursued as an integral part of a wider set of managerial activities.

The need to manage the design and development process is also expressed by Powell (2006: 13), as it is rarely a straightforward process. The process is hard to foresee and fraught with the unexpected as design does not guarantee commercial success. In the research of Walsh *et al.* (1992: 85), there were cases of firms which were recognised for their design excellence, but which were not doing very well commercially. One example is the toy company Meccano, which had a following among generations of budding engineers, and was listed on the Design Index, but went bankrupt for a variety of

reasons. Some of these reasons included failure to reinvest in more efficient production equipment, failure to keep up with trends in the market and failure to explore the possibility of potentially doubling their market by appealing to girls.

Good design in isolation is not necessarily sufficient to ensure business success. There is also evidence to suggest that firms which pay particular attention to design also invest in other activities that maintain or improve their product quality. It was noticeable that in all the sectors Walsh *et al.* (1992: 42) studied, the financially most successful firms were those which co-ordinate the inputs of managers, design and development, marketing and production staff. The need for design to be managed is also expressed when Fox (1993: ix) mentions that the purpose of his book was to address the role of management in the design process to ensure proper monitoring and decision making as the design progresses. The same sentiment was also shared by Cooper and Press (1998).

However design is structured, there is invariably a close link between design and other departments. Marketers actively try to influence the design process to ensure that market factors are incorporated in the design decisions. Production managers are keen to influence specifications which will make production easier. The financial manager is always concerned with overall cost. These forces can inhibit creativity. A way must therefore be found to incorporate these influences into a positive creative process. The design process needs to be managed like any other business function. Design is seen as a significant management resource, susceptible like every other management resource to intelligent direction and control (Cooper & Press, 1998: 222). The only question is how it should be done.

2.10 Functional Design Management

It has been established that design needs to be managed. This section addresses Functional Design Management. It presents suggestions in respect of where the design process can fit in the management structure of a company. Research was also done on the different ways of managing the design process and this will be presented next. Inevitably this leads to the debate whether in-house designers or an outside design consultancy should be used. With the latest trend in favour of outsourcing, attention must then be given to the management of the design linkages or interfaces. This leads naturally to the discussion of multi-disciplinary management teams in which designers participate as equal members. Finally the discussion concludes with suggestions on how to best manage designers.

2.10.1 Placing design in the company

Design is often placed in the research and development department (R&D), because design can always be associated with the process of developing new products. Although there is considerable overlap between R&D and design, since an important aspect of development work is design and vice versa, design also differs from R&D in two important aspects.

- First, design is more widespread than R&D. Design plays an important part in both technological innovation (R&D) and other activities in the business, such as distribution, retail space and advertising.
- Second, design is very much the poor relation compared to R&D. Firms regard R&D as an activity for professional, technically qualified staff and one which must be done properly. In contrast, the image of design is far more patchy, with a substantial number of firms not regarding it as very important in terms of resources, even though they do carry out design in some way or another (Walsh *et al.*, 1992: 20 – 22).

Design can also be linked to marketing, for example Bruce and Cooper (1997a: 3). They use three examples, one each from fast-moving consumer goods, product innovation and financial services, in which design is used by manufacturers and service companies to meet various customer requirements. Design is integrated into the marketing mix as follows:

Product: Design influences quality, function, usability and appearance. It affects all the differentiating features of products, such as performance, reliability, style, etc.

Price: Products can be devised that are economical in terms of materials, energy and manufacture. Product enhancement, by adding a feature, can affect the perceived value of the product, allowing it to be sold at a higher price.

Place: Design influences packaging to facilitate storage and display. Shelf appeal is critical for FMCG goods.

Promotion: Packaging, promotional and sales literature, all forms of media advertising, point-of-sale displays and the retail environment all involve the skills of designers (Bruce & Cooper, 1997a: 17 – 18).

A valuable attempt is made by Bruce and Cooper (1997a) to incorporate design systematically in all the marketing processes. Different design disciplines are incorporated in different stages, for example, Product Design in the “product” of the marketing mix, and Graphic Design in the promotion mix. What is lacking is an integrated approach. In the debate, whether Product Development should be part of Marketing Management or Production Management, Bruce and Cooper sided with Marketing. Once again, an integrated approach is lacking.

The next phase in the progression of the place of design in a company is to see design as part of inter-functional teams that work together in order to see a plan to a successful conclusion. In their ultimate chapter, Cooper and Press (1998: 222 – 274) discuss the management of design under the traditional headings as follows: *Planning Design, Organising for Design, Implementing and Monitoring Design and Evaluating Design*. The problem is that they view the process from a design perspective, “selling” the benefits of design to each management function.

This study would like to propose a different way in which design can be approached from a business manager’s perspective. A business manager will take as a point of departure the mission statement,

then put a strategy in place that will realise the mission. A crucial part of that strategy should be a design input, along with, for example, a financial or marketing input. Then the manager will put a structure in place to support the strategy. In the structure there are a number of functions to be performed for example, design, finance and marketing. Because design is one of the strategies and a specific function, a structure to support the design input should then also be put in place, whether in-house, outsourced or a combination. Design is then managed as any other business function, such as finance or marketing, which is crucial to be co-ordinated in order to realise the mission of the organisation.

The position of design has progressed from being a part of Research and Development to being part of the marketing function, and ultimately the suggestion is made that it should be a management function in its own right. Apart from debating the place of design in the management structure of a company, one should also look at managing the design process.

2.10.2 Managing the design process

Design can be organised in a company in a number of ways. Views differ what the best approach is. The design process is not necessarily sequential. Success in a project, particularly in new product development, occurs when activities to some extent run simultaneously, for example, market testing and design during prototype development. As a result there can be several approaches to these processes.

Companies can organise the design in a number of ways. Walsh *et al.* (1992: 139 – 143) mention the following:

Sequential (the relay race): To develop a new product the project goes sequentially from phase to phase: concept development, feasibility testing, Product Design and tooling, pilot production and full production. Different specialists carry the baton at different stages.

Iterative (the volleyball game): It may sometimes be necessary to return a project to the preceding department for correction. Projects get passed between two departments several times before progressing on to the next stage. This type of project structure can inspire destructive internal rivalries.

Multidisciplinary (the rugby team): This refers to organisational structures that attempt to break down functional barriers so that designers and production staff are all on the same side working towards the same goal. This approach involves a multi-disciplinary team, with members working together from start to finish of the development process.

The theme of the rugby approach, as a way of co-operating, is also addressed by Cooper and Press (1998: 126 – 129). In the rugby approach, problems are worked on simultaneously and ideas are passed around among team members. Senior management picks a multidisciplinary team that is given broad goals and hands-off support. This process has been followed in Japan at Fuji-Xerox, where it is called the *sashimi* approach – named after the Japanese presentation of overlapping slices of raw fish. The result of such methods is that product development time is greatly reduced. In motor vehicles, an average product lead time of 3.5 years in Japan compares with 5 years in Europe and North America. In other industries the rate of product development can be startling. In 1981 Yamaha took on Honda in a bid to dominate the motorcycle market. Honda's response was to launch 113 new models in less than 18 months, representing one new model every four days. That is a somewhat lethargic performance compared with Seiko, the watch manufacturer, who introduced one new model every working day (Cooper & Press, 1998: 27).

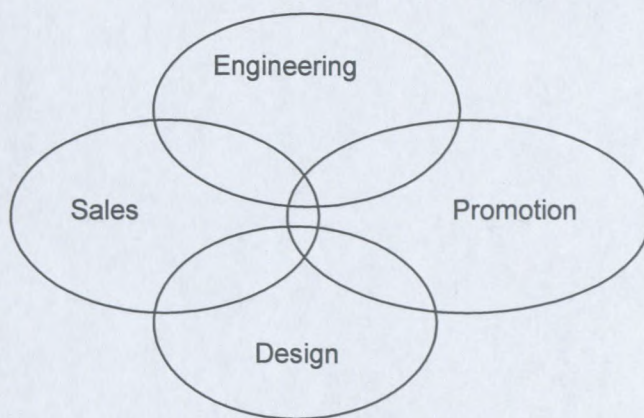


Figure 2.1 The rugby approach (Cooper & Press, 1998: 27).

2.10.3 *Modelling the design process*

A design management model has been developed by Bruce and Cooper (1997c: 76 – 103), incorporating the key phases of the design management process from recognising a need for design to briefing, sourcing, launching and evaluation. The model highlighted critical points in the process and suggested that reviews should be made at key stages in the design process.

The official beginning of the Design Management Model can be taken as the process of establishing the brief. It can be argued that the start lies in market conditions or new technology providing the stimulus for innovation, but from the designer's point of view, the process commences when a brief is received. The brief is therefore one of the most important documents in Design Management as it determines everything that is to follow. A fairly typical brief would contain certain key elements, such as the background to the company, corporate strategy and its relationship to the brief, the design problem, attribute definition, consumer and market information.

The preparation of the brief should be considered carefully. Background information is essential as it provides a rationale for the project and helps to ensure that the design project corresponds to the corporate values and reflects the organisation's overall strategy. The design problem could be stated in general, or with a great deal of detail about the product attributes, the materials to be used and the desired functionality. The brief should also contain market information as it focuses on the type of consumer, the target market, price parameters, and distribution, as well as competitive products.

Once the brief is finalised, it is followed by a process of idea generation and concept development, which is often an iterative process. An idea arises, market research is undertaken, the idea is modified, followed by design concept development and testing, which frequently leads to further refinement of the idea, etc. Many companies desire to rush through this process, in an attempt to reduce time to market. This, in most cases, is false economy: too many projects fail because the early concept planning and testing has been overlooked, which results in the need for costly changes later in the production process or failure in the market. It is much more time- and cost-effective to make changes and test concepts at the earlier stages than later on in production.

Working from the brief designers provide alternative solutions for evaluation and selection. The selection of the design solution should always refer to the original design brief and should include all company stakeholders, i.e., those who are involved in the production or use of the design. At the end of the concept stage the design is translated into detailed layouts, drawings, or prototypes or mock-ups for testing and further evaluation.

Once the decision has been made to go ahead with a given design, the design is put into production and/or implemented. This process varies according to the complexity, innovation and type of design. Obviously a complex computer product requires a different production and manufacturing process from that of an annual report. Once the design is in use in the marketplace, it is important to gauge reaction to the decision and to intercept any problems or potential problems as early as possible. The most important form of post-launch evaluation is in terms of sales and payback. If the design fulfils the commercial and financial targets and expectations, it is regarded as a success (Bruce & Cooper, 1997c: 76 – 103).

The above process is followed in many instances, although there may be small deviations according to specific circumstances. Although companies instituted Design Management processes that are appropriate to specific circumstances, they are on the whole the same (Lockwood, 2004: 32 – 39). With such a variety all the design tasks do not necessarily have to be done by the employees of the company that would like to implement the design. Other expertise can also be involved.

2.10.4 Sourcing design

Design professionals can be organised as an in-house design department or outsourced or as a combination of both. What is important is that design is integrated effectively with the organisation and that control and communication is attended to.

Traditionally designers were part of the research staff. None of the companies surveyed in Walsh *et al.* (1992: 145) had a separate research department as such, but about a quarter referred to *research staff* who was involved in developing ideas to a certain stage before being fully implemented. The

research staff was within functional departments, although in nearly half the firms surveyed they would be involved in some sort of project team. This is typically found in matrix organisations. Most firms, however, make use of three types of design management, namely an in-house design function, solely external expertise and a mixture of internal and external design expertise (Bruce & Cooper, 1997b: 36 – 38). When making use of *in-house design sources*, the design capabilities are housed in a design department or are dispersed through Research and Development (R&D), production or marketing as full-time design staff members. When making use of *external design sources* the design capabilities lie outside the firm and design professionals are selected and commissioned to carry out the design activities required by the firm. Design Managers source, commission, liaise with and evaluate the design skills.

The strength of the in-house approach is that the designers are integrated into the overall team and aware of company practices. They can integrate more easily and because of their knowledge of the company can provide advice that others could have overlooked. However, the danger is that they may become complacent and fail to provide innovative ideas. In contrast, external design professionals can make fresh inputs and not be hampered by the politics and culture of the firm or any other rigidity. Yet, because of this lack of familiarity with a company, they may make mistakes because of insufficient knowledge of the company. Fear of leakage of proprietary knowledge is another problem.

When making use of a *combination of design sources*: Design capabilities comprise a blend of in-house and external design expertise. The external design professional is brought in to inject additional resources to incorporate fresh ideas, or to provide a specific expertise. The in-house designers ensure smooth integration with the rest of the company. A blend of in-house and external expertise appears to overcome the problems and build on the positive aspects of each situation. However, the integration of the in-house and external professionals has to be managed carefully to ensure that they are truly working together. The tension between fear of giving away commercially sensitive information and the need to build up an open and trusting relationship is particularly acute. Whatever the approach adopted, the interface between the design capability and other functions has to be managed and the nature of this interface considered, planned and integrated within the firm (Bruce & Cooper, 1997b: 36 – 38).

Outsourcing of design seems to increase as delayering and downsizing of organisations has occurred. According to Bruce and Morris (1998b: 40), this has led to changes in the organisation of the design function. A number of factors have contributed to this trend:

- The increasing complexity of products and their shorter life cycles demand expertise from a range of different sources.
- The use of technology in the design process has facilitated a change in practice. The pressures for switching to firms perceived as more effective is intensifying.
- The development of the virtual organisation or network organisation means that companies utilise a network of suppliers to carry out value added functions.

·Design expertise is being utilised by service organisations, which are moving away from more traditional in-house design practices towards buying in design expertise. To manage this effectively, organisations like the Royal Mail, the British Airports Authority (BAA) and British Telecom have dedicated Design Managers.

The integration of design from outsourced consultants is not only limited to the project level. There is also evidence of Industrial Design consultants becoming increasingly involved with top management in determining product and marketing strategy. The reason is that designers are seen as being in close touch with technical and market trends and opportunities across a wide range of products and cultural fields. For the same reason some firms, especially international leading design conscious firms like Olivetti, Fiat and Sony take care to ascertain the latest ideas being produced in the design community (Bruce & Morris, 1998b: 41).

Whether the design function is located in-house, externally or is managed as a combination, it is important that the integration into the (rest of the) company is managed effectively. According to Walsh *et al.* (1992: 136 – 137), the successful use of design consultants depends on whether they are properly managed by individuals at senior level with an understanding of design, and on whether the consultant's work is integrated with that of in-house staff. The firms which make most effective use of Product Design consultants retain them on a long-term basis, rather like in-house staff that can maintain an independent view of design. More important, however, is that the firm's management regards design as an investment justifying the best professionals it could afford (Walsh *et al.*, 1992: 136 – 137).

When design is managed using a combination of in-house and outsourced designers, control and communication problems are of the utmost concern. These can be dealt with in various ways:

- Time is taken in the selection of designers – for external designers pitching is usually involved;
- The brief is defined early and form part of the contract, rather than evolving as the design work progressed;
- Intense level of contact in the initial stages of the design project is established via regular meetings;
- Familiarity with the company is regarded as an assets that in-house designers would have, however, project managers make specific efforts to overcome this problem, e.g. through intensive briefing and in depth discussions.
- Long term relationships are preferred because of their stability, loyalty and trust, which facilitated a creative and open atmosphere (Bruce & Cooper, 1997: 43).

In summary, the design function can be in-house, outsourced or a combination of the two. There are both advantages and disadvantages to using in-house or outsourced designers, while it seems that a combined effort has more advantages than disadvantages. There is a trend lately towards increasingly outsourced design as a result of delayering and downsizing of companies. This has given rise to an increase in the number of design consultancies, as well as Design Managers to co-ordinate the design

process. The next problem to address is therefore how to manage the integration of the design process.

2.10.5 Managing the design linkage/interface

With (at least part of) the design function becoming increasingly outsourced, and therefore fragmented, it has become important to manage the inter-firm linkages. From the perspective of design as a competency, rather than a pool of skills that can be tapped into, the totality of the inter-firm linkages between an external design capability and client firm needs to be considered. Over time, the design knowledge and its management in the inter-firm alliances can become a source of distinctive strategic competence and so become difficult to replicate or substitute. Long-term relationships with external design consultancies are one approach to the building of a design competence, according to Bruce and Morris (1998b: 41). Jevnaker (1998c: 6) agrees, and adds that the integration of design within the company's strategy and its interfaces with other functions, notably marketing and production, becomes critical.

The new trend is towards more collaborative Industrial Design approaches. Samsung, a Korean electronics firm, has recently chosen to co-locate itself with a design firm just across the street of the firm's main studio in Palo Alto, California. This shows the value of rich, intensive interaction in current Product Design. The international design consultancy Fitch works through close partnerships, and invites its major clients to so-called *war rooms*. These are dedicated space for genuine interdisciplinary collaboration on their *design farm* in Columbus, Ohio. Such mixed hybrid approaches may combine, tailor and stretch external creativity in design with internal people and skills, bringing in the critical interfaces with other functions such as Marketing, Technology and Strategic Management (Jevnaker, 1998b: 17).

According to Jevnaker (1998c: 1), a design alliance, or design partnership, is a collaborative and interactive business relationship between a company and its design resource. Design alliances are of particular use in situations with high strategic importance and where a flexible and innovative approach may be called for. Such a design alliances can bring to the firm:

- *Closer access to design expertise.* Since design knowledge resides in human experts, it is not easily transferable and firms need to nurture this competence over time.
- *Managing uncertainty.* Collaborative relationships are seen as beneficial when neither buy (classical contracts) nor make (through internal resource) are considered to be feasible.
- *Visualisation and product decisions.* Design is a key factor in the era of knowledge-based competition, where the invisible assets or competent resources are seen as the core sources of competitive advantage. It can create the meaningful X-factor.
- *Design – First Mover Advantage.* In the current competitive environment, design can play a major role to attain first mover advantage.

·*Access to flexible but familiar design resource.* If firms only need to use professional design services infrequently, then an alliance with a design consultancy may be beneficial. Long-term relationships with design consultancies have some advantages, such as familiarity.

·*Strengthen name and reputation.* By investing in design, the firm may strengthen its market position through, for example, brand building and projecting a quality image.

·*Achieving a comprehensible visual image.* Design can be co-ordinated. Using design strategically can bring commercial benefits by creating a coherent corporate identity (Jevnaker, 1998a: 2 – 3).

The point of collaboration is often between the design consultant and the marketer. In order to improve this interface, Kotler and Rath (1997: 211) suggest that a two-way process of education must occur.

First, marketers should acquire a better understanding of the design process. Marketers need to be aware of the split in the design community between the functionalists and the stylists. The orientation of the functionalists is based on putting good functional performance, quality and durability into the design. The orientation of the stylists is to put good outer form into the design. Functional designers are normally responsive to marketing research and technical research, while stylists often resist a marketing orientation. The stylist prefers to work by inspiration and tends to pay less attention to cost. Fortunately, few designers are at either of the extremes and most are willing to pay some attention to both orientations.

Second, designers should acquire a better understanding of marketers, who are often split into the same two camps. Some marketers, notably those in the sales force, often plead with designers to add 'bells and whistles' to the product to catch the buyers' attention and secure the sale. They press for features and styling. Other marketers hold that the key to customer satisfaction and repeat sales is not simply attracting initial purchase but providing long-term product use satisfaction. These marketers are more interested in supporting the incorporation of good performance, quality and durability characteristics into the product.

An example of an effective marketing-design interface is that of Ingersoll Rand, as reported by Bruce and Morris (1997: 109 – 127). Ingersoll Rand developed a new product family of industrial products. For example, the new Irgo-Pic demolition tool was designed to bring together power and comfort. Traditionally, powerful construction tools were heavy and uncomfortable to hold and considerable hand and arm vibrations were experienced, which were health and safety risks. Irgo-Pic weighed only 10kg but delivered the performance of the 13kg competitive tools. This was achieved by an innovative design that combined advanced materials, engineering developments and ergonomic design such as grip areas and handles to spread force, reduce stress and give protection to the operator's hands.

Within a year of launch, Irgo-Pic was the market leader and was a highly successful product. The head of the product development team considered two main factors to have led to its success: first, the small, close knit, interdisciplinary product development team; and, second, the continuous

involvement of the user in the product development process. The product development team comprised marketing, design and engineering managers, all of whom were equally responsible for the decisions. Tasks were carried out in parallel, and a blend of marketing and technical managers visited key customers together to ascertain their attitudes to and views of the company's product and those of their competitors. The product was launched on time and, despite the worst worldwide recession, was successful (Bruce & Morris, 1997: 109 – 127).

On the subject of design interface, Raymond Turner, group design director of BAA, the world's largest privately owned airport company, offers three lessons:

Design management is a commercial imperative. Customers expect a product to function properly. What is much more important to users is the experience they have when using the product or service. Design can be used to shape these customer experiences. This means design directly affects company reputation and business profitability.

Design is a business tool that makes strategy visible. Strategic decisions by the board, for example, offering luxury products, are made visible by the design of these products.

Design investment increases brand value. When design investment is strategically focused and coherently managed, the value of the resultant brand increases.

Originally design is not considered to be an interface. Yet that is exactly what it does. It acts as an interface between the company and the customer, ensuring that the company delivers what the customer wants in a way that adds value to both (Gierke, *et al.*, 2002: 10 – 17).

A collaborative and interactive business relationship between designers and the purchasers of design can benefit all parties. If this interface can be managed properly, there are examples of successful products launched such as the Irgo-Pic demolition tool. As this particular example has demonstrated, the interface is best managed if a team is formed.

2.10.6 Managing design in multi-disciplinary teams

A strong theme in the product development literature is that of multi-disciplinary teams that work together from inception to completion of the process. Previous sections have indicated that there is acceptance today that the concept of a design team's handing over a design to a manufacturing manager is not the way to do it. It is necessary to interact with a wide variety of functions such as marketing, manufacturing, business planning, finance and serving.

A project team is proposed for a major new product and should involve subcontractors, consultants, suppliers, product distributors, etc. Although the type of team may vary, two crucial factors for success

appear to be the use of a dedicated Project Manager and the support at senior management level of a product champion. Design as a multidisciplinary activity can only be successful if there is a clear team leader. Hollins and Hollins (1991: 137) stress the importance of one person's being the product champion who leads the design team. This person is a constant member of the design team, attends all the design meetings, leads the group and co-ordinates the design process. The Design Manager is the ideal person to be product champion, although in some companies the Marketing Manager is just as suitable.

Designers, as part of a multi-disciplinary team, also need to be managed. Managing a group of designers, who sometimes do things in unconventional ways, can be very difficult. According to Sarah Meyer (2000: 10 – 16) it involves the interaction of self-management, co-operative behaviour, feedback and flexibility.

(a) Self-management

Self-management implies that a business consists of people who act independently of one another and without guidance from central control. Designers must therefore know what the objectives are for individual projects and the studio. A regulatory framework, such as office hours, is not required as the process is internally driven by the designer. Self-management, therefore, requires each individual to be a self-starter with initiative. It does not, however, encourage designers to behave like prima donnas.

(b) Co-operative behaviour groups

As the individual becomes an active member of the group, co-operation becomes necessary. Co-operation is needed to bring order, which can be seen in the creative energy that often emerges in the form of brainstorming sessions or friendly banter.

(c) Feedback

The designer and the practice learn from feedback, and adapt as a result of the information, whether positive or negative. The designer and the client must be willing to spend time, to communicate clearly and to recognise each other's efforts. Feedback is the main ingredient that makes self-management possible and is a learning tool in the design process.

(d) Flexible specialisation

Self-management and feedback contribute to an environment in which flexible specialisation is encouraged. It gives the individual freedom to continuously redefine and refine abilities in order to fill a void. An individual designer may fill a specialised behaviour niche as an art director, but this

does not limit him/her to those tasks. Other designers may specialise as computer fundis, photography experts, etc. A design practice may specialise in a certain direction, such as web design or corporate identity. Differentiation can only work effectively in the context of integration. Each individual contributes a speciality that makes the collective greater.

The previous paragraphs dealt with managing the design, describing how designers can get their jobs done. The following paragraphs deal with managing the design function from the Managing Director's point of view. The subject is how a manager, such as one who also manages Marketing, Finance, Production, etcetera, can best manage the design function.

A matrix is provided by Cooper and Press (1998: 226) to describe how design can be integrated in an organisation's management structure. It assists designers to integrate with the traditional management processes. See Figure 2.2.

	Planning design	Organising Design	Implementing design	Evaluating design
Level 1 Board, Top	Design vision, strategic direction and approval for design			
Level 2 Middle Functional	Implementing and monitoring design strategy, creating management structures, developing projects, evaluating outcome.			
Level 3 Operational	Managing design, identifying skills, implementing, monitoring and evaluating design work			

Figure 2.2 Integrating design in an organisation's structure (Cooper & Press, 1998: 226)

An agenda for each level of management is also set by Cooper and Press (1998: 223):

- Planning for design*: Planning involves the inclusion of design in the organisational goals, developing strategies and policies.
- Organising for design*: Creating an organisation which uses design effectively means having the right structure and investing in design.
- Implementing the design*: The business needs to implement design programmes and projects successfully. This also entails effective communication and documentation.
- Evaluating the design*: Factors to be considered are: Was the design project completed on time and within the budget? What was the impact of the design project on the business? How did the design project contribute to attaining the objectives of the business?

This section has discussed the functional management of design. Design needs to find a suitable place in the management structure of a company. The design process is not necessarily linear; it can also be iterative or multi-disciplinary. It is important that a design management model be developed to show the flow of activities. The design process can be an in-house operation, outsourced, or be a combination of the two, as long as the interface is properly managed. The best way to manage the design process is in the form of multi-disciplinary teams. Not only the process, but also designers need to be managed, although differently from other employees. From a managing director's point of view, design can form part of the structure of the company as does any other business function. Apart from the Functional Management of design, it is still necessary to explore the role of design in the Strategic Management of a company in greater depth.

2.11 Strategic Design Management

The role of design is not confined to the functional level. It can also have an influence on the Strategic Management of an organisation. This section investigates the strategic specification that is necessary in such instances. The expansion of the traditional role of design, as well as how design can play this expanded role, will also be highlighted. Thereafter design's role in a company's strategy to increase its competitive advantage is demonstrated. Finally the strategic role of design is illustrated by a few examples.

A traditional definition of *Strategic Management* is that of Chandler (1962:13) who defined strategy as the determination of the long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out those goals. In a somewhat more recent and slightly different approach, David (2001: 5) defines *Strategic Management* as the art and science of formulating, implementing and evaluating cross-functional decisions that enable an organisation to achieve its objectives. Strategic management focuses on integrating management, marketing, finance/accounting, production/operations, research and development, and computer information systems to achieve organisational success. Chandler stresses the establishment of long-term goals, while David emphasises cross-functional integration in the achievement of these goals.

2.11.1 Importance of the strategic role of design

The role of design in the functional management or project level of a company mainly involves direct contributions to specific projects. Design can also play a role in the strategic management of a company. This contribution is more abstract and indirect.

Design's role in a company's functional level of management could be to start from a developed product and add styling, packaging or an advertising campaign. As a result of the fact that design can add value to products, thus improving profits; and that design can tailor products to particular markets,

thereby improving sales, design is often only considered on the functional level of management by managers and marketing staff. Design can, however, also be a strategic tool influencing the formulating, implementing and evaluating of cross-functional decisions. According to Barngrover (2005:30) design leadership aims to provide innovation in order to achieve the evolving goals of the company. This is done by design champions at the highest level of the company. Von Stamm (2006: 8) adds that it is essential to understand that the key to success is to put design and innovation at the core of the company's strategy. It is not about bringing in a designer for a new product irregularly. It is about making design and innovation a way of life in the company.

At Procter & Gamble (P&G) design was traditionally seen as a late-stage activity. The emphasis was on packages that can fly down the manufacturing line. They have, however, learnt that if you let the machine rule, everything ends up in the shape of a brick or a cylinder. Bricks and cylinders are easy to fill, but as the package is not distinct, it suggests that what is inside is a mere commodity. P&G's new innovation model is more design driven. The designer is now part of a holistic approach to product development, and the designer's voice is heard from the earliest stages of discovery through development and launch. Kandoo, an extension of the Pampers brand, is a splendid example of the new model. Pampers spends a lot of effort making connections with moms and their children. But once the children grow out of diapers, those connections are lost. Through Kandoo, and as a result of the early influence of the design function in the development process, a new market for toddlers has been created. Kandoo products include flushable moist wipes and foaming hand soaps for three to five year olds (Barngrover, 2005: 30 – 32).

Design can enable marketing managers to match customer requirements to a product's performance. Designing can, for example, discover which set of attributes prospective purchasers would value and discover a product configuration embodying them at the right price. Customers value certain attributes differently. Price may be the key factor at the lower income market, while styling and image are crucial for fashionable clothing, and technical excellence essential for high-performance products. Design's role in a company's strategic level of management is thus to design products or services that support the chosen direction of the company. A brief overview of the role of design in the three levels of management puts its contribution in perspective.

At the *strategic level*, it is essential for a business to build a strategy for the role of design. For example, how the business might be affected by, or exploit, the demand for environmentally friendly products.

At the *functional level* it is important to have structures in place that enable everybody to appreciate the role of design and/or participate in design and to ensure that their efforts are properly co-ordinated. In smaller businesses effective communication between designers and other staff members may be informally. In larger businesses it is usually formalised.

At *project level*, design management is concerned with the thoroughness with which design is carried out, from planning and briefing to design, development, manufacture and evaluation.

Designing a service or product could thus be part of the business's strategic plan. The design aspect could be one of the strategies employed to realise the mission of the company. For example, if a company's mission were to offer high quality products in certain niche markets, the strategic role of design would be to design products suitable for such a market. As a result of design supporting the strategic thrust of a company, it is difficult for a design team to respond to a single brief without a broader knowledge of the organisation's strategic goals. Designers, therefore, also need a strategic brief, or sometimes called the strategic specification.

The European Union has also recognised the strategic role design can play. Designers' ability to predict consumer behaviour and help industry save money on wrong-headed new product development has received European Union endorsement in the form of an EU-funded research project. The project, called Design for Future Needs, is a yearlong study of design and designers' roles in shaping the future. It was felt that designers are good at predicting and interpreting future consumer behaviour in ways that scientists and economist would never get to (Nicholas, 2001: 3

As the role that design can play in a company's strategic management is being recognised by more senior managers, the functions that designers performed have expanded beyond the traditional. One of the areas where the expectations of design have evolved, centres around increased pressure on design's ability to provide radical new innovations. Design was always known for its ability to provide radical innovation, although it is also accepted that radical innovations cannot be guaranteed as a constant outcome in a mechanical sense. However, increased competition has added pressure on design to increase the frequency and scope of radical innovations.

As the quest for breakthrough innovation has increased, so too has the demand for consulting services that can provide expertise and a fresh perspective (Weiss, 2002: 34). The requirements for design are no longer limited to the well-defined problem in which a project brief addresses a fairly well understood and stable business context. Today, much bigger questions are being asked, which move beyond product specification to broader, more challenging issues. Instead of asking the designer to design a new product, a client might ask whether he/she should be designing such a product, a new product and a service bundle, or something else altogether? The client's need is to identify an appropriate direction for the innovation effort it can embark on. Thus the demand for the designer is to provide the direction of the innovation alongside the innovation itself. Whereas traditional core services offered by design consultancies focussed on helping clients do things the right way in terms of design, engineering and manufacturing, now they are engaged in strategic services to help them choose to do right things in the first place.

As a result of the fact that innovation programs today are increasingly strategic, traditional design services should grow and develop additional capabilities. A consultancy such as IDEO expanded their industrial design and engineering activities, to also incorporate the investigation of business factors (Weiss, 2002: 34 – 36). The strategic services that design firms render are extended. In the past it

used to be concept design and concept development. Now it can also include concept discovery, as in a new product. This requires of design to play a role of opportunity identification. Figure 2.3 is used by Weiss (2002: 36) to demonstrate the extended services required by design consultative firms.

As businesses ponder where to put their resources to assure future success, they are increasingly turning to innovation firms to help sort out the options related to these long-term decisions. Weiss (2002: 33-38) indicates how the acceptance of design as a strategic resource can change the services and profile of design firms.

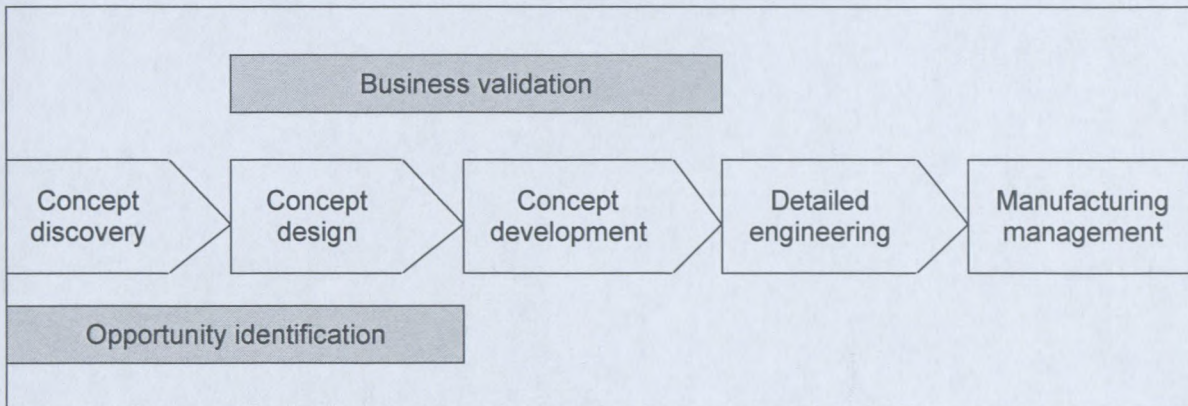


Figure 2.3 Early stage conceptualisation (Weiss 2002: 36)

This section indicated that design can contribute in realising the mission of the company by following a specific design strategy. The role of design has lately broadened to not only provide an innovative product or service, but also provide the direction of the innovation programme. Design is not only expected to exploit an opportunity, but also to recognise or create the opportunity. These broader expectations of design let it play a role in the strategic management of an organisation. The problem is how design can successfully be integrated in the strategic management of an organisation.

2.11.2 Integrating the strategic role of design

As a result of the increased expectations for design to broaden its contribution beyond the traditional inputs a strategy is needed to integrate the management of design into the management of the strategy of an organisation. Japan's success is a good example of how the management of design is successfully integrated with the management of a company. Product innovation is recognised more in Japan than in other countries as vital for competitiveness, with design providing the vision and communication to bind the process together and provide direction. This is in contrast to the predominant western view of innovation as a fragmented, compartmentalised process comprising engineers, marketers, designers and sales staff, all tightly guarding their disciplinary boundaries. In Sony for example there is a Design Director who sits on the board and is accountable directly to the chairman. In addition, there are monthly meetings between members of the board and design staff. A

similar arrangement exists at Canon (Cooper & Press, 1998: 124). Some examples of the role of design in achieving strategic goals are summarised in table 2.9.

Challenge	Strategic goal	Role of design	Examples
Small firm in consumer electronics market	Secure distinctive international niche	Provide niche through unique styling, identity and product innovation	Consumer electronics: Bang and Olufsen Linn, Psion
Survival in a mature industry with keen price competition	Concentrate on added value markets or processes	Add value through fashion orientation	Textiles: Leeds Group Issey Miyake
Transnational manufacturer with diverse world markets	Coherent identity and appropriate exploitation of scale economies	Corporate identity and co-ordination of design resources to target global markets	Electronics: Philips
Japanese companies in competitive western markets	Quickly develop products appropriate to diverse lifestyles	Integrate innovation process and humanisation of product	Electronics/ motor vehicles: Canon, Ricoh Sony, Toyota
Service supplier in newly competitive market	Develop distinctive identity	Corporate identity and environmental design	Services: Prudential Scottish Power Royal Mail

Design can play a role in realising the mission of a company, provided the management of design is integrated with the strategic management of a company. Achieving strategic goals is also closely related to building a sustainable competitive advantage and here too design can play a role.

2.11.3 Building a sustainable strategic competitive advantage

Design can make a contribution towards achieving a competitive edge on the functional or project level through innovation of specific products. The question now is: How can design make a contribution towards achieving a sustainable strategic competitive advantage? What is necessary is that design should become a core competency of an organisation. Design, can then, like any other core competency, lead to a sustainable competitive advantage.

The strategic input of design to achieve a sustainable strategic competitive advantage may lie in the competencies of the designer(s). Casaleggio (s.a.: 4) argues that the source of a sustainable com-

petitive advantage lies in the pool of competencies in an organisation. A firm can be seen as a pool of productive resources and the firm's endowment of these resources and capabilities is seen as the source of its competitive advantage, and therefore as the principal source of economic revenue. These resources and capabilities are the basis on which a firm's competitive advantage is built. Design is therefore the ideal competency on which a sustainable competitive advantage can be built, for example companies such as Braun, Olivetti, Bang & Olufsen. According to Jevnaker (1998b: 19), creating new designs seems to be more about nurturing and combining competencies, than just administration and control of the assets.

Design can therefore contribute to a sustainable competitive advantage, by establishing a design-based competence. This strategic competitive advantage can then add value to an organisation according to the value chain concept made famous by Michael Porter (De Mozota, 1998: 244). For an organisation to build a sustainable competitive advantage using the architecture of the value chain, three possible directions for differentiation exist:

- *The optimisation of elementary functions*: analysing each basic activity in terms of its contribution to building a competitive advantage and choosing one or two functions that are recognised as strategic.
- *Inter-functional co-ordination*: competitive advantage is provided by improving the co-ordination within the value chain that is concentrating on the links between functions.
- *External co-ordination*: the value chain of any organisation is linked with various value chains of all the organisations involved in the activity. Competitive advantage is built by better co-ordination with suppliers, sub-contractors and distributors.

The value chain concept provides a framework for explaining how design contributes to a sustainable competitive advantage by creating value within an organisation. Design management requires various competencies that are value creating at three different levels:

- *Operational design management* (managing a design project): Select and programme design resources in the organisation's elementary activities.
- *Functional design management* (managing the design function): Integrate the design expertise into all management processes such as production, communications, strategy, human resources and so infuse design in the structure of the organisation.
- *Strategic design management* (managing the design vision): Integrate and control the coherence of design methods and decisions with the company's mission and strategy (De Mozota, 1998: 244 - 245).

This section indicated clearly that design can contribute to the building of a sustainable competitive advantage as part of the strategic management of an organisation by establishing a design-based competency that can add value to an organisation.

2.11.4 Competing in foreign markets based on the strategic role of design

It is sometimes, when doing business in foreign markets, that the strategic role of design in providing a competitive advantage can be seen at its best. Design can, on a functional level, adapt products to local conditions. This would involve *ad hoc* changing of individual products. The question now is how can design on a strategic level contribute to a sustainable competitive advantage in different countries? This would involve the strategy of the design approach, which is applied over a range of products.

When it comes to designing products and/or services in different countries, Cai (2001: 59 – 64) groups strategies into three categories:

- Adaptive design*: Design that takes an existing product and modifies it to suit other cultures. An example of an adaptive design is Motorola's new Chinese cellular phone. The phone offers typical cellular features, as well as Chinese input and storage of short messages. It also employed a yin and yang design on its panel in co-ordinating colours.

- Configurable design*: Firms creates modular components that managers and consumers can select and rearrange to satisfy preferences of other cultures. For example Nokia designs its communication products with an open platform so that independent suppliers could develop value adding software or accessories, and this allowed a company in Shanghai to develop software for a Chinese-English dictionary to be used in Nokia products.

- Interface design*: Software serves as the medium for transforming a generic product into a market-specific product. The design of global products creates a new arena for software interface agents that facilitate the processing of complex information across global boundaries.

The strategic role that branding can play in developing markets, for example, is shown by Malhotra and Mangrulkar, (2001: 53 – 58) both from Aliagroup in Mumbai, India. Their central theme is that successful branding in countries such as China and India should emphasize relevance, experience and local packaging rather than simply import and advertise existing products. The potential for sales is enormous, but small retail outlets and limited incomes require different tactics. Items have to fit or enhance the lifestyle, which may mean developing new products or adapting existing ones. In India, for instance, Kellogg's did not have much luck selling breakfast cereal, so it broke into the market with snack biscuits, which were a huge hit. People can not afford large quantities, so single-use bottles, boxes and sachets are a way to entice people to try and to continue to buy a product they would otherwise perceive as too expensive. In addition, for areas in which reading skills are low, packaging should help customers recognise the product. It should have a name that is easy to pronounce or an easily translatable symbol.

Sometimes a flexible strategy can be followed. A very flexible strategy known as *face of the brand* (FOTB) might be applied across international markets, suggests Blumenthal (2001: 65 – 71). Instead of focussing on the corporate logo, FOTB uses a palette of images, colours, shapes and languages.

As it does not use a single visual format, it can be thoughtfully adapted to various cultures and audiences. As a practical consideration the brand palette can be expanded with modest effort. To be credible, FOTB depends on careful research and monitoring and works best when implemented as an ongoing partnership between the local company and the FOTB consultant. It is a different way of approaching global branding, another choice for design managers who have to deal with a world in which one size definitely does not fit all (Blumenthal, 2001: 65 – 71).

Sometimes a more constant approach can be followed. Kristensen (1998: 234) mentions when designer Raymond Loewy was working with Coca-Cola, there was a period with only incremental changes in the design for a very long time. An anecdote notes that Loewy was asked why Coca-Cola paid him so much, whilst his designs changed so little. Loewy responded: *That's why*. Creating and sustaining a strong identity may mean not changing it, when persistence over a long period is the best strategy. In this way, long-term engagements can give sustained competitive advantage, if the designer and the firm understand the particular context in which they are working.

It has been proven that design can contribute towards establishing a sustainable competitive advantage, by sometimes pursuing a flexible strategy and at other times maintaining a constant approach. The final question remains why design is not utilised more.

2.12 Indifference towards Design Management

Notwithstanding the fact that the benefits of design and design management were the subject of many publications, only a few companies incorporated design in their businesses. As these companies are the exception rather than the rule, it must be concluded that design is not being recognised sufficiently. This section provides an overview of the problems that still exist, as well as indicate deficiencies in past literature.

2.12.1 Lack of recognition of design

There is sufficient evidence of the importance of design. The benefits of design were researched and published, but design is still not being used on a large scale by managers of businesses. The problem is that many managers, especially in North America, are not committed to innovation (of which design is but one example) according to a survey of 900 human resource-managers and 4 500 leaders in other departments across 42 countries and 36 industries. The responses of the HR Managers, who could select more than one of the ten choices, reveal that 39% of North American HR Managers regard creativity and innovation as important, compared to 72% of their counterparts in China. Of the non-H R Managers, who could only select one out of ten choices, only 4% of North American Managers while 16% of Managers in China listed creativity and innovation as the quality most respected by their organisations (Wellins, 2006: 2).

When design is being used, it is within limited scope. This makes the discontinuity between design and business all the more puzzling. A typical example is the production manager who wanted to specify the design time for a project so tightly to not allow for the possibility for change once the designs were being agreed. The production manager joked about designers' use of words like *soft*, *curvy*, etc. He wanted a shade and tone of colour to be given to the designers, that is, to build in more constraints into the design process. From the designers' viewpoints these constraints were so constricting that the designers felt inhibited in their creativity (Bruce & Cooper, 1997b: 54).

Designers are often called upon to solve acute problems in projects or are wanted for styling in already planned products just to add creative flair. Not surprisingly, designers are demanded when managers have had negative feedback from the market or otherwise are using a push marketing strategy. Managers seem not to see or realise that their problems have anything to do with design. Hence, this design neglect is a mental as well as practical problem: connections are seldom made between design, business development and strategic market issues. Not surprisingly, design problems are treated in more or less random ways. In depth descriptions and evidence from practitioners, from design councils and from research, all point in the same direction: a qualified design approach in business is an exception more than a rule; and yet exceptional firms highlight the usefulness of design in various settings ranging from a tea cup to the design of aeroplanes (Jevnaker, 1998b: 15).

There is mixed reaction on the recognition of the role design can play. A survey by Walsh *et al.* (1992: 41) found that in commercially successful firms, senior staff had a broad understanding of what was involved in design, while in less successful firms managers had a much narrower view. The opposite was stated by Peters (1996: 16) who claims that the ability of design to transform an institution is not yet as widely accepted by top management. This seems to indicate that where an appreciation of design exists, it is used to good effect, but in general design is not much appreciated. According to Jevnaker (1998a: 1) although Design is acknowledged as a critical source of value and competitiveness of companies, the use of design from a business perspective has been neglected.

It seems to be a fact that companies are slow to pick up on design. According to Bruce and Cooper (1997b: 14), it has been well documented that UK companies have been slow to adopt design, despite successive government campaigns targeted at companies to create awareness of design's commercial role (Farr, 1995; Heskett, 1980; Sparke, 1986). Given the competing demand for resources, design is often treated as an activity that can be bought as and when required in an one-off way and may be regarded as a dispensable luxury. Firms may view their projects as an one-off investment rather than as a way of incorporating design investment into their long-term strategy.

Apart from the above, many authors published works with the purpose of convincing business managers of the benefit of design, for example Bruce and Jevnaker (1998), Thackara (1997), Kao (1996) and Cooper and Press (1995) but somehow, business managers remained unconvinced. A

perfect example is the statement by Jevnaker (1998a: 1) that her book is about the management of the design expertise needed to develop profitable and user-friendly products. A major theme of her book is the ability to nurture and protect the advantages created through design alliances. Cooper and Press (1998: 94) agreed that while there is much theoretical and empirical evidence that innovation is related to economic growth, there is less recognition in Britain of the role played by design in the various phases of innovation. In similar fashion Hands (2005: 3) stated that, although design has been recognised as an important strategic tool for achieving a competitive advantage, design management is still a relatively new field for both managers and designers. Media Tenor SA and idea engineers (2004: 4) suggested that the reason for the lack of recognition might be the fact that innovation, and R&D do not receive adequate coverage in the general financial and business pages of the mainstream media.

The only conclusion that can be drawn is that, although the benefits of design are the subject of many publications, only a few companies have incorporated design in their businesses. The fact is that design is not being recognised sufficiently. What would the causes be of this insufficient recognition?

2.12.2 Causes for the lack of recognition of design

The appreciation of design evolved as unique capabilities in particular firms only. Most firms do not exploit design effectively, nor do they explore it as a strategic resource. This paragraph investigates the causes of this lack of recognition.

According to Jevnaker (1998b: 16), design can be seen as the missing link, as it is not easy for companies to master. It is not surprising, therefore that many firms face great difficulties in utilising design resources effectively, as most countries' school systems, referring in particular to Britain and Norway, do not seem to give their citizens a good introduction to design subjects such as aesthetics, ergonomics and semiotics. In addition Kotler and Rath (1997: 210 – 211) mentioned four factors that keep executives from becoming more effective design managers:

- Design illiteracy*: Some charge that US managers are largely illiterate when it comes to design. American industry is run by managers. They are trained in business schools to be number-oriented, to minimise risk and to use analytical, detached plans.
- Cost constraints*: Many managers think that good design costs more than they can afford.
- Tradition bound behaviour*: Tradition bound behaviour is difficult to modify. A catalogue format is very hard to change; and a product design or a company name is even harder.
- Politics*: Company politics play a role in every firm. Some executives might oppose a proposed design for totally irrelevant reasons.

Bruce and Cooper (1997a: 15) pondered whether the risk involved in design could be a factor. The degree of risk varied across different types of design. Graphic Design projects appear to involve little technical uncertainty or financial risk. Yet in Product or Engineering Design a relatively high risk of

failure exists at the start of a project. Once a project has been implemented, the prospect of a rapid return on the investment becomes very good. However, what is of particular interest in their study is that the main cause of project failure was not the result of a poor idea but rather the inability to budget fully for the design work and its market implementation, the failure to provide the designer with adequate information about the target market, the distribution channel and the manufacturing procedures available to the company (Bruce & Cooper, 1997a: 15). It is thus not the financial risk, but rather an inability to manage the process, which ultimately resulted in failure.

The human failure to incorporate design is very well illustrated by a survey of UK manufacturing companies that shows that few companies have full-time Design Managers and Designers (Walsh *et al.*, 1992: 19). Most decisions about design were taken by managers who had full time responsibility for another activity, such as R&D and Marketing. Design is not institutionalised in UK companies, as the other functions. Hence the responsibility for creating design briefs, sourcing designers and managing the project is rather *ad hoc*.

Another problem in the lack of proper recognition of design could be a poor relationship between design and business. John Kao teaches creativity and entrepreneurship at Harvard Business School. Having been at Harvard Business School for fourteen years, he has seen firsthand what is going on out in the business world. It became clear to him that there were puzzling discontinuities in terms of the relationship between design and business. *It was almost as if I had encountered two distinct tribes, with two distinct sets of concepts and two distinct languages for describing reality. I was puzzled by the tone of polarisation that I heard when I talked to people about the relationship between design and business* (Kao, 1996: 9).

Managers do not always understand designers or the contribution of the design process. Kao (1996: 10) mentioned that he routinely saw people from the business world who seems to be dramatically out of touch with what designers actually do and who was not inclined to provide an appropriate seat at the table for design to allow discussion of the integration of design and business. By the same token, he had talked to many designers; some of whom he felt was out of touch with the core needs of business. Fortunately, there were signs of hope for him. There were interesting corporate environments that had seamlessly and very persuasively effected integration between design and business.

The problem of lack of understanding also manifests in the different styles of marketing and design, according to Cooper and Bruce (1997: 53). They claim that the differences between marketing and design styles are deep-rooted and lie in the different psyche of marketing and design disciplines. Marketers are trained to be adept with words and numbers, whereas designers are trained to be visual and emotive. The two groups are located in two separate worlds that have different professional styles. According to Schrage (1996: 46) the challenge is how do managers build bridges between inherently different parts of an organisation with different vocabularies and different sensibilities – both design and financial?

This section indicated that some of the reasons why the potential benefit of design is not being realized lie in the perceived risk of design, an inability by senior personnel to manage the design process and a different approach by for example designers and marketers towards executing their respective responsibilities. The reasons are centring around a mutual misunderstanding between designers and other staff members, built on what seems like a lack of sufficient knowledge of one another's contribution to the success of the company. There may be other reasons, but the point is made that it is not currently working very well. What are some of the solutions that were put forward?

2.12.3 Possible solutions and research aim

Various authors have offered various solutions to ensure that design receives its rightful place in an organisation.

Design mindfulness is proposed by Peters (1996: 25). According to him design mindfulness is as potent a tool for small companies as for large ones. The tragedy is that most small companies, in particular, do not get it. They do not understand that design clearly is the principal path to standing out from the crowd. Design mindfulness applies to the accounting and purchasing and logistics and training departments as well as to engineering, R&D, marketing and design itself. Accounting for example is about the flow of information. It can be performed elegantly. It can be performed with the beauty of perfect simplicity.

Better understanding is offered by Bruce and Cooper (1997c: 74). The issue of understanding what a designer can do is critical to the successful use of design. In order to achieve the best result, according to them, a company should ensure that it understands exactly how it will use designers and what skills it requires. It must have expert advice on sourcing and briefing designers and this may mean it is more cost-effective to use a design manager or communications strategist, either in-house or outsourced.

The *research aim* in this study is thus rooted in the need for better understanding of design by business managers. As the traditional method of researching and publishing the benefits of design has clearly not been successful, another approach was necessary to integrate design and business. This approach was found in integrating design with the Knowledge Management process, and in particular with Knowledge Creation Management. The main research aim was formulated as: *How can the competitiveness of businesses be improved through the application of Product Design as a Knowledge Creation Management tool?*

This approach necessitated an investigation into Knowledge Management, the subject of the next chapter.

2.13 Design Management: Summary

The first part of this chapter established the contribution design can make to improve a business's competitiveness. The process through which this contribution is integrated into the rest of a company's business functions is a part of Design Management. The design input, like any other in a business needs to be managed. Project Design Management concentrates on the flow of the design activities, from the establishment of a brief through the whole design process. Functional Design Management concentrates on a design department, which can be an in-house operation, outsourced or be a combination of the two. Strategic Design Management concentrates on design's contribution in realising the mission of the company through for example the general direction of the innovation programme. From a managing director's point of view design can form part of the structure of the company as any other business function.

Notwithstanding the advances of Design Management and the fact that the benefits of design are the subject of many publications, only a few companies have incorporated design in their businesses. As these companies are the exception rather than the rule, it must be concluded that design is not being recognised sufficiently. Some of the reasons lie in the perceived risk of design, an inability by senior personnel to manage the design process and a different approach by for example designers and marketers towards executing their respective responsibilities. Ultimately, the reasons centres around a mutual misunderstanding between designers and other staff members, based on what seems like a lack of sufficient knowledge of one another's contribution to the success of the company.

The research aims to investigate how this lack of sufficient knowledge can be overcome, but a theoretical overview of Knowledge Management is first necessary.

Chapter Three

Product Design as Knowledge Creation Management (a conceptual model)

3.1 Introduction

Against the background of the research aim, how the competitiveness of businesses can be improved through the application of Product Design as a Knowledge Creation Management tool, the second chapter concluded that previous research has revealed good reason to believe that design can contribute to a business's competitiveness. Despite the advances of Design Management, managers, however, do not use design as widely as they could, mainly because of a poor understanding of the contribution of design. This chapter explores new avenues of how to understand design's contribution to business. The second research objective, namely how Product Design can be understood as a Knowledge Creation Management tool, is thus addressed.

The aim of this chapter is to provide the theoretical background to the contention that competitiveness can be improved by using Product Design as Knowledge Creation Management in the new globalised economy. The chapter briefly explains globalisation and how it led to boundaryless organisations, which increased the need for Knowledge Management. Knowledge Management is seen by many as an approach that can increase competitiveness, by increasing knowledge and its application. Becoming a learning organisation can increase the knowledge assets through experience, knowledge sharing and forming communities of practice. This chapter indicates how knowledge can also be increased by using Product Design as Knowledge Creation Management. A conceptual model of Product Design as a user and producer of knowledge is provided. The chapter concludes by indicating what research is still required and how it influenced the research aim of this study.

3.2 Globalisation

One of the key driving forces behind Knowledge Management is globalisation. Globalisation is characterised by the fact that distance and national borders no longer matter, the ease with which business with a customer across the globe can take place and that the nation, state, and geography are no longer relevant for economic success (Loots, 2001: 2 – 3).

A good example of globalisation is the Ford Fiesta. The British Design council claimed it to be British, but it is assembled in Valencia, Spain, from components made in Basildon, Belfast, Bridgend, Dagenham, Enfield, Halewood, Leamington, Treforest, Berlin, Cologne, Saarlouis, Wulfrath, Genk and

Bordeaux. Its interior was designed largely in Britain by a multinational team of designers led, at the time, by a Canadian. Its body was designed in Germany. The company that manufactures it is a Delaware Corporation. The new Ford is indeed a *world* car (Bayley, 2006).

This section explains the origins of globalisation and its impact on companies, individuals and the South African economy, followed by the effects of globalisation, contributing among others to an age of abundance and resulting in volatility in the market place. During the same time economic growth declined and, combined with a slow population growth, led to increased competition between companies and a wider choice of goods for consumers. The combined effect put pressure on companies to respond to the challenge. The resultant changes in companies prepared the way for the Knowledge Economy. But first, where did it all start?

3.2.1 *Origins of globalisation*

This section tracks the origins of globalisation. Historians take globalisation back to the year 1492, when Columbus landed in the Americas, and 1498, when Vasco da Gama journeyed around Africa. A globalisation boom took place in the late nineteenth century when the benefits of breakthroughs in transportation and communication resulted in rapidly growing international trade (Loots, 2001: 2).

Globalisation is based on a technological revolution that, according to Drucker (1993), is as a result of major paradigm shifts that affected not just businesses but societies as a whole. Such transformations took place over 50 to 60-year periods. Earlier periods of dramatic changes in the Western World were:

- Thirteenth-century Europe: The rise of medieval craft guilds and urban centres and the development of long-distance trade.
- 1455 – 1519: The Renaissance period of Gutenberg's printing press and Lutheran Reformation.
- 1776 – 1815: The Industrial revolution, starting with Watt's steam engine.

The Industrial Revolution was followed in the twentieth century by a technological revolution, centred on information and communication technologies (ICT). During the Cold War period the development of both electronic computers and communication technology was driven by military requirements (Little, 2002: 374). In 1962, Paul Baran from the US Air Force developed a packet-switching network which involved sending data from one computer to another. In 1969, a physical computer network was set up between four universities in the USA. This ability to link computers and send information electronically from one computer to the other, soon led to the Internet (Nel, 2003: 330). This technological revolution led to economies throughout the world becoming globally interdependent. The ICT revolution sped up communication across national boundaries (Doole & Lowe, 2004: 21). With it came economic deregulation and the elimination of trade barriers. As a result, companies started to compete with one another across the globe.

Not everybody agrees on the benefits of globalisation. For some globalisation means the removal of trade barriers and therefore increased opportunity. For others globalisation means big companies dominating international business, exploiting the resources and influencing the economy of every country and moving their factories from country to country without regard for those who lose their jobs or those who are paid extremely low wages (Doole & Lowe, 2004: 180).

According to Loots (2001: 4), there was general consensus that the driving forces behind economic globalisation are:

- A reduction in transport and communication costs in the private sector;
- Reduced policy barriers to trade and investment by the public sector;
- An increase in the availability of and access to information and technology;
- The speed with which information and technology can be transmitted across national boundaries.

3.2.2 Influence of globalisation on businesses

Globalisation had an effect on businesses and on the markets in general. This section discusses the effect of globalisation inside a business. Initially it was the Internet that influenced the way companies conducted their business, but gradually other effects were also felt. In the industrial economy, two reasons for going global were economies of scale and the need to reduce physical transportation costs by manufacturing close to key markets. Now globalisation is as much a response to regional specialisation and the expansion of long-distance relationships and markets. Through the Internet, firms can reach distant markets at a price little different from customers in their locality. Furthermore, higher value to weight ratios and networks like that of FedEx mean that global distribution is virtually cost-free (Skyrme, 2000: 17).

The Internet offers the opportunity to re-establish the communication loop between manufacturer and customers. The manufacturer can now produce for the world market but at the same time communicate with every single one of its end customers through the Web. The Internet and available production technology combine two advantages. They allow companies to reap the cost advantage of mass production, while at the same time companies can also reap the benefits of high customer satisfaction through customised production (Wiegran & Koth, 2000). The Internet thus has a profound effect on the way companies operate and therefore on how they are managed. The ability to send information over the Internet has made management concentrate on information and the knowledge it can generate. Concentrating on the knowledge would allow managers to mass produce and customise at the same time. The locus of organisational exemplars therefore shifted to information-intensive and innovation-driven industries (Miles *et al.*, 2002: 280).

Progressively throughout the latter half of the 20th century consequent types of organisational innovations gave rise to competitive advantages such as just in time, management by objectives, Kanban, matrix management, outsourcing, downsizing, and lean production. If you belonged to the in-crowd,

your organisation was supposed to look like a blueberry pancake, a fishnet, a shamrock, gazelles or even boiling spaghetti (Holmberg & Ridderstrale, 2000: 38). As companies careered from the machine age into the information age, the more questionable became the traditional practices and precepts of management. As useless as a horse-drawn plough is on a factory floor, so irrelevant is management tools developed in the machine age for the information age (Hamel & Prahad, 1996: 237).

The current shift is towards the knowledge economy and the knowledge worker (Drucker, 1993; Economist, 2006). In the knowledge society, the basic economic resource is no longer capital, but knowledge. The Organisation for Economic Cooperation and Development (OECD) estimated that in advanced industrial societies, eight out of every ten new jobs are for knowledge workers. Even in manufacturing industries, it is estimated that three-quarters of the value added comes from knowledge work (Skyrme, 2000: 11).

One of the best descriptions of the effect of globalisation on management attitudes was provided by Grulke (2000: 31) referring to a little-known statue of a pharaoh being counselled by two deities in the Egyptian museum in Cairo. On the left is *Horus*, the god of structure and predictability and on the right is *Seth*, the god of chaos. In a very real sense, today's business executives are in the same position. Everything they have been taught about business was crafted in the Industrial Age where central authority, predictability and control were the touchstones. They are the sons and daughters of Horus, but are now living in Seth's world. Table 3.1 describes some of the difference between the two worlds.

Table 3.1 Differences between the ages of Horus and of Seth (Grulke, 2000: 31)

Industrial Age 'culture' In the Age of Horus	Information Age 'Spirit' In the Age of Seth
Learn a skill	Lifelong learning
Security	Risk-taking
Job preservation	Job creation
Capital equipment	Intellectual capital
Status quo	Speed and change
Hierarchical and regulated	Distributed and networked
Zero sum	Win-win
Measure inputs	Measure outputs

While large established companies need to reinvent themselves to become global, some new companies are born global. These are a specific group companies who view the world as its marketplace from the outset (Doole & Lowe 2004: 154). Operations must support all continents and/or markets right from the establishment of the company. Studies on such fast growing, global high technology companies have indicated that early setting of global objectives and early entering of lead markets are crucial. Firms entering foreign markets step-by-step can adjust their resources and capabilities gradually; whereas born global companies need to respond very fast to opportunities in the global market (Sasi & Gabrielsson, 2002: 3). According to Kantor (2000: 252), companies in new technology fields such as software, biotechnology, medical devices or telecommunications tend to design their products with standards in mind and partners in many places, even before they are ready to ship a single item outside their home country market.

The effect of globalisation was demonstrated by Ulrich (2000: 236) in the following three points:

(a) Global village

We live in a global village. The Internet enables colleagues around the world to be more accessible than those next door. As businesses like automotive, banking, energy and airlines engage in global mergers, large domestic companies become giant global companies. Global awareness and sensitivity will enable firms to adapt products to local conditions and cultures. Simultaneously, global homogeneity, where things become the same, for example, food, fashion and tastes, and global heterogeneity, where cultural differences are respected, for example, food, fashion and tastes, will continue to challenge companies to live in the paradox of being global and local.

(b) Technology

Technology will make the world smaller and faster. What would have taken days before, now takes hours. As technology gets more sophisticated, it can only be imagined how it will connect people more quickly. While the downside of technology (for example personal and emotional isolation, and loss of privacy) will need to be addressed, it would be hard to conceive a world without technology. Technology will affect both where and how people work and the type of work people do. Technology also adds a fundamentally new distribution channel for products. As people become more comfortable with the Internet, more products and services will pass through this channel.

(c) Speed

Speed will become a major determinant of organisational success. Product life cycles will shorten and first-mover advantages will become ever more important. When Sun Microsystems was first with Java, a computer language, it won great market share, only to be at risk when the next generation of products emerged. With speed comes the requirement for agility to change, adapt and learn more quickly. Speed means shorter cycle times for among others implementing new products and services. Agility means taking advantage of opportunities that arise as soon as they present themselves, or losing out to a competitor who has the knack and will to move quickly.

Another effect of globalisation on businesses is an ambivalent approach towards homogenisation. On the one hand there is a move towards homogenisation as companies are becoming more similar. International consulting companies are diffusing identical solutions around the world. A cadre of MBA students from all continents study the same texts and learn the same recipes. As nearly all firms become virtual and wired, Holmberg and Ridderstrale (2000: 38) foresee that information technology will make companies even more similar. The similarity is increased by the use of the English language for practical reasons. According to Kantor (2000: 251), about 78 per cent of all websites use the English language and over 91 per cent of websites with secure servers are in English.

On the other hand, globalisation does not necessarily mean homogenisation. Globalisation also requires strategies and practices that accommodate the diversity that exists across countries. Some business processes require local differentiation, especially distribution which has to connect with local infrastructure. For example, in its initial entry into Brazil, Wal-Mart made some obvious merchandising mistakes, such as stocking American footballs in a soccer-playing country or leaf blowers in a tree-less, yard-less, concrete-dominated São Paulo. Its stock handling system could not handle Brazilian pallet sizes nor its computerised bookkeeping system Brazil's complex tax laws.

Globalisation can also lead to heterogeneity as local companies adapt to the presence of international competitors by creative upgrades, while foreign companies accommodate local practices. In Lima, Peru, a local seafood restaurant in the same shopping mall as Burger King, studied and adapted the foreign chain's techniques to create a fast-food-style ceviche, which was more popular locally than hamburgers. In Peru, McDonald's incorporated into its menus a major Peruvian soft drink, Golden Cola, because it sold better than international brands (Kantor, 2000: 252). While there is certainly a tendency to homogenise everything in the global village, there will always be room for heterogeneity.

The final effect of globalisation is that it introduced an era of abundance. According to Holmberg and Ridderstrale (2000: 33), globalisation created an excess economy, with markets for absolutely everything from raw material and financial resources to patents and people. This is the age of abundance and competition has gone totally mad. How else can it be explained that the average US citizen is exposed to 247 advertisements per day? Or that he or she has encountered 350 000 commercials before turning 18? One example of the era of abundance is that of the 1000 new types of soda that were introduced on the Japanese market in 1996, fewer than one percent were still for sale in 2000. That same year, Sony launched 5 000 new products, more than two new products per work hour. Walt Disney CEO Michael Eisner claims that the company develops a new product – a film, a comic book, a CD or whatever – every five minutes. In Norway, a country with 4.5 million inhabitants, the average consumer can choose from 200 newspapers, 100 weekly magazines and 20 TV channels.

The era of abundance put the pressure on competing. In 1960, US universities saw 5000 MBAs graduate; last year that figure was 75 000. In the UK, the number of MBA courses has risen from 2 to 130 in the past 30 years. More of the same graduates mean that in the near future there will be a surplus of similar companies, employing similar people with similar skills, launching similar products and services, with similar quality, price and performance and they will all be competing. Consumers will love the freedom of choice. Executives will hate it. Once supply exceeds demands, the executive will have to deal with the demanding customer, and the demanding customer is a dictator. In such a competitive environment, companies will have to compete differently. Competitiveness will gradually shift toward the things that customers cannot touch. (Holmberg & Ridderstrale, 2000: 34).

In summary then, globalisation grew mainly as a result of the Internet's ability to transfer information over a network of linked computers and the abolishing of trade barriers as a result of deregulation.

This technological revolution led to a change in the way companies conduct their business and as a result management attitudes have changed. Although globalisation and its implications developed gradually in most organisations, some were born global. The effect of globalisation on companies is mainly felt in the areas of the global village, technology and speed. While there is a trend towards homogeneity, heterogeneity will always have its place. The effect of globalisation on consumers is to swamp them with abundance. With a market full of similar products, competitiveness will be based on the intangibles. Apart from the effects of globalisation on businesses, it also has an effect on the market place at large.

3.2.3 *Influence of globalisation on the market place*

The effect of globalisation on the market place was profound change. This section discusses this change and the resultant market volatility, highlighting companies' need to manage the change and become flexible. Globalisation caused discontinuous change in the market place, mainly as a result of the transition to the knowledge economy. According to Marzano (1999: 5), today's companies are living at a time of transition from the Industrial Age to the Information Age.

Discontinuous changes in the competitive landscape forces companies to compete globally. The competitive landscape is altered dramatically by deregulation of industries (for example, power, telecom, and water), the growing importance of emerging markets (for example, China, India and Brazil), the ongoing effect of the convergence of technologies (for example, fusion of food and pharmaceutical knowledge, communication, computing and consumer electronics) and the blurring of industry boundaries, as in the case of retailing and financial services. The ICT revolution sped up communication across national boundaries. With it came deregulation and the elimination of trade barriers. Companies started to compete with one another across the globe (Prahalad, 2000: 141).

The result of these discontinuous changes is that managers have to deal with volatility in markets. With increasing costs of product development, and decreasing product life cycles, managers will be forced to adapt quickly. In the high-volume electronics, business products can become a great success in a very short time, for example, the Playstation from Sony. This calls for dramatic scaling up involving suppliers, logistics, and manufacturing. The reverse is also true. Scaling down, when demand falls sharply for a product, is also critical (Prahalad, 2000: 145). One example of market volatility is the case of Asea Brown Boveri (ABB). Historically, North America and Europe accounted for the vast majority of new power plant demand. By the year 2000, China's demand greatly exceeded that of the USA or the whole of Europe. While the company's resources were all in the west, its future opportunities were all in the east. The company has had to reduce employment in the west by 54 000 people, while building up an organisation of 46 000 people in the east. (Ghoshal, Bartlett & Moran, 2000: 132).

Companies should manage market volatility and change with it. Every year *Fortune* conducts an analysis of the world's most admired companies and found that innovation is the ingredient all top

companies embrace passionately for example Coca-Cola, 3M, Pfizer and Intel (Fortune, 1997). It means that business needs to change constantly. If they do not, they will not survive. The average life of most sizeable corporations is less than 30 years. Comparisons of Fortune 500 or The Time Top 1000 with those of just ten years ago show dramatic changes with once strong companies no longer being listed (Skyrme, 2000: 3). Globalisation, intense competition, demanding customers, regulatory changes, the relentless progress of technology, are all factors that recur high on the list of key challenges affecting business. How do they respond? A common thread is the need for organisations to be flexible, adaptive and to continually reinvent themselves (Skyrme, 2000: 3).

One way in which companies manage market volatility is to flex everything. Organisations will have to have more flexible employment practices (part-time, full-time, contract employees), compensations practices (flexible pay and rewards) and ways to get work done (work at home or from the office). Executives will create flexible management practices that encourage capacity to change. Organisational structures are likely to be more fluid and dynamic. For example, rather than be hired to work in one department or function for an extended period, employees may work in ever-changing task forces, assigned projects and colleagues, depending on the requirements of the customer (Ulrich, 2000: 240).

In summary, globalisation forced companies to adapt to market volatility or discontinuous change in the market place. While some traditional companies adapted, others did not and as a result no longer exist. Some companies responded by flexing everything. The next question is how these global changes affect South Africa in particular.

3.2.4 Influence of globalisation in South Africa

Globalisation had different effects on different countries. This section provides an overview of the effects of globalisation in South Africa and illustrates it with the mixed benefits experienced by a typical industry. In South Africa, international trade is the main driving force behind globalisation also.

South Africa has always been heavily dependent on international trade. During the period leading up to World War II, there was a strong move towards the development of domestic industry as a substitute for imports. However, towards the end of the 1960s it became clear that greater attention would have to be given to developing the export potential of the manufacturing industry (Hough, 2003: 311). South Africa re-entered the international economic arena at a stage when the forces of globalisation, especially for emerging markets, became more prominent. Since the early 1980s, South Africa has moved from a situation where domestic-owned corporations contributed more to economic output, towards a more dominant position by foreign-owned corporations. Since the early 1990s the net position has been moving towards foreign-owned enterprises contributing more to economic output (Loots, 2001). Since 1994, a policy aimed at the creation of an open, internationally competitive economy was pursued.

The current South African government is committed to making the economy more competitive. International competitiveness is seen as the only way in which South Africa will be able to provide sustainable and high-value employment. Within the current global environment, South Africa has witnessed the strengthening of the systems of global governance such as the United Nations Conference on Trade and Development (UNCTAD) and the World Trade Organisation (WTO). A close adherence to the principles of the WTO has presented new challenges to marketers domestically and abroad as they are faced with greater direct competition from abroad. Although, this prevents protection for the local industry by, for example, high import tariffs the South African government's attitude is that the advantages of membership of the WTO outweigh the disadvantages (Hough, 2003: 312).

The mixed benefits of globalisation to South Africa can be demonstrated by its effects on the textile industry. The textile industry is a very typical example of an industry built up under import substitution policies and which now has to adjust to increased import competition as a result of trade liberalisation. It exemplifies both the threats and the opportunities of globalisation.

According to Roberts and Thoburn (2002) as a result of trade liberation and global competition, the textile industry could not compete with products being produced at lower cost elsewhere in the world. Production stagnated and employment fell significantly with over 30 000 jobs lost over the period 1996 – 1999. Stagnating production was accompanied by falling real prices, leading to declining output value. Company performance, in terms of profitability and turnover, weakened in the mid 1990s, but performance picked up in 1999, with some of the major companies having made significant investments in upgrading machinery. Export incentives were introduced and a number of trade agreements with the EU and the US were signed. For example the *Africa Growth and Opportunity Act (AGOA)*, which came into effect in early 2001, provides for reduced duties for exports of clothing to the US market for an initial period of eight years.

There are indications that new investment levels rose in 2000. Firms responding to liberalisation with a mix of new investment, upgrading of capabilities, product differentiation and specialisation, have been more successful. The ability to meet increased competition on all the dimensions of price, design and quality has yielded success. Becoming more competitive was so successful that only 22 per cent of South Africa's exports to the US are made under the special arrangements of AGOA. As far as employment is concerned, the fall in formal textile employment has been more than matched by a rise in the informal garment sector. Garment employment expansion has proceeded with a process of relocation to low wage, non-unionised rural areas.

It can therefore be concluded that globalisation has delivered mixed benefits for a country with an emerging economy, such as South Africa. Trade liberation put companies under pressure but also forced them to rise to the new level of competition. This new level of competition means competing in a global market.

3.2.5 Effect of globalisation: Increasing competition

One of the effects of globalisation is worldwide competition between companies. Multinational companies, with their huge budgets, take the lead in developing new products. In addition, ease of distribution of technology and market forces are also eroding competing forces. Local companies can thus only compete if they can deliver tailored made solutions to specific groups of consumers.

Globalisation has many profound effects, not least in the sheer number of markets that has opened up for Western companies. Three movements have made it easier for companies to compete on a global scale. The North Atlantic Free Trade agreement (NAFTA) aims to eliminate trade barriers among the United States, Canada and Mexico. The General Agreement of Tariffs and Trade (GATT) aims to reduce tariffs and import duties among the countries that are party to the agreement. The establishment of the European Union (EU) aims to eliminate most of the physical, tariff and technical barriers to trade among the Western European countries. The impact of these movements is that strong multinational companies can now compete favourably with local companies in their own backyard.

One of the outstanding features of globalisation is that multinationals have the ability to shorten the life span of products (Bruce & Cooper, 2000: 6). Globalisation and access to emerging foreign markets by multinationals have a strong influence on Product Development in terms of the type of product developed and where the product will be manufactured and sold. For example, the World Trade Organisation reached an agreement early in 1997 whereby many developing countries are opening their markets to some degree of competition. Another aspect of emerging foreign markets and globalisation is the emergence of low-cost-labour countries that are becoming a more attractive form of production than organisations in developing countries. With more and more companies having access to the same technology, markets, methods of production and channels of distribution; the competitive environment has fundamentally changed (Doole & Lowe, 2004: 183 – 187).

Managers of most companies think of other companies individually as their competitors and, indeed, they are. In a globalised economy all of them are joint competitors, for these companies are the market. Companies try to make high profits. The market marshals forces that bring prices down to the level of variable costs. Companies try to grow, to diversify, to globalise – to become big and powerful. The market's forces work to break them up, to make them small and powerless. For each and every company, big or small, the ultimate competitor is not another company but the global market. A company survives and prospers only when it can beat the global market, and loses its right to exist when this is no longer the case (Ghoshal, Bartlett & Moran, 2000: 121). How can a business successfully compete in these conditions?

A business can only compete successfully if it can create a unique competitive advantage. In the beginning, a competitive advantage was primarily derived from location. It was the access to raw materials that provided the specific advantages. The successful companies of the 19th century profited

from access to resources such as oil, forests, and mines. However, the capitalist economy is ruthless. Soon, free markets for raw materials made it increasingly difficult to use location as the single source of competitive advantage. Then technology and innovation, together with access to capital, became the new differentiator.

The key to competitiveness was creating more value out of the same input. At the beginning of the twentieth century, the business community was thus dominated by a number of well-known capitalists, a few entrepreneurs and their innovations – Thomas Edison, Alfred Nobel, Otto Diesel, the separator, the automobile and the ball bearing. A competitive edge was based on ingenuity. However, once again the market struck back. Products were imitated and patents were sold or acquired. When these innovations were turned into everybody's property, competitive advantages could no longer be based on a former technological monopoly (Holmberg & Ridderstrale, 2000: 37).

This phenomenon is referred to as the self cancelling technological advantage, according to Davenport and Prusak (1998: 16). As technology transforms the logic of competition, technology disappears as a sustainable source of competitive advantage. When the same technology is available to everyone, it cannot provide a long-term edge to anyone. A global market place for ideas has developed and there are very few concepts and formulae that are not generally available. Competitors can quickly duplicate most products and services. When only Citibank had automated teller machines, they briefly had a significant advantage over their competitors. But ATMs soon become available throughout the world, and what once was a competitive edge is now simply a baseline requirement for consumer-oriented banks.

Although the globalised market is eroding competitive advantages, the basic law of survival of the fittest will continue to apply in the business jungle. Firms that do not meet financial goals will fail. Financial success will become not just reducing costs but creating growth. Cost-reduction pressures will continue as evidenced in attention to improved processes, avoiding redundancies and higher productivity. An agenda for growth will continue through attention to global distribution, customer intimacy and innovation (Ulrich, 2000: 239). In a market economy, business basically boils down to making money. This may not be the reason why all people start successful companies, but showing a profit is still necessary to secure the survival of the firm (Holmberg & Ridderstrale, 2000: 35).

In an attempt to make profits, all managers share the same secret dream to create temporary monopolies (Holmberg & Ridderstrale, 2000: 35). A temporary monopoly is created when the product offering adds unique value to a specific set of customers – a niche. Unless the firm is in a monopoly position, competition will force it to engage in ruthless price wars resulting in zero profits. To create a temporary monopoly, the company needs to be different. The product offering must add value in a way that nobody else can.

The development of new products and processes increasingly becomes the focal point of competition. Firms that get to the market faster and more efficiently with products that are well matched to the needs and expectations of target consumers create significant competitive leverage (Wheelwright & Clark, 1992: 1).

It is thus clear that, in a global economy, competition is increasing. Companies are trying to create temporary monopolies by offering an increasing number of products. The only response is to innovate products, processes and services to match and exceed the needs and expectations of targeted consumers. The result of this is an increase in the standard of offerings to consumers, which continues to raise their expectations.

3.2.6 Effect of globalisation: Increasing customer expectations

As a result of increased competition between companies and thus increased offerings, customers are left with increased options. These increased choices raise customers' expectations and make them more demanding. Consumers require high-quality goods and services that are accessible, available and convenient. Manufacturers and retailers are pressurised to meet these expectations and are forced to focus not just on price but also on their products' creativity, quality and durability. Companies are committing themselves to the continuous development of products while changing market needs are difficult to ascertain and customers are unable to articulate their requirements in the abstract. Yet, incremental innovation demands a deep knowledge of user needs and therefore a close relationship with customers would be beneficial (Bruce & Cooper, 2000: 49).

Such a close relationship with customers has come full circle since the first products were customised. A few hundred years ago every product could be said to have been customised. If you needed a chair or a horseshoe, you went to the carpenter or blacksmith and the product was made to your specifications. The communication with the customer was very personal, always one to one, and in fact, seller and buyer might know one another very well. This customised production, pricing and communication changed considerably with the advent of mass production. Products needed to be standardised in order to reap the full benefit of the assembly line. Henry Ford's famous line: *you can have your car in any colour as long as it's black*, indicates that the preference of the individual consumer was secondary to the need to have standardised features that fitted into the production process (Wiegman & Koth, 2000: 3).

Where the standardised production process lost the close relationship with the customer, customisation became possible again with modern production techniques. The era of customisation began around the middle of the twentieth century when some firms had accumulated know-how that could not be fully utilised in the production of their existing goods and services. A new organisational form, the divisional firm, allowed companies to serve related markets with differentiated goods and services.

In the divisional form, know-how that accumulated in one market could be utilised by a newly created, semi-autonomous division to provide products or services to different but related markets. Although each division typically produced a standard product, the divisional form enabled companies to achieve limited amounts of customisation by market segmentation (Miles *et al.*, 2002: 281).

The movement from standardisation to customisation continued into the late 1960s and 1970s as firms adopted mixed organisational forms, such as the matrix, that allowed a dual focus on both stable and emerging market segments and clients. For example, by employing a matrix organisation, an aerospace firm such as TRW could produce differentiated but standard products for the civilian and military markets in one or more divisions, while simultaneously transferring some resources from those units into project groups that designed and built prototypical products for space exploration. The matrix organisation provided companies with a more finely grained mechanism for exploiting their know-how across a wider range of both standardised and customised products. By the 1980s a rapidly growing number of firms around the world were using their know-how to enter an increasingly deregulated global marketplace. New entrants competed with lower prices, improved quality and distribution and seemingly endless choices among styles and models. Companies with divisional and matrix organisations, designed for less challenging and turbulent markets, found it difficult to unleash their competencies and know-how to meet the new market opportunities and pressures (Miles *et al.*, 2002: 282).

Customisation provided opportunities for individuality and flexibility. The current technological climate has the potential to promote individuality and this fosters the search for flexibility. Greater flexibility is the result of increased sophistication in production capabilities such as mass-customisation and the use of integrated technologies. No longer do customers have to settle for a product that fits a number of persons in an interval as in the usual target marketing approach. Instead, a one-to-one approach is needed (Doole & Lowe, 2004: 421 – 427). For example, in the apparel industry, full body scans and a direct link to the factory can produce an exact fit at the cost of a production line article. Mass-produced automobiles can be customised at no extra cost. Technology has become so advanced that products can be produced with the character of handicrafts. That is, products that are high quality, well adapted to their context of use, and even customised and individualised (Bull, 1999: 7). This is how sophisticated products have become in order to meet increased customer expectations. The increase in sophistication in turn increases customer expectations and the circle starts over again.

South Africa needs to increase its competitiveness against the background of globalisation. Globalisation, accelerated by Information and Communication Technologies, caused profound changes in the market place. Companies adapted to this change by increasing flexibility, which allowed them to offer individualised products. Better products led to increased competition as companies attempted to offer the customer better satisfaction. Accelerated change, increased competition and technological advances resulted in mass customisation. These changes have a profound impact on the way companies are managed. Traditional boundaries may no longer be valid.

3.3 Boundaryless organisations

Globalisation caused companies to change. Flexibility, mass customisation, and increased competition put pressure on the way companies were traditionally managed. Traditional boundaries will disappear and organisations will increasingly become boundaryless, to use the concept coined by Jack Welch (2001), CEO of General Electric. Boundaryless organisations refer not only to the fading physical boundaries of organisations, but also to mental boundaries that are falling away.

This section indicates how authority is becoming boundaryless, resulting in the boundaries of control becoming blurred. As employees are increasingly taking their fate into their own hands, boundaries of loyalty and affiliation are shifting. With continuous learning by employees, boundaries of experience are crumbling. New insights in technological advances make national boundaries irrelevant. When managers become global players, boundaries change between the physical and the intellectual. This requires leaders that can change the boundaries of the present for those of the future. In this new economy, with its boundaryless organisations, outsourcing is very popular, resulting in networked organisations. This in turn leads to a growing number of small firms. According to Doole and Lowe (2004: 155) Many SMEs expand their markets by networking with other companies.

In the machine age, a manager was a professional, but those boundaries are gone. Managers were credentialed (certified accountants, MBAs or alumni of Harvard's Advanced Management Program). In South Africa is The Association of Professional Managers. A manager was an analyst, doing break-even analysis, value chain analysis, segmentation analysis, and cost structure analysis. Management was by the rules, by the numbers and by the book (Hamel & Prahad, 1996: 237). In the globalised economy, those boundaries have gone. Removing the multiple boundaries most firms create over time makes an organisation both more efficient and quicker. For example, General Electric has worked hard to remove many types of boundaries. It encourages information sharing, talent movement, teams and rewards to be shared (Ulrich, 2000: 246). The following seven points demonstrate seven areas in which boundaries have been, or are in the process of being removed.

3.3.1 Fewer authority boundaries

Traditionally, authority was vested top down, from shareholders to corporate officers to managers and then to staff. Levels of authority were delineated in terms of discretionary spending limits and the scope for autonomous action. Practical power derived from the control over resources, the proprietary information one possessed, and the sanctions one could impose. The higher up one was in the hierarchy, the more information / knowledge one was supposed to have. So, with the higher position in the hierarchy, came the privilege of strategic thinking (Roos & Von Krogh, 2002: 256). However, in the new economy, every employee thinks and acts strategically. Everyone is informed about market

conditions, thinks about new products that will best satisfy customers, and makes suggestions how these products or services can be produced, or how processes can be improved.

As a result of boundaryless authority, managers need to learn that their jobs entail no longer looking over people's shoulders. In the future, work will be based on productivity, not hours. The new way is: Get the job done, regardless of when or where you do it. The role of managers then becomes one focused on strategising and problem solving, not whip-cracking. The role of managers will encompass things like managing information flows, hiring and retaining qualified people as the competition for talent intensifies, monitoring intellectual property and keeping up with technological advances. As companies become increasingly networked to include outsourced workers, suppliers, external customers, managing these webs is going to require a whole new set of skills (Greco, 1998: 37).

Occasionally, authority can command compliance, but it can never command commitment. The current generation entering the workforce is unconvinced by authority. Managers cannot get things done by simply using their positional authority; they have to build legitimacy around decisions. This is increasingly difficult when personal computers, networks and corporate e-mail systems are creating something close to an information democracy. If every decision can be previewed, and if relevant facts are broadly accessible, decisions can be challenged. *Just do it* may be a great advertising slogan, but it does not carry much weight when employees are in possession of all the facts, are capable of making their own judgements, and are more than willing to challenge the judgement of those they work for (Hamel & Prahad, 1996: 238).

In the new economy managers will have less authority and their decisions will not be accepted readily. This will have implications for the level of control managers can exercise.

3.3.2 Fewer control boundaries

In the machine age, control was everything and manifested in painfully detailed reporting systems, endless review meetings, and brusque phone calls when budget variances were spotted. There was an equally strong tendency for managers to try to bring all the resources important to success within their direct control. Business unit boundaries were closely defined. Companies integrated backwards to gain control of critical inputs. However, control is often illusory. To measure is not to control, as every weatherman knows. In our fast forward world, product life cycle can be shorter than accounting cycles. Accounting data is great for autopsies but lousy for direction. The important question in today's opportunity driven economy is management's ability to anticipate and proactively respond to incipient opportunities. What is needed is over-the-horizon radar (Hamel & Prahad, 1996: 239).

In the emerging world of networked, global organisations, it is inevitable that more and more of the resources critical to the success to the firm will lie outside the direct control of the firm's managers.

The hierarchy is giving way to the network. De-integration brings greater dependence on suppliers. The scale of R&D investments demands risk sharing with alliance partners. New opportunities transcend business unit boundaries. Geographic specialisation leaves national subsidiaries dependent on far distant affiliates for critical resources. As the boundaries of the firm become more imprecise, so do the boundaries of managerial control. This raises the following questions: How can managers control resources when those resources lie outside their firm or business unit? How can a manager be asked to take responsibility for that which he or she does not control? (Hamel & Prahad, 1996: 239).

In the new economy, with less authority and less control, managers have to influence the behaviour of other employees. Employees will think for themselves and manage themselves, guided by their managers. This arrangement will have implications for the loyalty of employees.

3.3.3 Fewer loyalty and affiliation boundaries

The moral contract between companies and employees has changed. It was once the case that unless you were caught with your hand in the till, or publicly slandered your boss, you could count on a job for life in many large companies. Loyalty was valued more than capability. However, in the new economy, managers have gleefully abrogated the social contract between the firm and its employees. Jobs for life do not exist anymore. In stead of being the most important resource many employees feel like they are the company's most expendable resource. Commitment is not reciprocal. In a world of downsizing, rightsizing, and re-engineering, companies do not offer lifetime employment. This has resulted in reduced loyalty and affiliation from employees (Hamel & Prahad, 1996: 239).

Employees become valuable to a company by becoming specialised in the company's businesses and activities. The more specific the employee's knowledge and skills are to a company's unique set of customers, technologies, equipment, and so on, the more productive they become and the more efficient the company becomes in all that it does. On the one side without employment security, employees hesitate to invest their time and energy in acquiring such specialised knowledge and skills that may be very useful to the company, but may have limited value outside of it. This limits their employability and mobility in the market. On the other side without any assurance of a long-term association, companies lack the incentive to commit resources to help employees develop such company-specific expertise (Ghoshal, Bartlett & Moran, 2000: 130).

To resolve this tension the new management philosophy needs to be grounded in a very different moral contract with people. In this contract, each employee takes responsibility for best-in-class performance of the part of the company to which he or she belongs, and commits to a continuous process of learning that is necessary to support such performance. In exchange, the company undertakes to ensure, not the dependence of employment security, but the freedom of each individual's employability. Companies do this by providing all employees with the opportunity for continuous skills

updating to protect and enhance both their job flexibility within the company and their opportunities outside. At the same time they create an exciting and invigorating work environment that not only enables employees to use their skills to enhance the company's competitive performance but also motivates them to stay with the company even though they had the option to leave (Ghoshal, Bartlett & Moran, 2000: 131 – 133).

In the new moral contract each individual, according to Ulrich (2000: 246) bears primary responsibility for what a career looks like and how the individual wants to interact with the organisation. This means clearly understanding the skills you bring to the organisation, how you want those skills to be used and how you want to be treated by the organisation. In the new moral contract each employer is in business with herself. Nobody owes her a career – she owns it as a sole proprietor. And the key to survival is to learn to add more value every day (Ghoshal, Bartlett & Moran, 2000: 135). Leaders, therefore, have to do two things: lead a strategy that will ensure the company's competitiveness, while at the same time offer employment that will both realise this goal and contribute towards the long term personal growth for the employee. Employees will stay as long as they are convinced that their personal careers and employability are enhanced by their contract with a specific company.

In the new economy, flexible employment practices result in loyalty shifting towards the individual. Individuals are taking responsibility for their own careers and further that with a variety of experiences.

3.3.4 Fewer experience boundaries

Experience does not always bring authority. In an increasingly limited number of instances experience does bring authority. A young mountain climber has much to learn from a veteran who has led an expedition up and down Everest. The assumption has been that the same is true in companies. Of course, experience is of value, but only to the extent that the future is more or less like the past. In other instances experience does not bring authority. In industry after industry the terrain is changing so fast as to make experience irrelevant, or dangerous. The people at the top may know more, but it is about the past. They may miss the future because experience blinds them to new opportunities. In a world of discontinuous change, authority should be as much a function of foresight as of hindsight.

Changing industry boundaries and convergence of technologies, for example, challenge the value of industry experience and seniority. Computers and consumer electronics are being integrated as computers become life-style appliances. Cosmetics and pharmaceuticals are being wed into cosme-ceuticals. Retailing, banking, and publishing are all available online. In such an environment, what is the value of experience gained solely within one industry context? What is needed is the capacity to think across industry boundaries: to spot opportunities at the juncture of two or more industries; or to draw relevant analogies from seemingly unrelated industries. Traditional banking experience is of little value when confronted with the Internet and virtual reality. Managers have to recognise that their

accumulated experience will be devalued and the retention of value for their knowledge is incumbent on their recognising the importance of intellectual diversity. (Prahalad, 2000: 148).

In the new economy, managers will have to unlearn irrelevant experience and continuously learn about new developments, such as technological advances. These advances have allowed companies to overcome geographical boundaries.

3.3.5 Fewer national boundaries

Multinational companies were traditionally built around countries. The basic organisational unit was the national subsidiary. Typically the home market was assumed to be the lead market. Not surprisingly, most managers operated in a largely national context. An American manager on a two-year assignment in Paris was still an American. And the company, wherever it operated in the world, was still an American company. However, companies in the new economy operate in globally integrated economies and markets. Nike, Sega, Acer, MTV and many others are defining what global really means: they are welding together a generation of global customers. They are linking capabilities across the globe to produce unique products and services. There is no single lead market anymore (Hamel & Prahad, 1996: 240).

Fewer national boundaries affect many organisations and have profound implications for the nature of work. In order to work effectively in an international setting, companies are increasingly turning to trans-national teams: teams working in a distributed environment across the globe (Li & Barlow, 2000: 2). Virtual project teams meet via information technology, for example product development teams find themselves increasingly in different countries of the world. One of the advantages is that the best talent of the world can be brought together to work on a project. Management of such a virtual project team is an emerging management skill (Bruce & Cooper, 2000: 6).

Business strategy in key industries has changed from a country-by-country approach to global lines of business in which the same product is sold in every part of the world at the same time, manufactured in fewer places that supply the world, and supported by global procurement. Consider Gillette's shift to world products. Starting with the Sensor razor in 1990, Gillette created a global product with a global launch (Kantor, 2000: 252). This required global distribution. Another example is Disney cartoon characters with toys available everywhere even before films are released. This sets in motion a global cascade: global purchasing by these companies, which pressurises suppliers to globalise or join global networks. Managing global logistics becomes a critical source of competitive differentiation. Fewer national boundaries are also found in the geographical distribution of the total design to delivery task. For example, in the laptop business it is quite common to have the design work done in the USA, components sourced from Japan, South Korea and the United States, and assembled in Taiwan,

China or Malaysia and introduced in global markets. All suppliers and participants in the total chain may be independent legal entities (Prahalad, 2000:145).

In the new economy geographical boundaries will not matter. The global manager is becoming a global player in a global market. This requires a shift from focusing on the physical boundaries to focusing on the intellect.

3.3.6 Fewer boundaries between the physical and the intellect

The machine age was a physical world, while the new economy is an intellectual world. The machine age consisted of things. Companies made and distributed things (physical products). Management allocated things (capital budgets); management measured things (the balance sheet); management invested in things (plant and equipment). In the machine age, people were ancillary, things were central. However, in the new economy, things are ancillary, knowledge is central. For more and more companies the ratio of market value to book value is a multiple of 3, 5, 10 or more. A company's value derives not from things, but from knowledge, know-how, intellectual assets, and competencies – all of these embodied in people (Hamel & Prahad, 1996: 241). One example of this is Microsoft, whose ideas are worth more than its assets.

Today's intellectual assets should be managed differently. Centuries ago, manufacturers and nations maintained commercial supremacy by keeping material and processes secret. Today, real trade secrets are a rarity. There are a few well-known examples, like the formula for Coca-Cola. For the most part though, it is virtually impossible to prevent competitors from copying and even improving new products and production methods fairly quickly in an era characterised by mobility, the free flow of ideas, reverse engineering, and widely available technology (Davenport & Prusak, 1998: 15).

Ideas and dreams will become differentiators between companies. This will require leaders that can expand the intellectual capability of a company. The 21st-century leader is a dream-searching leader (Chowdry, 2000:1). The constant search for new dreams and taking effective action to make them real is at the heart of dream-searching leadership. Kotler (1990) argues that in the latter half of the twentieth century many companies were over-managed and under-led.

In the new economy, intellectual capital will become more important than a company's physical assets. Dream-searching leadership will be necessary to set direction, inspire and motivate people. Such leadership will require managers to look to the future.

3.3.7 Fewer boundaries between the present and the future

Few managers are visionaries. The synonyms for management are administration, supervision and governance. Managers live in the here and now. The long term is someone else's problem. However, in the new economy, the future, and imagining it, will matter. Why was it that CNN and not the BBC envisioned a world of global television news? The problem is not one of prediction, it is one of imagination. There is not one future; there are as many potential futures as companies. But one company that cannot imagine the future is unlikely to be around to enjoy it. Living in the here-and-now, caught inside industry conventions, many managers fail miserably at the task of imagining the future (Hamel & Prahad, 1996: 242).

The present and the future do not abut one another. They are not neatly divided between the five-year plan and the great unknown beyond. The present and the future are intertwined. Every company is in the process of becoming – of becoming something anachronistic and irrelevant to the future, or of becoming the harbinger of the future. The goal must be to shape the future, rather than to be its victim (Hamel & Prahad, 1996: 242). Tomorrow's managers will create roles and structures that will ensure their people are always looking around for new opportunities. These roles will include:

Converters: those taking today's technology and converting it to tomorrow's needs.

Scanners: people charged with finding new niches and customers.

Expediteurs: those who can help others to bypass red tape and bureaucratic regulations.

Browsers: employees who scan related industries, technologies and professions for ideas their organisations can use.

Linkers: those who persuade individuals and related companies to join short-term partnerships.

Talent scouts: those who look for people with potential to become leaders (Farren, 2000: 104 – 105).

In the new economy, managers need to realise the future. They must be driven by what the future should be like and how they can realise that today. The result of the above seven trends, fewer authority boundaries, fewer control boundaries, fewer loyalty and affiliation boundaries, fewer experience boundaries, fewer national boundaries, fewer boundaries between the physical and the intellect, and fewer boundaries between the present and the future, is that the structure of organisations will become more loose.

3.3.8 The result: Outsourcing and network organisations

In organisations with fewer boundaries, there seems to be a progression towards the externalisation of relations and towards diversified activities, performance-based control and open-market mode of regulation. One of the prominent occurrences is that of strategic outsourcing. This section explains outsourcing, addresses the introduction and growth of the network organisation, the cellular organisational structure as a way of managing an increasing number of network organisations, how the new

structure differs from previous organisational structures, the involvement of employees, as well as a brief description of the virtual organisation.

Outsourcing is becoming increasingly popular and can take on many forms. According to Storey (2002: 350), outsourcing occurs when a company subcontracts to a supplier, work that is normally performed in-house. In practice, there are many different types of outsourcing. Sometimes it is piecemeal and opportunistic with little strategic character, for example, office cleaning. Other outsourcing decisions might arise from a close analysis of the value chain. For example Marks and Spencer, like Woolworths in South Africa, derives its competitive advantage from a reliable level of quality, which is in turn supported by links between the company and suppliers.

There are many reasons for the growth of outsourcing. It is a speedy way of gaining access to specialist services or it can reduce costs by using low-cost producers. With the advantages in communication technologies, companies headquartered in high-wage cosmopolitan areas can outsource such tasks as routine billing to remote stations almost anywhere in the world (Storey, 2002: 351). One striking example of the growth of outsourcing is the fact that by the mid-1990s the labour agency Manpower had displaced General Motors as the largest employer in the US. In a more recent study of businesses and government agencies in the US, 44 per cent of the executives surveyed said that they were outsourcing more than they had five years ago and 47 per cent said that they expected to increase the amount of work they would outsource in the future (Storey, 2002: 350). According to research done by Gartner, the global outsourcing market increased by 10.5 per cent to \$122 billion in 2003 (Sukazi, 2003: 6).

Outsourcing requires new management techniques. Organisational hierarchies are much flatter and the priority for managers shifts from handling physical and capital assets to handling processes and staff who are not direct employees of the company. The negotiation of contracts with providers extends into issues of confidentiality and risk sharing. Managers share their objectives with suppliers in terms of costs and performances and the suppliers share their ideas of new products with the managers (Planting, 2004: 3). A new structure is needed to co-ordinate the multiplication of external relationships. Companies are seeking new configurations of organisational structure. They are dissolving internal boundaries and procedures while reaching out to engage suppliers, associates and even competitors in new forms of relationships, such as joint ventures, strategic alliances, partnerships, spin-offs and networks. The model that evolved was the network organisation. Information and communication technologies enable managers to transcend organisational boundaries and allow work to be done in new ways on a distributed basis. A network organisation is an economic entity that operates through a cluster of compact business units and is characterised by relatively few levels of decision-making and a willingness to outsource whatever can be done better elsewhere (Storey, 2002: 353).

The network organisation was introduced to cope with increased external relations, as well as helping firms use and extend their capabilities. The key contribution of the network form was not just its ability to respond rapidly to market demands for differentiated products and services, but to do so efficiently. In their search for flexibility and responsiveness, most traditional companies began by downsizing and then refocusing on those areas where their assets and know-how added the greatest economic value. Companies began to outsource non-core operations to partner firms. As a result numerous potential partners around the world began to occupy points along industry value chains, offering increased overall flexibility and therefore more opportunities for customisation. In many networks in the 1990s, it became difficult to determine where one organisation ended and another began, as cross-firm teams resolved interface issues, representatives of important customers were invited to participate in Product Design processes and suppliers were given access to large firms' scheduling and accounting records through electronic data interchange systems (Miles *et al.*, 2002: 282).

Firms in a network of organisations can best be described as cellular. Cells in living organisms can act alone or, by acting in concert, cells can perform more complex functions. Evolving characteristics, or learning, can create a higher-order organism. Similarly, a cellular organisation is made up of cells, such as autonomous business units, that can operate alone but that can interact with other cells to produce a more competent business mechanism. Strategies and information are shared with other participants in the network (Storey, 2002: 353). It is this combination of independence and interdependence that allows the cellular organisational form to generate and share the know-how that produces continuous innovation. It is a very fluid, very amoeba-like structure, where cells divide and come together, again and again (Greco, 1998: 36).

A good example of a cellular approach to organising is Technical and Computer Graphics (TCG), a privately held information technology company in Sydney, Australia. According to Miles *et al.* (2002: 287) TCG developed a wide variety of products and services, including portable and data hand-held terminals and loggers, computer graphic systems, bar-coding systems, electronic data interchange systems and other IT products and services. The 13 individual small firms at TCG each had its own purpose and ability to function independently, but it shared common features and purpose with all of its sister firms. Some TCG member firms specialised in one or more product categories, while others specialised in hardware or software. At TCG, the various firms have come into the group with existing high levels of technical and business competence. The three principles of cellularity were tightly interconnected: Acceptance of entrepreneurial responsibility, self-organisation and responsibility for the individual firm's profit (Miles *et al.*, 2002: 287).

Organisational networking focuses on four aspects, according to Kok (2002: 146):

- (a) internally driven – networking within the enterprise
- (b) externally driven – networking between enterprises
- (c) technologically driven – connecting computers
- (d) people driven – connecting people

The main difference between these networked structures and the traditional hierarchical structures can be portrayed by the two columns in Table 3.2.

Organisations in the network can easily become virtual organisations. Free flow across organisational boundaries can cause a situation in which the organisation per se becomes indefinable. Such an organisation has a continuously changing interface between its core, its suppliers and its customers. In traditional organisations clear demarcation lines separated insiders from outsiders. Roles were relatively clear. The virtual organisation, on the other hand, constantly

reforms according to need. Job responsibilities shift, as do lines of authority – even the notion of the employee becomes problematic as some suppliers and customers spend more time on company premises than do some of the firm's permanently contracted employees (Storey, 2002: 353).

Influencing behaviour of organisations in the network is of critical importance. In the global marketplace, sourcing of components and sub-assemblies from specialist manufacturers, joint venture partners and other collaborators suggests that managers ought to learn to influence behaviour without ownership. Learning to share a common competitive agenda, sharing information once considered confidential, allowing investments to be made in good faith, and reducing total costs through system-wide efficiencies require a commitment to build a powerful information infrastructure. Information must become a corporate resource and not remain a source of private power (Prahalad, 2000: 148).

In the new economy, outsourcing and network organisations are the response to boundaryless organisations. The focus is shifting to one dimensional businesses that can act on its own, but also in unison with others. This has given rise to many small businesses making use of the opportunities.

Old structures (hierarchical)	New structures (networked)
Imposed control	Self-managed
Appointed leaders	Natural leaders
Command and control	Consultation
Formal job descriptions	Loosely defined jobs
Vertical communications	Lateral interaction
Centralised	Distributed
Compartmentalised	Boundary spanning
Independence	Interdependence
Inward looking	Outward looking
Passion for order	Tolerance of ambiguity
Conformity	Valuing differences
Power of personal knowledge	Power of shared knowledge

3.3.9 *The role of small businesses*

Another trend associated with the dispersion of business activity in network organisations, is the resultant growth of small businesses and self-employment. Skyrme (2000:9) confirms that the growth in small businesses is due to the fact that many of the large companies in the West downsized in the early 1990s. As organisations focus on their core activities, opportunities abound for small business to pick up on these non-core activities.

As they often do, small businesses will display a flair for entrepreneurship. Complete cellular firms will achieve a level of know-how well beyond that of earlier organisational forms by combining entrepreneurship, self-organisation and member ownership in mutually reinforcing ways (Miles *et al.*, 2002: 286). The customers of a particular cell can be outside clients or other cells in the organisation. Each cell must therefore have the entrepreneurial skills required to generate business for itself and the overall organisation. In return being part of a network is also vital for the entrepreneurial firm's development (Lechner & Dowling, 2003: 10). In this situation self-employment is also a strong driver of the growth of small businesses. A significant trend is the rapid growth of self-employment by professionals. Many draw on their previous experience in large companies to create innovative opportunities, often global in nature. In turn, many large organisations contract with these individuals for specialist services. Another trend, associated with being part of a network, is that of co-opetition, i.e. when a small business co-operates with a competitor. This happens at peak times (it is better to sub-contract to a competitor than to lose a client) and when expertise are needed that is not present in the specific business (Luo, Slotegraaf, & Pan. 2006: 67 – 80).

The important economic role of small businesses has gradually been recognised since the 1960s. The value of small businesses to the growth of the economy is demonstrated in both the developed and developing economies in the world. In the USA, for instance, approximately 22.1 million out of the 22.4 million businesses (98.5 per cent) can be considered small. Small businesses thrive in virtually every industry (Scarborough & Zimmerer, 1997: 24).

Smaller enterprises have created most of the new jobs per unit of invested capital. According to Scarborough and Zimmerer (1997: 24), small companies employed 53 per cent of America's private workforce and in the mid 1990s, small companies created 75 per cent of America's new jobs. Eksteen (1997: 2-4) claimed that the smaller-scale sector initiated much of the innovation and invention leading to the creation of industries for future growth. Timmons (1999: 10) mentioned a list of small companies' innovations that led to major industries. Some of the names on the list are: airplane, cotton picker, heat sensor, Polaroid camera, quick frozen foods, six axis robot arm, aerosol can, artificial skin, helicopter, hydraulic brake, soft contact lens, air conditioning, assembly line, bakelite, continuous casting, heart valve, safety razor and sonar fish monitoring.

Just how important small businesses are was shown by the fact that they produce 52 per cent of America's gross national product (GDP) and accounted for 47 per cent of all business sales in 1997. The most important is the fact that research has concluded that small firms created four times as many innovations for each research and development (R&D) US dollar as medium-sized firms did and 24 times as many as large companies (Scarborough & Zimmerer, 1997: 25). The European Commission estimated that companies with fewer than 500 employees account for 70 per cent of economic activity and employment within the European Union. In the USA, between 1980 and 1990. At the same time that 3 million jobs were shed by the Fortune 500 companies, smaller companies created over 19 million new jobs. The Organisation for Economic Co-operation and Development (OECD) said that small businesses represent the largest potential for economic growth (Skyrme, 2000: 9).

In South Africa, also, small businesses play an important role in the economy. According to Maas (interviewed by Matthee, 2003: 15), small businesses in South Africa were responsible for about one-third of the 11.4 million job opportunities. Between January 1999 and July 2002 new businesses created 1 million employment opportunities. Other estimates (Karangu, Marabwa & Stettler, 2000: 13) suggested that eight out of every ten new jobs created in South Africa are in the Small, Micro and Medium enterprises (SMMEs). A particular concern was that five or six of these new jobs created were again lost within a year and often go unmentioned when government or the press punts the importance of SMMEs.

The precise contribution the sector makes, is difficult to assess, and the statistics are unlikely to be very accurate by virtue of the characteristics of especially micro and very small enterprises. However, the figures published by Ntsika provide a very useful snapshot of the sector. Table 3.3 makes it clear that of the 906 690 enterprises in existence in South Africa, only 6 017 are considered large, and hence that about 900 000 enterprises fall into the SMME category. About 57 per cent

Table 3.3 Kind of enterprises and employment in South Africa (Karangu, Marabwa & Stettler, 2000: 14).

Firm type	Number of firms	%	Number of employees	%
Survivalist	184 000	20	184 400	3
Micro-enterprise	466 100	51	848 549	11
Very small	180 000	20	1 068 431	14
Small	58 851	7	1 225 972	17
Medium	11 322	1	909 880	12
Large	6 017	1	3 159 931	43
Total	906 690	100	7 397 163	100

(over 4.2.mil) of South Africa's employed people work in enterprises that are classified as SMME. These figures underline the importance of the sector in terms of economic growth and development.

Table 3.3 also shows the breakdown into the different categories of SMMEs. In survivalist enterprises, the income generated is less than the poverty line. The expression is somewhat controversial, and instead here it will be included in the micro-enterprise category, which refers to those enterprises

where the turnover is below the VAT registration limit and which are unlikely to employ more than five paid employees. Very small enterprises are defined as those which employ between five and ten employees (20 in some sectors). Firms that have up to 50 employees are categorised as small enterprises and those employing up to 100 (or 200 in the mining, electricity, manufacturing, and construction sector) are included in the medium enterprise category. The full definitions and all the criteria are according to the National Small Business Act (Karangu, Marabwa & Stettler, 2000: 14).

In the new economy, boundaryless organisations give rise to network organisations. The result is a proliferation of small businesses. Managing the information flow in the network, between the organisations, as well as inside each company, has become important. This has led to the phenomenon known as Knowledge Management.

3.4 Knowledge Management

Knowledge Management has risen to prominence in most organisations mainly as a result of the nature of the new economy and the loss of expertise. The effect of the renewed interest in Knowledge Management is that value is shifting from the old product-driven economy to the new knowledge-intensive economy. This, in brief, is the rationale and background of Knowledge Management provided in this section. Before a description of Knowledge Management can be discussed, it is essential to understand the term knowledge, how it is explained by referring to the hierarchy of data, information, knowledge and wisdom, the difference between know-how and know-what, how knowledge is divided into explicit and tacit knowledge, and the role of Information Technology. Finally a description of Knowledge Management will be provided and an indication why knowledge is an important source of strategic competitive advantage. Firms that utilise their knowledge do so by managing their intellectual capital. This approach to management has led to a knowledge-based view of the firm.

3.4.1 Rationale and background to Knowledge Management

This section provides a brief background of the importance of knowledge. It indicates why Knowledge Management, which is nothing new, has suddenly risen to prominence in many organisations. This section also indicates that value is increasingly being generated from intangible assets.

One of the biggest events triggering the rise of Knowledge Management is the approach by Peter Drucker (1993) that organisations will in future be more competitive as a result of their knowledge, rather than as a result of their physical assets. Nonaka and Takeuchi (1995: 7) agree that the economic and producing power of a modern corporation lies more in its intellectual and service capabilities than in its hard assets, such as land, plant or equipment. The value of most products and services depends primarily on how knowledge-based intangibles – like technology, know-how, Product

Design, marketing presentation, understanding of the customer, personal creativity, and innovation – can be developed. According to the management philosopher Charles Handy, the ability to apply knowledge and know-how is the new source of wealth (Farren, 2000: 105). In future, he believes people's ultimate security will lie not in land and buildings but in their brains.

Interest in knowledge is not new. Greek philosophers, such as Plato and Socrates set out key principles that have stood the test of time. Often quoted in business circles today is Francis Bacon's observation made at the end of the sixteenth century: *Knowledge is power* (Skyrme, 2000: 44). The economist Alfred Marshall mentioned as early as 1890 that capital consists in a great part of knowledge and organisation, and stated that knowledge is a company's most powerful engine of production. The realisation that the management of knowledge is a core process within organisations has only recently become widespread. From the mid-1990s there has been a rapid growth of interest across the world in Knowledge Management and how it might be managed within and between organisations (Quintas, 2002: 1).

The first international conference, *Knowledge: The Strategic Imperative*, was held in Houston in 1995 and the first journals on the topic, including *Knowledge Management*, *Knowledge Inc.*, *Knowledge Management Review* and *The Journal of Knowledge Management* appeared in 1997. By 1997 the Knowledge Management bandwagon was rolling. In 1996 – 1997 there were over 30 conferences on Knowledge Management in the USA and Europe, a whole raft of books and other publications and an estimated \$1.5billion in consulting revenue. Talk of the knowledge economy became widespread, with new posts of chief knowledge officers and directors on intellectual capital being created in many firms (Quintas, 2002: 2).

The key question is why did knowledge come to the top of the management agenda in the 1990s? No single factor is responsible for the surge of interest in Knowledge Management. What appears to have occurred is that a number of factors have come together to place Knowledge Management high on the agenda of organisations. One driving force is a new globalising economy (Davenport & Prusak, 1998: ix; Little, 2002: 370). Information systems led the way in making products and services available over electronic networks. The growth of e-commerce is only the leading edge of a much deeper phenomenon; e-services delivered over the Internet might be even bigger, from remote medical diagnoses to satellite-based systems that can tell a farmer the specific weather conditions or dampness on every part of his fields. The defining feature of the global information economy is not the flow of goods – but the flow of information (Kantor, 2000: 251).

While technical competency is one of the big enablers of the information-based economy, it is ironic that the technological limitation of the information systems was one of the big driving forces behind the prominence of knowledge-based organisations. According to Quintas (2002: 7), there is a strong tendency for the information technology focus to dominate in the subject of Knowledge Management but by definition, information technology is concerned with information and not knowledge per se.

There has been an increasing awareness that information systems do not capture the knowledge that managers use in their daily lives. Although technology has a number of potentials as a medium of knowledge communication, such as reducing time and distance constraints and access to knowledge depositories on a global basis through the World Wide Web; the knowledge skills of sense-making and learning is still needed if the WWW is to contribute to our knowledge resources and processes (Quintas, 2002: 7-8).

Another key factor in the growth of interest in Knowledge Management in the 1990s was the rediscovery that employees have skills and knowledge that are not available to (or captured by) the organisation. It is perhaps no coincidence that this rediscovery of the central importance of people as the possessors of knowledge vital to the organisation, followed an intense period of corporate downsizing, outsourcing and staff redundancies in the West in the 1980s. Organisations that downsized and introduced early retirement packages for older workers in the 1980s found that they had lost much of their organisational memory or intellectual capital. Rather than innovating, firms found themselves reinventing the wheel and repeating the mistakes of the past. In many cases people who had been made redundant had to be re-hired, often as consultants, because their knowledge was found to be irreplaceable (Little et al., 2002: 299; Quintas, 2002: 5; Economist, 2006: 9 – 12). Some expendable middle managers proved by their absence to have been key knowledge co-ordinators and synthesizers. A specific example of this corporate amnesia can be found at Ford, where new car developers wanted to replicate the success of the original Taurus design team. But no one remembered, or had recorded, what was so special about that effort (Davenport & Prusak, 1998: ix).

Perhaps the example that created the greatest impact in the early 1990s, indicating how wealth is generated from knowledge and intangible assets, was the example of Microsoft. Microsoft, with fewer than 14 000 employees, was valued by the stock market (in terms of market capitalisation) as worth more than IBM, which employed more than 300 000. The key to Microsoft's profitability and success lies in the fact that it owned an intangible asset, MS DOS (and Windows), which has become the *de facto* standard for personal computer operating systems software. The market value of companies that own key intangible assets such as intellectual property rights, a standard or a brand may exceed the value of their conventional assets many times over. In 1996 about 94 per cent of Microsoft's market value came from intangible assets, as did 85 per cent of Intel's and 96 per cent of Coca-Cola's market value (Quintas, 2002: 4). One of the features of the new economy is that knowledge has become the major raw material on the input side of companies (Bateman & Snell, 2002: 159)

The management of knowledge is nothing new, yet it has risen to prominence in organisations for a number of reasons. The two most important are the nature of the new economy and the loss of expertise. As a result companies realised how valuable the knowledge input is. Within the management field, academic interest is converging on knowledge from a number of different perspectives including information management, organisational learning, strategic management, change management, human resource management, management of innovation and measurement and management

of intangible assets. Although this study takes an interdisciplinary approach, it focuses more on the management of innovation as is embodied in Product Design . The next question to address is what exactly is being understood by the different terminologies.

3.4.2 Describing knowledge

This section concerns itself with a description of Knowledge Management, but first the term knowledge must be made clear.

The *Shorter Oxford English Dictionary (SOED)* (1993: 1503) provides several definitions of knowledge. Those relevant to this study are as follows:

- (5) *The fact of knowing a thing, state, person, etc.; acquaintance; familiarity gained by experience.*
- (8) *Acquaintance with a fact or facts; a state of being aware or informed; awareness, consciousness.*
- (9) *Intellectual perception of fact or truth; clear and certain understanding or awareness, especially as opposed to opinion.*
- (10) *Understanding of a branch of learning. A language, etc.; (a) theoretical or practical of an art, science, industry, etc.*
- (11) *The fact or condition of being instructed, or of having information acquired by study or research. Also, a person's range of information; learning, erudition.*

The *Webster's New World College Dictionary* (4th ed) (Merriam-Webster, 1993: 793) adds

- (3) *all that has been perceived or grasped by the mind; learning, enlightenment.*
- (4) *The body of facts, principles, etc., accumulated by mankind.*

The theory of knowledge creation and utilisation builds on the traditional definition of knowledge as justified true belief or skills (Reinmoller & Chong, 2002: 166) and has its origin in Western philosophers who have generally agreed the concept was first introduced by Plato in his *Meno, Phaedo, and Teaedetus* (Nonaka & Takeuchi, 1995: 21). The Greeks used the word *sophia* to refer to wisdom. For the Greeks *sophia* involved what Socrates referred to in Plato's *Phaedo* as *the explanation of everything, why it comes to be, why it perishes, why it is* (Friedman, 2000b: 12).

The adjective *sophia*, used frequently from Pindar onwards, and the noun *sophia*, found from Homer onwards, always denote in Greek an attribute, never an activity. They indicate unusual ability and knowledge, earlier in the practical sphere as well, for example the *sophia* of a carpenter (Homer II., 15, 41ff), but later concentrated on theoretical knowledge. The members of the College of the Seven Sages were renowned for their world wisdom and political discernment (Plato, *Prt.* 343a); whereas the *sophia* of a later time (the Sophists) was regarded as knowledge which could both be taught and

acquired. For Aristotle, *sophia* and *philosophia* (love of knowledge) were identical. With the Stoics, theory and practice coincide: wisdom is realised knowledge. The conduct of the wise man is *sophia* (Brown 1978, vol 3: 1026). Friedman describes this form as speculative knowledge (2000b: 12).

Today, knowledge is that which is believed and valued, based on the meaningfully organised accumulation of information through experience, communication or inference. Knowledge can be viewed both as a thing to be manipulated and as a process of simultaneously knowing and acting – that is applying expertise. As a practical matter, organisations need to manage knowledge both as object and process (Zack, 1999). According to Davenport and Prusak (1998: 5), knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates from and is applied in the minds of knowers. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, practices, and norms.

The most appropriate definition of knowledge in relation to an organisation is the contribution of Davenport (2006: 73). Knowledge is defined as the value-added information comprising what an organisation knows or could know, including the skills and experiences of employees, documents in its libraries and filing cabinets, relationships with other firms and individuals that could yield knowledge and, sometimes, materials in computer databases. This study will define knowledge as the skills and practices used in different disciplines to create winning strategies based on knowledge. In order to unpack this concept, it is necessary to explain the various concepts in more detail.

3.4.3 Describing data, information, knowledge, and wisdom

The terms information and certain types of knowledge are often used interchangeably. There are, however, according to Skyrme and Amidon (1997:28), a difference between data, information, and knowledge. A hierarchy can be described where wisdom is located at the top and in descending order there are understanding, knowledge, information, and at the bottom, data. See Table 3.4. Each of these includes the categories below it – for example, there can be no wisdom without understanding and no understanding without knowledge. Other authors have also explained the difference between data, information, knowledge, and wisdom. In Table 3.5 the contribution of a later description by Skyrme (2000:47) is compared with that of Bellinger (2006:10).

Table 3.4 A hierarchy from data to wisdom (Skyrme & Amidon, 1997:28).

Wisdom
Understanding
Knowledge
Information
Data

Table 3.5 Descriptions of data, information, knowledge, wisdom by Skyrme (2000: 47) and Bellinger (2006: 10).	
Skyrme	Bellinger
<p>Data: Facts and figures: 03772 41565 83385 10157</p>	<p>Data is represented as an item or event out of context with no relation to other things. If one considers 5 per cent, it is just a piece of data out of context.</p>
<p>Information: Data with context: (from above data): Heathrow weather station; visibility 15 km, sky completely cloudy; wind direction north-west, speed 85 kts; temperature 15.7°C.</p>	<p>Information is represented by relationships between data, and possible other information. The relationship may represent information, yet the relations do not actually constitute information until they are understood. Also, the relationships which represent data have a tendency to be limited in context, mostly about the past or present, with little if any implication for the future.</p> <p>If one understands that the 5 per cent is an interest rate, and 100 per cent is principal, and that they interact in a multiplicative fashion to create interest, one has relationships between data, which represent information.</p>
<p>Knowledge: Information with meaning: My experience indicates that this weather will cause severe flight delays.</p>	<p>Knowledge is represented by patterns between data, information and possible other knowledge. These patterns may represent knowledge, yet the patterns do not actually constitute knowledge until they are understood. Also, the patterns that are present have a high level of predictability associated with them, such that the pattern suggests its past, its present and its future.</p> <p>When one understands the pattern of interest rates, predictions for the future can be made.</p>
<p>Wisdom: Knowledge with insight: Book a train through the Channel Tunnel before all the other passengers find out about this more reliable alternative.</p>	<p>Wisdom constitutes the patterns which represent knowledge. They are what they are because of foundational principles. When one understands these foundational principles one then understands why knowledge is what it is.</p> <p>Based on the above calculations investment decision can be made.</p>

Skyrme and Amidon (1997: 29) are convinced that there are some fundamental differences between information and knowledge. In other words, the data-information-knowledge-wisdom spectrum has a definite discontinuity between information and knowledge. Table 3.6 portrays the distinction between information and knowledge as described by Rogers and Skyrme (1992) in another publication.

The knowledge-based view explicitly recognises that information and knowledge are distinctly different phenomena. Information can be understood to consist of facts and data pertaining to natural or social states of affairs, natural or social events and the consequences of such events under given circumstances or states of affairs. The total stock of information available, or potentially available, to organisations is vast, but it is also theoretically finite. At any given point in time there are a finite

number of natural or social states of affairs in the world. The events that may occur as a result may be numerous and may not all be anticipated by an organisation. They are nevertheless finite in number. In contrast, knowledge is potentially limitless. Information can be input in the decision making process, and it can be interpreted, but it also depends upon knowledge for that interpretation. Information is seen to be important and relevant in the light of knowledge which may be added to, amended or changed in the light of new information (Carlisle, 2002: 124 – 125).

Table 3.6 Distinction between information and knowledge (Rogers & Skyrme, 1992)

(i) Information	Knowledge
Tangible	Intangible – human process
Processing changes representation	Processing changes consciousness
Physical objects	Mental objects
Context independent	Context affects meaning
Easily transferable	Transfer requires learning
Reproducible	Not identically reproducible

Another difference between information and knowledge is validation. Validation is testing and evaluation of knowledge claims. Validation is not the same as justification. Justification is a process of proving that a knowledge claim is true. Validation never proves anything with certainty. It simply provides a record of how well competing knowledge claims stand up to tests, or personal experience of how well competing beliefs stand up to tests. Justification of knowledge claims and beliefs is impossible, but validation of them is not (Firestone, 2003: 115).

An important characteristic of both information and knowledge is that unlike other resources, it is not depleted when used. In fact, it grows when shared. An asset is usually being divided when shared, but knowledge is one of the few assets that multiplies when shared (Harrigan & Dalmia, 1991). This difference is often explained by comparing them with some food and a book. If someone has food and gives it to someone else, she has less. However, if someone has a book and lends it to someone else, she has not lost the knowledge contained in the book. On the contrary, if they later discuss the contents, the knowledge of both is enriched. This means that the economies of scarcity do not apply to knowledge. The traditional economy operates on the basis of limited resources that deplete when used. In contrast, information and knowledge continue to grow, even more so when used. Take for example an electronic copy of a document sent to someone else. The recipient can annotate it, add notes, return it, and both sender and recipient will have the original information. Furthermore, the annotations and discussions enrich and add to the knowledge of both (Skyrme, 2000: 29).

Data, information, knowledge and wisdom all have different meanings. Some authors put them on a continuum, while others see a definite discontinuity between information and knowledge. Both are, however, similar in that they, in contrast to the traditional sources, multiply with use.

3.4.4 Describing explicit and tacit knowledge

Most views of knowledge are in the form of mutually exclusive or complementary pairings, for example know-what/know-how, tacit/explicit, tacit/focal, and cognitivist/constructionist. In contrast, knowledge can be viewed as a continuum rather than opposites. The two extremes can be regarded as *tacit* knowledge, which are unconscious knowledge held in people's minds, and *explicit* knowledge, that is knowledge which is codified and structured. Most knowledge exists somewhere between these extremes (Kimble, Li & Barlow, 2000: 2).

Explicit knowledge (also formal knowledge) can sometimes be referred to as knowledge which can be articulated in formal and systematic language and transmitted among individuals. Explicit knowledge can be codified, which makes replication and transfer easier to achieve. It records past events, facts or objects in objective and abstract form that separate it from context. Indeed, one of the reasons for codifying knowledge is to enable it to be more readily communicated to others, but applications of explicit knowledge may still be causally ambiguous. Explicit knowledge can be shared in the form of data, scientific formulae, specifications, manuals and suchlike (Barclay & Murray, 2006: 2; Carlisle, 2002: 130; Nonaka, Toyama & Konno, 2002: 43; Reinmoller & Chong, 2002: 166). Most organisations have captured explicit knowledge in the systems or operating technologies of the firm, thus making it available to all the members of the organisation (Erikson & Parviainen, 2002: 3).

Tacit knowledge (also informal knowledge) is personal knowledge rooted in individual experience and involving personal belief, perspectives and values. Tacit knowledge is highly personal and hard to formalise. It is created 'here' and 'now' in a specific practical context. Tacit knowledge is by definition unarticulated and therefore less amenable to transfer. It is a human resource and manifests itself only in human use. Subjective insights, intuitions and hunches fall into this category of knowledge. Tacit knowledge lies at the core of sustainable competitive advantage (Barclay & Murray, 2006: 2; Carlisle, 2002: 130; Nonaka, Toyama & Konno, 2002: 43; Reinmoller & Chong, 2002: 166). The characteristics of tacit knowledge present some interesting management challenges. Making tacit knowledge explicit means that it can more readily be copied, diffused and shared. On the other hand, this makes it leaky, and it could reach undesirable parties. The increasing rate of knowledge generation means that much existing knowledge has a short half-life and its values decay quite quickly. It needs constant refreshing and revalidating through use (Skyrme, 2000: 49).

Tacit knowledge can also be seen as knowledge which resides in the culture of the organisation and is present in the most processes where new knowledge is created. For instance, certain corporate

cultures cultivate employees towards self-motivated creativity. In such environments, employees are encouraged to develop and use their abilities in a new manner (Eriksson & Parviainen, 2002: 3). Tacit knowledge is often viewed as the real key to getting things done and creating new value. Tacit knowledge therefore often encounters an emphasis on the learning organisation and other approaches that stress internalisation of information and generation of new knowledge through managed interaction (Barclay & Murray, 2006: 2).

The understanding of the concepts of explicit and tacit knowledge makes it easier to understand how knowledge is created. According to Nonaka, Toyama and Konno (2002: 44), an organisation creates knowledge through the interaction between explicit knowledge and tacit knowledge, which they call *knowledge conversion*. Through the conversion process, tacit and explicit knowledge expands in both quality and quantity. There are four modes of knowledge conversion. They are socialisation (from tacit knowledge to tacit knowledge); externalisation (from tacit knowledge to explicit knowledge); combination (from explicit knowledge to explicit knowledge); and internalisation (from explicit knowledge to tacit knowledge). Using its existing knowledge assets, an organisation creates new knowledge through this process. The knowledge created then becomes part of the knowledge assets of the organisation, which become the basis for a new spiral of knowledge creation. The four nodes of knowledge conversion are portrayed in Table 3.7.

Table 3.7 Four nodes of knowledge conversion (Nonaka, Toyama & Konno, 2002: 44).

		Tacit knowledge to explicit knowledge	
		Socialisation	Externalisation
Tacit knowledge from explicit knowledge	Socialisation		
	Externalisation		
		Internalisation	Combination

The difficulty comes, not through handling explicit knowledge, but through tacit knowledge which is harder to express or codify. Very often the most valuable knowledge that an organisation has is in the heads of its people, and those of its stakeholders, especially customers. The reality is that people leave companies, so forward-looking companies continually seek ways of locking the knowledge into their organisation. Two complementary approaches are:

- (a) Converting it to a more explicit form such as in documents, processes, and databases. This is often referred to as decanting the human capital into the structural capital of an organisation (Skyrme, 2002: 68). He calls it the Western tendency since it is the main emphasis of many European and US knowledge programmes.
- (b) Enhancing tacit knowledge flow through better human interaction, so that the knowledge is diffused around the organisation and not held in the heads of a few. In Japan various socialisation activities support this kind of knowledge flow that by its very nature also sparks the generation of new ideas

and knowledge. Add some basic elements of good human resource management, including a stimulating environment, personal development plans, motivation and suitable reward and recognition systems, such as knowledge sharing awards and stock options, then there is less chance of the best knowledge workers wanting to leave the company (Skyrme, 2002: 68).

The distinction between explicit and tacit knowledge contributes to our understanding of knowledge, especially when it helps to explain the creation of knowledge by the conversion process between explicit and tacit knowledge. It has shown some of the complicated processes involved, especially in preserving the knowledge. In order to manage all these processes, Knowledge Management has become a necessity.

3.4.5 Describing Knowledge Management.

Managers have recently realised that they have relied on knowledge for many years. Even before the days of expert systems and strategy focus, good managers valued the experience and know-how of employees – that is, their knowledge. What is new is that recently many firms have come to understand that they require more than a casual (an even unconscious) approach to corporate knowledge if they are to succeed in today's and tomorrow's economies (Davenport & Prusak, 1998: ix). Knowledge needs to be managed. This section indicates why it is necessary to manage knowledge. Various definitions of Knowledge Management are presented, followed by a description of the Knowledge Management process and the need for a Knowledge Management system. In this process and system, knowledge workers have an important role to play, both in big and in small businesses.

Today a number of companies have come to realise that the management of knowledge is crucial to their future success and are taking practical steps to implement good Knowledge Management practice in their organisations (Skyrme & Amidon, 1997:31), but what exactly does Knowledge Management mean? As in any emerging field, many definitions are proposed. The purpose of this section is to raise and address key issues arising from typical attempts to define Knowledge Management. Quintas (2002: 1) is of the opinion that the interdisciplinary nature of this field means that there is only partial agreement on what Knowledge Management consists of and what its agenda may look like. In a study by Earl (2002: 40) most of the Chief Knowledge Officers have little time for conceptualising a definition of a Knowledge management, but they do, however, agree on three points:

- (a) Knowledge is a necessary and sustainable source of competitive advantage. In an era characterised by rapid change and uncertainty, it is claimed that successful companies are those that consistently create new knowledge, disseminate it through the organisation, and embody it in technologies, products and services.

- (b) There is a general recognition that companies are not good at managing knowledge. They under-value the creation and capture of knowledge, they may lose or give away what they possess, they may deter or inhibit knowledge sharing and they may underinvest in both using and re-using the knowledge they have.
- (c) Recognising the potential of knowledge in value creation and the failure to fully exploit it, some corporations have embarked on Knowledge Management programmes. These are explicit attempts to manage knowledge as a resource

Barclay and Murray (2006: 1) define Knowledge Management as a business activity with two primary aspects: (a) treating the knowledge component of business activities as an explicit concern of business reflected in strategy, policy and practice at all levels of the organisation, and (b) making a direct connection between an organisation's intellectual assets – both explicit and tacit – and positive business results. Xerox defines Knowledge Management as the discipline of creating a thriving work and learning environment that fosters the continuous creation, aggregation use and re-use of both organisational and personal knowledge in the pursuit of new business value (Cross, 1998: 11).

Some definitions concentrate on the process involved. Reinmoller and Chong (2002: 165) state very briefly that Knowledge Management focuses on processes such as sharing or absorbing knowledge to increase the return on knowledge. Firestone (2003: 172) defines the Knowledge Management process as an ongoing persistent, purposeful interaction among human-based agents through which the participating agents aim at managing other agents, components, and activities participating in the basic knowledge processes (knowledge production and knowledge integration) into a planned, directed, unified whole, producing, maintaining, enhancing, acquiring and transmitting the enterprise's knowledge base.

Skyrme (2000: 59) proposes a practice-focused definition of Knowledge Management as the *explicit* and *systematic* management of *vital* knowledge and its associated *processes* of creating, gathering, organising, diffusion, use and exploitation, in pursuit of organisational objectives.

- Explicit: unless something is made explicit it frequently does not get properly managed.
- Systematic: creating consistency of methods and the diffusion of good practice. Systematisation also lends itself to automation, leading to additional efficiencies in handling explicit knowledge.
- Vital: every conversation and every new document in an organisation adds to the organisation's knowledge pool. Judgement must be applied as to which knowledge is critical and therefore worth managing in a more formalised way.
- Processes: as well as being an important dimension of management and business processes, knowledge processes are important in their own right.

Definitions of Knowledge Management abound, as is normally the case in a new developing field of study. The best is to try to reduce Knowledge Management to a few bare essentials. Approached in

this way, Skyrme and Amidon (1997: 32) say Knowledge Management involves a systematic approach to nurturing, protecting and exploiting that knowledge which is important to the success of the entire enterprise. Wiig (1994) contends that the central premises behind Knowledge Management is that all the factors that lead to superior performance – organisational creativity, operational effectiveness, and quality of products and services – are improved when better knowledge is made available and used competently. This is also the approach of this study. A final definition has not yet emerged, but what is important is that the use of knowledge increases a company's performance.

In order to improve a company's performance through Knowledge Management, it is necessary to look at how knowledge is used. Evans (2000:88) cites a personal interview he had with Bernard Reynolds, in which the latter said that businesses are in the middle of a data blitz. The next wave will be to trim that down into digestible pieces that are actionable. Distilling lots of data that can be digested readily is the key to communication. Collecting the data, understanding its implications in an economic sense, and then taking action to change what would otherwise be an inevitable outcome, are probably the most important actions companies can take. Roos and Von Krogh (2002: 257) provide an example of how a company in the US set out to improve its strategic management capability by using knowledge. It defines management responsibilities in terms of a smaller number of key functions: to develop new knowledge in the form of new options; to decide on which options are relevant; and to implement these options. The model is designed to be replicated at any level in the organisation. Middle managers use it in their daily activities, as do foremen in the manufacturing plant.

When using knowledge, firms must take decisions that involve a trade-off between the exploration and exploitation of knowledge, according to Ordonez de Pablos (2002: 3). Managers engage in exploration – the pursuit of knowledge, of things that might come to be known. And they engage in exploitation – the use and development of things already known. Both exploration and exploitation are essential for organisations, but they compete for the same scarce resources. As a result, organisations make explicit and implicit choices between the two. Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery and innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, and execution. Maintaining an appropriate balance between exploration and exploitation is a primary factor in survival and prosperity. An organisation that engages exclusively in exploration will normally suffer a lack of return on its knowledge. An organisation that engages exclusively in exploitation will normally suffer from obsolescence. The basic problem confronting an organisation is to find a balance between sufficient exploitation to ensure its current viability and to devote enough energy to exploration to ensure future viability (Ordonez de Pablos, 2002: 3).

In order to manage knowledge, a system is needed. Such a system according to Barclay and Murray (2006: 1) often involves identifying and mapping intellectual assets within the organisation, generating new knowledge for competitive advantage within the organisation, making vast amounts of corporate information accessible, sharing of best practices, and technology that enables all of the above –

including groupware and Intranets A Knowledge Management System is described by Firestone (2006: 13) as the on-going persistent interaction among agents within a system that produce, maintain and enhance the system's knowledge base. In saying that a system produces knowledge they are saying that the system (a) gathers information and (b) compares conceptual formulations describing and evaluating its experience, with its goals, objectives, expectations or past formulations of descriptions or evaluations. This comparison is conducted with reference to validation criteria. Through use of such criteria, intelligent systems distinguish competing descriptions and evaluations in terms of closeness to the truth, closeness to the legitimate and closeness to the beautiful.

According to Firestone (2006: 13) the Knowledge Management Process is an on-going, persistent interaction aimed at integrating all the components and activities of the Knowledge Management System into a planned, directed process producing, *maintaining* and *enhancing* the knowledge base. To maintain its knowledge, a system must ensure both the continued dissemination of its current knowledge base and continued socialisation of agents in the use and content of its knowledge base. A system that enhances its knowledge base is a system that adds new propositions and new models to its knowledge base, and also simplifies and increases the explanatory and predictive power of its older propositions and models. In short, the process of enhancing the knowledge base means to provide for the growth of knowledge.

The managing of knowledge, and the strong emphasis on the process, brings with it the necessity of knowledge workers. Peter Drucker used the term "*knowledge work*" or "*knowledge worker*" for the first time in 1969. At that stage he already referred to the knowledge society, in which the basic economic resource is no longer capital, natural resources, or labour, but knowledge, and where the knowledge worker will play a central role (Drucker, 1993). Since then the number of knowledge workers is increasing steadily. In one sense the organisation in which every member is a knowledge worker already exists: it is the professional-service firm favoured by lawyers, accountants, consultants and so on. Although this is not true of a firm with factory workers, the amount of thinking that is required by an individual worker is definitely increasing (Economist, 2006: 9 – 12).

The urgent need to understand knowledge workers and to create learning organisations is an important preoccupation of the current generation of managers. The challenge is daunting, owing to the lack of clear and useful frameworks for how knowledge is created by individuals engaged in business enterprises (Roos & Von Krogh, 2002: 255). A British head of a global oil company once told his top managers worldwide that what they need to succeed in their company in the future were brains. Brains were needed because new technologies and expanded market possibilities are revolutionising industries. Trying to conduct business while the system itself is being redefined, puts a premium on brains – to imagine possibilities outside of conventional categories, to envisage actions that cross traditional boundaries, to anticipate repercussions and take advantage of inter-dependencies, to make new connections or invent new combinations. Those who lack mental flexibility and imagination will find it harder and harder to hold their own, let alone prosper (Kantor, 2000: 250).

Brainpower is to the global information economy as oil was to the industrial economy. Research proves that soft or intangible assets are becoming the most important sources of a company's value. A Brookings Institution study showed that physical assets (property, plant and equipment) accounted for 62.8 per cent of the total market value of US firms in capital-dependent manufacturing and mining industries in 1982 but had dropped to only 37.9 per cent of the market value of those firms in 1991. For service industries, intangible assets create nearly all of the value. For consumers, the global information economy offers more and faster information, fewer graphic constraints and greater access to world products and services. For businesses, innovation translates to more competition, fewer protected quasi-monopolies, faster product obsolescence, higher standards and the need to juggle global scope and global responsiveness. To succeed, business must tap the power in brainpower: mental agility, imagination, the ability to learn and then to challenge that very learning with a new idea (Kantor, 2000: 254).

As knowledge moves more rapidly through invisible Internet space, each employee bears the burden of being current. Resilient employees are those who will learn, change and constantly be literate in their area of expertise. Those employees keep up with current ideas. Resilient employees experiment with new ideas, learn from their failures and successes and always think about what is next. They are likely to shift projects, work activities, or even careers when unplanned opportunities arise. They see risk as an opportunity to learn, not fail. Discovering innovative, untried and often risky ways to think about and carry out work, will distinguish the successful employee (Ulrich, 2000: 247).

The future belongs to the people endowed with knowledge. In a society based on knowledge, the knowledge worker is the single greatest asset. This includes a knowledge executive who knows how to allocate knowledge to productive use, just as the capitalist knew how to allocate capital to productive use. The capacity to manage knowledge-based intellect is becoming the most critical executive skill (Nonaka & Takeuchi, 1995: 7). In this regard it is interesting to note that Chief Knowledge Officers (CKOs) identify with the label of entrepreneur. In the CKOs studied by Earl (2002: 46), they all see themselves as builders, starting a new activity, capability or function.

Knowledge Management is not just for big businesses. Small companies need formal approaches to Knowledge Management even more, because they do not have the market leverage, inertia, and resources that big companies do. They have to be much more flexible, more responsive, and make better decisions because even small mistakes can be fatal to them (Barclay & Murray, 2006: 3). Small business also have very distinct advantages, as demonstrated by the next example: In 1993, BP Exploration, the division of BP's that finds and produces oil and gas, organised its regional operating centres into 42 separate business assets. BP Managing Director wanted these units to have the freedom to develop processes and solutions appropriate to their particular problems. The best and most adaptable local innovations could be used elsewhere in the larger company. In effect, BPX would be able to draw on the variety and creative power of 42 moderate-sized companies. The Managing

Director wanted to combine the agility of a small company with the resources of a large one. He understood that even giants would need to be light on their feet (Davenport & Prusak, 1998: 19).

This section has shown the importance of knowledge being managed properly. Although it can be defined in different ways, Knowledge Management should be used in order to improve the business. For this, a Knowledge Management process and a Knowledge Management system are needed. As a result, knowledge workers have an important role to play. One of their roles is to use their brains to provide innovation as a source of value to the company. As a result, knowledge can be an important source of strategic competitive advantage.

3.5 Knowledge Management as a means to increase competitiveness

A company can turn knowledge into an important source of strategic competitive advantage. This section will initially indicate how competitiveness is increased by increasing knowledge. Thereafter this section will indicate how knowledge can be increased by taking a knowledge based view of a firm and/or by creating a learning organisation. An alternative view, how knowledge can be increased by using Product Design to create new knowledge, will be dealt with in the next section.

3.5.1 Knowledge as a source of competitive advantage

It is well established in the strategic management literature that knowledge resources are important with respect to a competitive force. According to Doole and Lowe (2004: 416) knowledge, and the management thereof, has become essential in achieving a competitive advantage. For an increasing number of businesses it is *the* key factor. Reinmoller and Chong (2002: 165) show that creating knowledge is a source of innovation and renewable competitive advantage, while Rodriguez *et al.* (2002: 143) conclude that the dynamic and sustainable firm is a knowledge-based – knowledge-creating company.

How can companies use knowledge to secure a strategic advantage? In a nutshell, according to Skyrme (2002: 67), it's about generating greater value through the knowledge in products, people and processes.

- (a) Knowledge in products: Intelligent or smart products can command premium prices and be more beneficial to users.
- (b) Knowledge in people: Learning organisation programmes are one way of nurturing and applying under-utilised talent.
- (c) Knowledge in processes: In many companies there are often differences in performance levels among different groups performing the same process.

It is the proprietary knowledge that creates a comparative advantage for the firm. The existence of knowledge of internal production techniques or external opportunities in the hands of a small number of firms creates the market imperfections necessary to generate profits for the firm through better products. If a product tends towards being a commodity, the firm will search for a competitive advantage by emphasising non-price dimensions. The magnitude of the profit is a direct function of the success the firm has in gaining a competitive advantage through these approaches. The successful approaches are then distributed throughout the organisation. Multi-national corporations are known to use their knowledge transfer capability to build and develop their competitiveness (Tseng, 2006: 121).

The problem is, however, that the integration of a knowledge strategy with a business strategy is not always easy. Jones (2002: 58) considers the interaction and possible decisions manifested by the directions of both business and knowledge strategy. If business strategy is to be used as guidance for knowledge initiatives, then which strategy goals are best supported by knowledge? What knowledge resources are best driven by business goals? An illustration of these relationships is shown in Table 3.8, where both strategies are mapped to three strategic areas.

Table 3.8 Business and knowledge strategy drivers (Jones, 2002: 58).			
	Growth and value	Operational effectiveness	Customer intimacy
Knowledge strategy	Production innovation Knowledge creation Intellectual capital	Process innovation Knowledge sharing Developing learning culture	Product innovation Customer knowledge integration Branding knowledge
Business strategy	Product sales Time to market Distribution networks Pricing strategy Patent & product leverage	Process streamlining Supply chain management Accounting and finance	Customer retention Customer product needs Revenue growth Partnering / alliancing

What strategies are companies adopting to maximise the return on their knowledge asset? In a year-long study of international best practice, two types of strategy were found by Skyrme (2002: 67). The first is to make better use of the knowledge that already exists within the firm, for example, by sharing best practices. Too frequently people in one part of the organisation reinvent the wheel or fail to solve customers' problems because the knowledge they need is elsewhere in the company but not known or accessible to them. For example, Hewlett-Packard's early failure in the laptop market with a 23-pound product can be attributed to its lack of knowledge flow between its marketing and engineering

Porter's competitive-forces framework, obsolete. When the economy was relatively static, strategy could afford to be static. Companies then occupied positions like squares on a chessboard. Modern-day competition, however, depends on anticipation of market trends and quick response to changing customer needs. Successful competitors in the new economy move quickly in and out of products, markets, and sometimes entire businesses – a process more akin to an interactive video game than to chess. In such an environment, the essence of strategy is not the structure of a company's products and markets but the dynamics of its behaviour (Nonaka & Takeuchi, 1995: 46).

Resource-based theorists argue that resources can create competitive advantages because each organisation accumulates unique bundles of resources that can potentially sustain a competitive advantage. Such resources are difficult to substitute, replicate, imitate or transfer to other companies. According to the resource-based theorists, these capabilities and competencies are intangible assets which provide unique sources of competitive advantages to the firm. They argue that firms, which further develop unique capabilities in the management of knowledge processes, can build distinctive competencies based upon exploiting the growing knowledge these processes can generate (Peteraf, 1993; Carlisle, 2002). The knowledge-based view of the firm is thus a theoretical perspective which has grown out of the resource-based view in strategy literature (Carlisle, 2002: 125 – 126).

Brown and Duguid (2002: 20) state that all firms are in essence knowledge organisations and their ability to outperform the marketplace rests on the continuous generation and synthesis of collective, organisational knowledge. For all organisations, the cultivation of this knowledge is the essence of developing a core competency to maintain the organisation and resist its dissolution. The key questions for strategic managers are, according to Pitt and Clarke (1999: 303): (a) what sort of competencies are worth developing and sustaining in a particular firm, and (b) how is the firm to derive value from having them?

There is thus a renewed emphasis among strategists and economists on ideas associated with a competency-based or resource-based theory of the firm. Whereas traditional economies looked at the firm mainly as a black box and examined the resources going in and the products coming out, today's theorists are turning their attention to one of the essential dynamics inside the box: the knowledge embedded in routines and practices that the firm transforms into valuable products and services (Davenport & Prusak, 1998: ix). As a result a new transformation model, portrayed in Figure 3.1, can be drawn up.

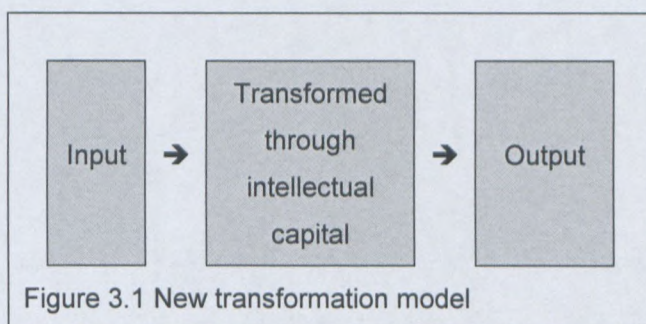


Figure 3.1 New transformation model

The difference brought about by the approach of the knowledge-based view can be demonstrated by comparing it first to strategy formulation and secondly to transaction costs.

Firstly, in the knowledge-base view, strategy formulation is not a linear process. Traditionally strategy formulation was a rational top-down endeavour involving the processing of environmental information to identify opportunities and threats. Alternative courses of action were identified and their risks assessed. In the light of this analysis, a choice was made. The emphasis was on rational planning. The knowledge-based view encourages the exploration of the structural, social and relational aspects of organisations within which knowledge creation, exploitation and transfer take place. Many corporations, which rise to positions of global market dominance, begin with an ambitious vision or strategic intent. Targets are set which demand a great deal of effort and commitment, and involve stretching resources and capabilities beyond their limits. This means that organisations must tap into the creativity and inventiveness of their members to achieve their goals. In the process, unplanned strategies for the exploitation of knowledge created may emerge. Strategy is not viewed as an exclusive top-down process. Good ideas can arise almost anywhere in the organisation and putting them into practice may require an input at the planning stage from almost anywhere (Carlisle, 2002: 129).

Secondly, in the knowledge-base view, the emphasis shifts from value appropriation to value creation. Transaction-costs theory leads strategists to emphasise processes of value appropriation. The knowledge-based view leads them to stress processes of value creation. This implies a focus for strategic thinking away from traditional market concerns to issues of internal organisational dynamics. The conventional focus on value appropriation calls for strategies which will ensure the development and maintenance of effective and efficient means of appropriating value from available scarce resources which will add value to organisational outputs. If the organisation can thereby maintain a favourable market position it will sustain its competitive performance. The more recent focus calls for strategies which will create value in knowledge and lead to its effective exploitation to produce outputs based upon unique competencies and capabilities which cannot readily be rivalled.

The conventional and knowledge-based approaches therefore seek to create and sustain competitive advantage in different ways: the one by searching out cost efficiencies and differentiation advantages which can lead to unassailable market positions; the other by investing in the creation and exploitation of useful new knowledge which cannot be readily appropriated by competitors irrespective of their market position (Carlisle, 2002: 129). A good example of the approach adopted by the knowledge-based view is the development of the Toyota Prius. When the development team of the Toyota Prius devised a plan to improve fuel efficiency by 50 per cent, which was ambitious enough, the top management rejected the plan and set a new goal to increase it by 100 per cent instead. This threw the team into turmoil; it eventually discarded its original plan to use the direct injection engine and developed the world's first commercially available hybrid car (Nonaka, Toyama & Konno, 2002: 61).

To summarise, the knowledge-based view of the firm is a theoretical perspective that views knowledge as a very important source of competitiveness. This view leads to a different approach in managing a business, which can be seen in a new transformation model, a new approach to strategic management and a changing emphasis towards value creation and organising.

3.5.3 Increasing Knowledge through the learning organisation view

Companies that regard knowledge as a strategic resource, and that endeavour to increase this resource, can also do so by becoming learning organisations. This section first indicates why learning is necessary, followed by a brief description of how learning can increase competitiveness by creating knowledge. This has become known as the knowledge creation imperative.

Learning, like so many other concepts of Knowledge Management, has a very definite link to globalisation. Globalisation requires more flexibility in learning, more extensive learning, and more learning from sources previously overlooked by most organisations. Focussing on the current knowledge within an organisation is not enough; the more important consideration is how to create knowledge (Quintas, 2002: 11).

One way in which organisations create knowledge, is instead of merely solving problems, they create and define problems, develop and apply new knowledge to solve problems and then further develop new knowledge through the action of problem solving. Such an organisation is not merely an information procession machine, but an entity that creates knowledge through action and interaction. Hence, the most important aspect of understanding a firm's capability concerning knowledge is the dynamic capability to continuously create new knowledge out of existing firm-specific capabilities (Nonaka, Toyama & Konno, 2002: 41). According to Quintas (2002: 9), the approaches such as those of Xerox and 3M to Knowledge Management are more generic, seeking to promote better communication, learning and knowledge sharing. These and some other organisations recognise the other half of the knowledge equation. That is the importance of knowledge creation as the basis for innovation and competitive advantage. They seek to build a culture that supports knowledge creation.

Knowledge creation is also what makes Japanese companies so successful, according to Nonaka and Takeuchi (1995: 3). They claim that Japanese companies remain an enigma to most Westerners. They argue that the success of Japanese companies is not due to their manufacturing prowess; access to cheap capital; close and co-operative relationships with customers, suppliers and government agencies; or lifetime employment, seniority system and other human resource management practices – although all of these factors, of course, are important. Instead, they make the claim that Japanese companies have been successful because of their skills and expertise at organisational knowledge creation. By organisational knowledge creation they mean the capability of a company as a whole to create new knowledge, disseminate it throughout the organisation, and embody it in products, services, and systems. Organisational knowledge creation is the key to the distinctive ways that Japanese companies innovate.

Another approach to learning organisations is that of systems thinking. Systems thinking, based on general systems theory, is the cornerstone of Senge's (1990: 65) ideas about learning organisations. System thinking enables managers to see the organisation holistically, its environment and the inter-relatedness of events affecting the organisation. Systems thinking principles suggest that cause and effect in complex systems are not usually closely related in time and space, and solutions which produce the most enduring results typically are the least obvious and involve small key changes (Galagan, 1991: 42). The core disciplines of systems thinking, according to Senge (1990:11) describe an organisational culture in which individual development is a priority; outmoded and erroneous ways of thinking are actively identified and corrected, and the purpose and vision of the organisation are clearly understood and supported by all its members. Within this framework, the application of systems thinking enables people to see how the organisation really works, to form a plan, and to work openly together, in teams, to achieve that plan.

Learning in organisations has been identified as central to firm's success. Organisations that learn seem to have the capacity to reinvent themselves, to manage knowledge and to adjust to changing competitive conditions. Ulrich (2000: 242) found that learning organisations have the capacity to both generate and generalise ideas with impact. Coca-Cola, for example, has invested heavily in a learning consortium where innovative ideas from one country are codified and shared with other countries facing similar issues. Investments in HR practices increase a company's capacity to learn by innovative training, compensation and communication efforts which encourage sharing ideas. Organisations that learn tend to be more innovative, able to manage knowledge workers and able to create strategies. Successful companies will have the capacity to regenerate themselves by both generating ideas and generalising those ideas.

The consequence is that an organisation that learns can increase its competitiveness. Quintas (2002: 11) states that the key relationship between knowledge and competitive advantage lies in the potential for knowledge creation to lead to innovation, which in turns provides the basis for a competitive advantage. According to Keys and Fulmer (1998: 7), other competitive advantages, whether capital resources, technical innovation, or even managerial talent, can be made obsolete by a competitor who reads the changing environment and learns in a more appropriate manner. De Geus (1980:17) mentioned as far back as 1980 that over the long term, the only sustainable competitive advantage may be an organisation's ability to learn faster than its competition. Such thinking has led many companies to search for ideas and techniques that will assist them to become learning organisations.

Increasing competitiveness through learning can best be done when learning is combined with the strategic management of a company. The strategies used in various knowledge initiatives can be distilled into two broad thrusts according to Skyrme (2000: 49 – 50). The first strategy is knowing what is known: better awareness, sharing and application of existing knowledge. Many organisations underutilise much of the existing knowledge, because its existence is unknown to those who need it. In one case, a department of AT&T spent \$79 449 to glean information that could be found in a

publicly available Bell Corporation Technical Information Document, priced at \$13. Part of the solution to a customer problem may already be known in the engineering department and another part in the marketing department, but it is not available to customer service. A survey in one company found that 80 per cent of all its electronic information was held on the disk drives of individuals' personal computers, and was not readily accessible to others in the organisation. The first imperative is therefore to make sure that you know what is known.

The second strategy, according to Skyrme (2000: 51) is faster and better innovation: more effective conversion of ideas into products and processes. Throughout the innovation process, knowledge is continually being converted from tacit to explicit and vice versa. It flows between people, gets codified into designs and databases, is disaggregated and recombined into new forms, and so on. This rather complex, even chaotic, view of innovation does not easily lend itself to systematic management. Nevertheless, it is a management responsibility to coax out new ideas and steer the promising ones along an idea-to-production pipeline. In general, as knowledge progresses through the pipeline it becomes more reproducible and costs less to distribute.

Given time, advantages derived from knowledge-based core competencies may be eroded by innovations elsewhere. Organisations which have developed strong organisational capabilities for managing knowledge creation and exploiting the value in knowledge created are better able to adapt to such change by developing new sustainable core competencies for the future (Carlisle, 2002: 131). Davenport and Prusak (1998: 17) agree that while knowledge can provide a sustainable advantage, eventually, competitors can almost always match the quality and price of a market leader's existing product or service. By the time that happens though, the knowledge-rich, knowledge-managing company will have moved on to a new level of quality, creativity, or efficiency. The knowledge advantage is sustainable because it generates increasing returns and continuing advantages. What is required to remain competitiveness is therefore knowledge leadership. This urgency to create knowledge is well summarised by Foppen (2000: 171) who states that knowledge leadership continuously contributes to innovation and learning. To be competitive in the new economy, it is not only about knowing what you know, but also about how fast you can innovate on a continuous basis.

This is the knowledge creation imperative.

In the new economy, knowledge is a strategic resource and companies will therefore endeavour to increase this resource. This means they will become learning organisations. This section demonstrated why learning is necessary, and how learning can increase competitiveness. Learning is essentially about creating new knowledge on a continuous basis. This study would like to present Product Design as one of the best ways to generate new knowledge on a structured basis.

3.6 Product Design as Knowledge Creation Management

Knowledge Management is the latest approach to increasing competitiveness, and is based on the fact that the increase in a company's knowledge should lead to an increase in its competitiveness. The previous section discussed how knowledge can be increased by the knowledge based view and by the learning organisation view. This section would like to add a third view, that knowledge can be created by using Product Design as Knowledge Creation Management.

Before the knowledge based view and the learning organisation view came in vogue, many companies traditionally generated new knowledge by Research and Development (R&D). In the new economy, however, R&D(design) is required. Design combines theoretical and technical information and is therefore the ideal knowledge creator. In the process of creating new knowledge, Product Design uses and produces information.. Product Design, as a user of knowledge, will be discussed and it will also be demonstrated how the Product Design process can produce knowledge. One of the unique features of such a process is the designer's ability to go beyond market research and anticipate consumer behaviour. This anticipation leads to potential products for the future and inherently encompasses an element of entrepreneurship. The section concludes by indicating how holistic Product Design embodies all the above. Holistic design, however, still needs more research.

3.6.1 Product Design in the knowledge economy

This section indicates how the traditional approach to R&D is not sufficient for the new economy. R&D needs to be supplemented with R&D(design). This supplement is described in more detail indicating how Product Design is the ideal combination of theoretical (explicit) and practical (tacit) knowledge.

Theories of the new economy emphasise the stimulus to growth that is provided by the increasing returns on knowledge. Management theory has long focused on operational efficiency. However, following the standard strategies for operations, such as increasing output and reducing input and time, result in diminishing returns. Even additional investments in advertising reap less and less market share. Under such conditions, strategists have begun to emphasize the knowledge-based creation of value and new interfaces with markets. Different knowledge strategies have emerged over time. Reinmoeller and Chong (2002) indicate the role of Product Design in these approaches; how some companies focus on research (R&d), some on development (r&D), and again others seek to balance research and development (R&D).

Traditional R&D is not applicable to the new economy, according to Reinmoeller (2000: 2). Historically Western companies followed a path from research only to R&D. The 19th-century German model of research at universities, research institutes or laboratories subsidised by companies concentrated on research only and separated pure research from development. Since Thomas A. Edison and other

engineers operated a laboratory in Menlo Park, New Jersey, where they created the seeds for commercial success in several industries, such as telegraph, railroad, mining, and electric lighting, research has been integrated with development. Corporate management of basic research, together with applied research, was seen as the foundation of US technological successes. With the successes of integrated research and development, the pioneers in R&D emerged, such as industrial research programmes at General Electric (GE), American Telephone & Telegraph (AT&T), Du Pont, and Eastman Kodak.

However, strengths in R&D did not necessarily increase company profitability. The inventions made in R&D laboratories contributed to growth of productivity and of the overall economy. After the war-driven R&D boom, the strong demand in the US economy during the 1950s and 1960s and the strong international market positions of the R&D pioneers in industrial research helped to sustain substantial investments in research without clear evidence of immediate payoffs.

Japanese companies followed a different path. According to Reinmoeller (2000: 2) Japanese R&D expenses are mostly covered by private enterprises. The government only intervened in favour of some important visions of new technologies that were too expensive to develop for individual companies. During the first R&D boom in the 1960s, many centralised facilities for applied research were established. With an average of 3 per cent of sales invested in R&D, Japanese companies have reached top levels worldwide. However, their investments in research have been criticised as being investments in development and superficially adapting products to meet market needs.

During the 1980s a second R&D boom in Japan focused on basic research. This change in Japanese R&D strategy emphasised the creation of seeds. With the former strength in development and new facilities for basic research, a balance of seeds and needs seemed inevitable. However, during the 1990s Japan experienced the worst post-war recession. The competitive advantage in operational efficiency was diminishing and several incidents weakened Japan's image as a leading manufacturing country. The former President of Toyota, later President of the Japanese industrial organisation, Keidanren, Mr Okuda, demanded a return to the roots of Japanese manufacturing excellence. The recession created strong pressures to create value and customer interface through R&D, but many R&D organisations had difficulties in adapting to the knowledge economy.

One of the reasons for this difficulty was that R&D in the industrial economy is distinctly different from R&D in the knowledge economy. In the industrial economy, most added value was generated in operations, for example the manufacturing process. This kind of explicit knowledge of operations turns into a commodity in the new economy. Tacit knowledge for value creation and customer interface becomes the key to competitive advantage in the knowledge economy. Therefore R&D in the knowledge economy has to transcend its common meaning and evolve into R&D(design) (Reinmoeller, 2000: 2). **As proven previously, design could add the innovation (tacit knowledge) that could lead to a sustainable competitive advantage.**

It has thus been proposed that Design, or more specifically R&D(design), could contribute to the knowledge economy. This contribution can be described as a combination of theoretical and practical knowledge. Theoretical knowledge is what the Greeks called *sophia*, and refers to wisdom, which is speculative knowledge. Practical knowledge can trace its roots back to the Greek *techne* which means an art, craft, trade or professional skill. It is from this that words such as *technology* and *technician* derive (Brown, 1978, 1: 279).

The distinction between theory-driven knowledge and skill-driven practice is simply a distinction between kinds of activity, according to Friedman (2000b: 12 –13). Theory-driven knowledge concerns the principles of thought and refers to philosophy. This is how the term philosophy entered the world of the universities. In the universities, this came to mean the sciences and liberal arts, what is referred to today as explicit knowledge. In contrast, skill-driven practice was rooted and situated. Skills refer to *techne*. A *techne* could not be explained in words, whether spoken or written. It could only be demonstrated. As late as 1700 or even later, the English did not speak of *craft*. They spoke of *mysteries*. It was not only because the possessor of a craft was sworn to secrecy, but also because a craft, by definition, was inaccessible to anyone who had not been apprenticed to a master and had thus been taught by example. Skill essentially involved what is referred to as tacit knowledge.

Traditionally, the sciences and liberal arts at the universities did not include the fine arts or the applied arts. The latter two were taught through the tradition of studio apprenticeship or guild apprenticeship. This was the domain of design until recently. At first glance, one might imagine design an unsuitable forum for philosophical inquiry. In its older incarnation as craft, this would certainly be so. Although inspired by and rooted in craft, design recently developed into knowledge-intensive configurations of professional practice. The knowledge economy is blurring the boundaries between products and services and between material and immaterial. In this context nearly every design practice has immaterial dimensions along with the material. In a new way, design links *techne* with *Sophia*, because design has developed a mental process linked to physical outputs (Friedman 2000b: 13).

In the new globalised economy with its emphasis on technical advancements and knowledge, design is in the ideal position to combine theoretical (explicit) knowledge and practical (tacit) knowledge. In this role, design is a user and a producer of information.

3.6.2 Design as user and producer of knowledge

This section illustrates how Product Design is both a user and producer of knowledge. This interaction is explained first, along with a few examples. In the following sections, Product Design as a user of knowledge and Product Design as producer of knowledge are explored separately in more depth. Lately Design is described by Von Stamm (2006:11) as a decision-making process by which informa-

tion (an idea) is transformed into an outcome, either tangible (a product) or intangible (a service). When, for example, a new chair is designed, the designer uses knowledge such as the properties of steel or wood, knowledge about the ergonomics of the human body and so forth. Knowledge is being produced as the completed design is a bundle of knowledge, for example the technical drawings and other specifications, from which the manufacturer can produce a number of chairs.

Almost every product is knowledge intensive, according to Skyrme (2000: 53), even if it is not always realised. When a prescription drug is bought, it contains not only the tablet but also the knowledge it encapsulates. This knowledge of the therapeutic benefits and side effects is gleaned from extensive clinical trials. Genetic knowledge can be used to create genetically modified foods, such as disease resistant vegetables. Skyrme and Amidon (1997: 37) state that one effective strategy is to encapsulate knowledge into products and services, thereby enhancing their value. Davis and Botkin (1994) describe knowledge-based or smart products, for example car tyres that notify the driver when the pressure is low. Recent examples include a smart oil drill with a sensor and a valve that allows it to get more oil from existing wells, and a smart microwave oven that works out the time and power levels to reheat food.

Knowledge-based businesses are using knowledge-based products more and more. According to Davis and Botkin (1994) such businesses have the following six characteristics.

The more you use knowledge-based offerings, the smarter *they* get.

The more you use knowledge-based offerings, the smarter *you* get.

Knowledge-based products and services adjust to changing circumstances.

Knowledge-based businesses can customise their offerings.

Knowledge-based products and services have relatively short life cycles.

Knowledge-based businesses enable customers to act in real time.

Knowledge is thus used and produced in that the more knowledge-based offerings are used, the smarter the offering gets, the smarter the provider gets, and the smarter the customer/user gets. Knowledge in products and processes can thus be improved by Knowledge Management techniques. Another example is that of companies which hold vast amounts of knowledge that can be exploited as part of their product or service offering. Such knowledge includes applications knowledge, market knowledge, and how to solve problems encountered by users. Much of this is accumulated during the product development and testing process, but is then overlooked. Only a fraction is encapsulated into the final product, leaving under-utilised a rich source of knowledge that could create additional revenues. This knowledge can be exploited in several ways. One way is through additional paid services, such as consultancy or training services. Another way is to make the product 'smart' or 'intelligent', such as the intelligent oil drill.

A company can also exploit knowledge that is generated as a by-product of its principal activities and turn it into a business opportunity. The Automobile Association in the UK operates motorists' rescue services, from which it builds an ever-expanding database about its customers and their needs. This has helped it add many new lines of insurance business, some related to motoring needs, such as holiday travel, but others in new areas, such as household insurance. Perhaps the best known example of business from knowledge as a by-product is American Airlines' reservation system SABRE, which was run as a separate business, and in some years, has made more profit for its parent company than flying their aircraft (Skyrme and Amidon, 1997:38).

While design is commonly painted as a user of knowledge rather than as a producer of knowledge, this is a delimited view and an examination of designing by Downton (2000: 4) makes it clear that all designing activities have the following aspects:

- designing inevitably employs various kinds of knowledge derived from sources outside design;
- designing utilises and reshapes knowledge previously produced within its own discipline;
- designing employs the existing knowing of the designer;
- designing also produces some new knowing on the part of designers; and
- there is a tangible outcome to designing which is evidence of something having been invented or created. Within this outcome, the 'something' is embodied knowledge, and may also be a representation of it. It is likely to lie on a continuum from unique knowledge for the individual designer, to unique knowledge for the global collective. In principle there is no difference in kind (Downton, 2000: 4).

When dealing with models for managing knowledge and learning in product creation, a Product Design project can be thought of as programmed innovation in which firms create new products by applying existing knowledge and creating new knowledge about components and their interactions. To create the information structure of fully specified and standardised component interfaces in a modular product architecture, requires a high level of knowledge about how components function and interact in a product. To the extent that a firm has inadequate knowledge of components and their interactions, creating a new product architecture requires learning by experimenting with new component designs and alternative arrangement of components (Sanchez & Mahoney, 1996: 68).

Innovation during Product Design may therefore involve, according to Sanchez and Mahoney (1996: 68): (a) creating new information about the functions components can perform, which implies learning about components *per se*, or (b) creating new information about the ways components interact and can be configured, which implies learning about product architectures. Extending the notion of learning at component and architectural levels, Table 3.9 identifies four nodes of learning – radical, architectural, modular, and incremental – that can occur in product innovation processes.

Table 3.9 Modes of learning in the product creation processes (Sanchez & Mahoney, 1996: 69)

		Learning about component functions and designs	
		Moderate	Significant
Learning about component interactions and configurations	moderate	<p><i>Incremental learning at the component level:</i></p> <p>Incremental learning through component development leads to limited functional improvements and design variations in components used within an existing architecture.</p>	<p><i>Modular learning at the component level:</i></p> <p>Learning about new kinds of component technologies leads to significant changes in feasible component functions and designs that can be accommodated within an existing product architecture.</p>
	significant	<p><i>Architectural learning:</i></p> <p>Learning about new product market opportunities leads to new product architectures based on changes in the ways existing kinds of components are combined and configured in product designs.</p>	<p><i>Radical learning at architectural and component levels:</i></p> <p>Learning about new market opportunities and new product and component technologies leads to major changes in both kinds of components used and ways components are configured to firm a product architecture.</p>

Designers use knowledge when they incorporate it into products. Designers also create knowledge by developing smart products and when companies exploit the knowledge incorporated in their product or service offerings. This interaction between design and knowledge has led to Teixeira (2000: 1) defining the term design knowledge. Design knowledge is a fluid mix of designers' experience, their values, contextual information about the production and use of products, and the combination of structured methods and designers' intuition that provides a framework for conceiving a product, fashioning the means to carry it out, and estimating its effects.

That the interaction between design and knowledge could be a source of innovation is also demonstrated by Zaccai (2006) who demonstrates that designers possess unique skills and sensibilities which, when combined with other disciplines in the collaborative process, can uncover opportunities for fundamental innovation – innovation that can redefine or create essential products and services.

Already in 2000, Skyrme (2000: 51) proposed that innovation be reconceptualised as a set of interacting knowledge processes, because it involves:

- the absorption of existing knowledge from the external environment;
- the creation of new knowledge through creative thinking and interchange of ideas;
- the rapid diffusion of ideas and insights through knowledge networking;
- the validation, refining and managing of innovation knowledge;
- the matching of creative ideas to unmet customer needs and unsolved problems;
- encapsulating and codifying knowledge into an appropriate form, such as a tangible product, a description of a new internal process, training material for a new service, a marketable design, or patent.

Design and the design process can play a vital part in these processes. In the first process Product Design can absorb existing knowledge. This process refers to Product Design as a user of knowledge, the topic of the next section. Product Design can also play a leading role in many of the other processes. This is the topic of the section depicting Product Design as a producer and diffuser of knowledge.

3.6.3 Product Design as a user of knowledge

Using and producing knowledge in Product Design can never be separated, as they are intertwined and often have a cause-result relationship. It is, however, necessary for discussion purposes, to deal with them separately. First Product Design is discussed as using and integrating various other knowledge fields. This section indicates how design knowledge can be extended by researching other knowledge, followed by various mechanisms to build the design knowledge. With Product Design interacting with such a wide knowledge field a classification is necessary. The typology of Faulkner (2002) and the taxonomy of Friedman (2000b) are shown.

To produce an object requires a great deal of technical and instrumental knowledge, much of which originates in other discipline areas. Designers may, for example, employ knowledge from materials chemistry or French philosophy to create a fondue set. In another example, a product designer may draw from the pool of the company knowledge, as is the practice at 3M. One of 3M's accepted norms is that products belong to divisions but technologies belong to the company. 3M encourages people to work collectively. They can share resources, including knowledge, without having to be certain of how precisely each of them will benefit personally – as long as they believe that the company overall will benefit, to their collective gain. It is, ultimately, this philosophical distinction in their beliefs about what a company is, that allows the organisation to create innovations through a spirit of collaboration among people from various disciplines (Ghoshal, Bartlett & Moran, 2000: 127).

Innovations are created by the fact that Product Design does not necessarily use complete knowledge. Although more knowledge is typically, but not always, likely to be useful for a designer, complete knowledge is not necessary to begin making product design moves. Minimally, a certain amount of knowledge is necessary to commence the product design task. The need for more knowledge is typically discovered during the process. This is not necessarily to be decried, for uncertainty or inadequacy of knowledge can be potent in creating something new. Both misreading and partial reading can lead to fertile invention when making product design propositions (Downton, 2000: 4).

The Product Design activity is seen to be a special case of a problem-solving process. It is an ill-defined activity and differs from well-defined problem solving. The solution of well-defined problems can be captured by algorithms (for example insurance premiums), while the solution of ill-defined problems (some kind of new lawn mower), can have numerous solutions. Designing therefore asks for generating ideas (Popovic, 2000: 4). In similar fashion, Snoek and Hekkert (1999:168) call design a creative, non-routine, problem-solving activity. In order to understand the relationship between knowledge and design, they consider designing a real world and creative, non-routine problem-solving activity. Non-routine problems are problems for which the problem solver must invent a new solution. In order to produce a new solution, problem solvers have to restructure the problem, i.e., they must become aware of new relations among problem components. Such activities are called productive thinking, which is closely related to creativity.

Analogous to non-routine problem solvers, designers face new situations, for example new consumer needs, for which they have to find a new, creative solution. The total amount of knowledge related to such a problem, including the outcome of the problem, is metaphorically called the solution space. The solution space covers all possible solutions that the problem solver might consider. Boundaries of a solution space are set by certain constraints such as technology, finances or production capabilities. The solution space of a design problem involves knowledge from a variety of domains. The body of knowledge present in the designer can be described as the initial solution space. However, the complexity of most design problems requires gathering additional information, either from domains closely related to the problem at hand or even from domains that have never been related to this particular problem before. Thus, the final solution space expands from the initial solution space as more knowledge is added. Productive thinking, i.e., restructuring the information in the final solution space, will lead to creative solutions to the design problem (Snoek & Hekkert, 1999: 168).

In addition, for a designer to arrive at a solution, knowledge of strategies, domain-specific knowledge and general process knowledge are also required. Categorisation of design knowledge distinguishes the following components according to Popovic (2000: 4):

- Domain-specific basic knowledge (knowledge about the human users or materials): Design is an interdisciplinary field. It draws knowledge from the other disciplines, for example, social sciences, engineering, material sciences, and human factors. In addition, the user-focused design approach has

become one of the key elements of the product design process, as product interface is becoming one of the major design concerns. Designers endeavour to predict human experiences with products or systems. Domain-specific basic knowledge is understood to be detailed specific knowledge necessary to solve problems successfully. It is an indication of what knowledge is required from other disciplines.

·Domain-specific design knowledge (knowledge of the design discipline itself): The design discipline has its own domain-specific knowledge, for example the principles of design. This is the knowledge that design disciplines develop in order to build up the domain-specific knowledge base which would be able to be utilised by education and practice. Therefore, designers ought to know more about their own expertise, relevant domain-specific knowledge and how this knowledge might be utilised.

·General process knowledge (monitoring and evaluation of design process).

Sources to look for design knowledge are people, processes, products, and activities, and their context. In the context of design, expertise can be understood as possession of a body of knowledge and creativity, and an analytical ability to extract, analyse and apply that knowledge. In respect of the development of a Product Design knowledge base, it is suggested that the research be divided into two main categories: (a) research into the nature of the design activity and (b) applied Product Design research (Popovic, 2000: 4).

That the use of additional information can improve the number of possible solutions was demonstrated by an experiment by Snoek and Hekkert (1999: 170 – 178). In an experiment, 30 students from the Sub-faculty of Industrial Design Engineering at Delft University of Technology were instructed to design two concepts of an alarm clock for five years into the future. The students were randomly assigned to one of two conditions, a control condition and an experimental condition. The students in the control group were not explicitly instructed to apply a particular Product Design method. The students in the experimental group were given additional information concerning the relationship between human needs, the product and the context in which the consumer and the product would interact. Further, it was stressed that human needs change over time due to changing contexts. The students were asked to keep these ideas in mind while designing, and to form a mental picture of the environment in which their alarm clock would interact with its consumers.

Snoek and Hekkert (1999: 178) came to the conclusion that the students who were instructed to map a future context for a human-product interaction, came up with more creative solutions than students who received no such instruction. The analysis of the students' activities in the preparation stage revealed that such instructions stimulated them to spend more time on searching for information from domains further away from the target domain. This information enabled them to enlarge their solution space and thereby resulted in the generation of more creative, i.e. original and appropriate Product Design solutions.

Product Design can use knowledge and incorporate it into the Product Design process. On the one hand, Product Design uses domain-specific basic knowledge, which is knowledge of other fields that complement the Product Design process, and on the other hand Product Design uses domain-specific design knowledge, which is knowledge of the design discipline itself. Through the design process, Product Design also produces knowledge, the topic of the next section.

3.6.4 *Product Design as a producer of knowledge*

Product Design not only uses knowledge, it also makes a contribution towards producing knowledge. This section will firstly discuss how Design Knowledge can be produced through research and experience. Thereafter it will discuss the structure of Design Knowledge and finally it will cover Strategic Design Knowledge.

3.6.4.1 Producing Design Knowledge through research

If design benefits from additional knowledge, and research can increase additional knowledge, it follows that design should actively pursue research. This section will look at how design increases knowledge when doing research and integrates that knowledge in the design process. The starting point for Zaccai (2006) is to ask: *Designing the what?* This means not to just merely accept a given situation as it is. To truly understand what should be designed, designers must apply their existing skills in new ways and develop new tools. The following are some basic steps according to Zaccai (2006):

- (a) Evaluate: As one would evaluate every aspect of a defined design assignment, evaluate all the information surrounding the assignments.
- (b) Observe and empathise: Observe users in their own environment. See what works for them, what delights them, what frightens them. Understand the user's experience holistically.
- (c) Analyse: Synthesise the observations and empathy into a model for the fundamental dynamics of the problem. What experience, not just product, does the user want? Understand the *gestalt* of the user. Then begin to think about design solutions. Determine what is possible within the laws of science and what is possible within the realm of human capability.
- (d) Hypothesise: Conceptualise potential solutions of each of the identified opportunities. Creatively and completely explore different forms for a defined solution. Then express the solutions in a way that consumers will be able to experience directly. Designers can provide models or sketches that express ideas.
- (e) Test: Get the possible solutions in the hands and lives of consumers. Experiment and observe directly and in context. Insert the ideas into the consumer's life and be there to watch and listen.

- (f) Evaluate: Assess the success of the experiment by considering not only what users say they like, but also what they might not say. Evaluate what the user communicates through actions, hesitations, smiles of delight, and curses of frustration.
- (g) Reiterate: Repeat the process as often as possible because each iteration is likely to uncover additional information.
- (h) Strategise: Take the knowledge gathered and plan the product line, not just the product. Plan the service system, not just the environment. Then focus every effort on defining the specific product or products that will bring life to the strategy.

On the one hand, research can complement the design process. One of the biggest benefits of asking designing the what? is that when research is integral to design, it brings the designer closer to the producer and user, and in the process deepens the designer's knowledge. A synergistic role for research and design has the potential to greatly improve a producer's competitiveness. On the other hand design can complement the research process. Traditional compartmentalised processes for innovation have led to products that were technologically unique but inappropriate because of costs, complexity or other issues. Traditional market-based processes have led to traffic jams of 'me too', or undifferentiated products who must wage commodity wars on the basis of price. By making designers integral to the innovation process, holistic design can create compelling innovation that provides breakthrough experiences which can improve a company's competitive position (Zaccai, 2006).

Design also contributes knowledge in the area of Applied Product Design Research. According to Popovic (2000: 4-6), Applied Product Design Research is based on utilisation of the design knowledge where interaction between theory and practice can be achieved. Research input is to be identified according to the point at which they take part during the design and development process. This is epitomised as follows:

- (a) Research before the design work is started. This is an initial research stage in which different qualitative or quantitative research methods can be utilised in order to acquire domain-specific knowledge to be applied to the design of particular experiences. The emphasis might be on generating the knowledge from a context, activity, life style and human interaction and understanding of knowledge shared between the activity players. The domain-specific knowledge generated from the relevant research should be implemented into a product scenario formulation.
- (b) Research during the early stage of the design process. The early stage of the design process is to be seen as the most significant phase where experiences and products are conceptualised. It is very important for the generation of an innovative design as it is seen to be the most creative phase. This is the stage where users' concepts, derived from the scenario, should be tested. This

can be conducted by applying relevant qualitative research methods. During the design process all design knowledge categories are utilised when relevant. The designers might also use their explicit knowledge based on previous experiences or analogies and apply it to the current tasks in order to discover and explore new innovative solutions. At this stage several design concepts usually emerge. Their representation is done in sketches and annotations and critical reflection or evaluation occurs during the design process. This enables a designer, or design team, to identify and recall the relevant knowledge required.

- (c) Research carried out concurrently with Product Design and Development. In this stage additional research may be conducted in the appropriate area that includes (i) detailed concept design and development and user's testing, (ii) final design development and user's testing, (iii) user's testing and prototype usability, (iv) product perception and cultural values. The number of different experts that contribute to the design and development of a product, share their relevant domain-specific knowledge within the design and development team. Nevertheless, this knowledge is integrated by a designer and represented by an artefact that conveys a lot of qualitative values that make this particular product contribute to the enhancement of the human activity. At this level of expertise, the domain-specific knowledge and strategies in Product Design are utilised.
- (d) Research when the product is on the market. In this phase, most common research refers to different aspects of product evaluation. They may include: usability research, task analysis, product cultural responses related to its visual attributes and compatibility between a user's and designer's concept. The research results are usually applied to improve a particular product or be utilised as research data. They can generate new domain-specific knowledge to be applied to design products. This supports the evolution of products which is reflected in the design of the next generation of products, for example, aeroplanes and computers. In this case, the design is an agent of change where the utilisation of new domain-specific knowledge leads to a new design and discovery.

Research contributes to a designer's personal, tacit knowledge. In most cases one would expect that the designers knew more at the end of the process of design than at the beginning, or that there were changes in the way in which they knew – their personal knowing. In the area of their knowing, individual designers can in principle identify, and thus reasonably claim, changes to, and possibly increases in, their suite of knowledge throughout the process of designing. As an outcome of this, the design community may well have a public increase in knowledge revealed subsequently as the initially individual knowledge is propagated through a process of being used by others and then being seen and used anew. If, for example, materials have been used in a new manner, or a new manufacturing technique developed, it will take time for others to absorb and perhaps extend such new knowledge. Likewise, the development or extension of conceptual, perhaps formal, ideas will flow from one instance to others if it is perceived as a valid area of exploration (Downton, 2000: 4).

There is one big difference in the way research is traditionally done and the way designers do it. Traditional research is objectified through standard processes and made explicit through disclosure. The very essence of the design process is akin to research that increases the designer's personal knowledge. Designing is a means for inquiring. In testing, experimenting, and investigating what is going on in an effort to achieve a desired end, each designer is conducting research. Like knowing, this research is personal, and while it may be refined, honed, and conducted with rigour in an effort to truly test the current horizons of design knowledge and understanding, it will not be repeatable as science would prescribe: an act of designing will not produce the same findings that would occur if it was carried out by another person. In fact, the suggestion that the same designing could be carried out by another sits oddly and attests to the personal particularity of the process (Downton, 2000: 4).

In designing, knowledge is therefore often contained in a particular designer, and it includes a mix of intuitive and systematic procedures. Problem definition is an analytic sequence in which the designer determines all the elements of a problem and specifies the requirements that a successful design solution must have. Negotiation is an intuitive process of identifying a problem and negotiating the terms that might successfully solve the problem. Problem solution is a synthetic sequence in which the various requirements are combined and balanced against one another, yielding a final plan to be carried into production. Therefore, the mix of intuitive and systematic procedures for defining and negotiating a design solution happens through a process that mixes two types of knowledge: fluid or tacit knowledge, and formally structured or explicit knowledge (Teixeira, 2000:2).

Design research increases the personal, tacit knowledge of the designer which in turn increases possibilities for innovative solutions. In the design activity knowledge about a product is created through expert insight by combining intuition and structured methods for conceiving of a product, fashioning the means to carry it out, and an estimation of its effects. This transformation is possible through comparing information from different situations, analysing the consequences of information to decisions and actions, creating connections between different bits of knowledge. In the process the designer uses explicit and tacit knowledge to create new Design Knowledge. Another means of increasing Design Knowledge is through the experience of the designer.

3.6.4.2 Producing Design Knowledge through experience

Design Knowledge can be increased by the design experience. Design experience refers to the cumulative experience of designers or design groups in mastering competence in developing products through a long period of time in many diverse circumstances. One of the prime benefits of experience is that it provides designers with a historical perspective with which to compare and understand how new situations and events relate to existing products. Designers' past experience is a critical element for defining criteria for the development of products. Knowing what to expect and what to do in relation to a product concept is a key aspect of design knowledge. Experience is information about products that a designer possesses in a form that can be immediately used for developing product concepts.

Experience has four major components that are related to the design activity. They are: historical perspective, comparison, pattern recognition and knowing what works (Teixeira, 2000:23). One of them, comparison, is a mechanism that transforms information into knowledge. The use of past experience can be beneficial when applied to making comparisons and to help with the development of analysis from new information. The cumulative experience of designers' activity through different periods and contexts provides a framework for designers to compare and understand how new situations relate to existing products. This is done by using models to extrapolate from past behaviour, in the presence of existing designs, to future behaviour. Knowledge born from experience recognises familiar patterns and can make connections between what is happening now and what happened then (Davenport & Prusak, 1998: 7-8). Pattern recognition involves the understanding of which factors affected the development of products in the past and how this differs in the present (Teixeira, 2000: 3).

Experience changes ideas about what should happen into knowledge of what does happen. The analysis of the gap between 'should' and 'does' involves an examination of what was supposed to happen, what actually happened, why there was a difference between the two, and what can be learned from the disparities. In most cases, there is a gap between rational analysis (should) and grounded truth (does). The analysis of such a gap enables the development of new knowledge. In this case, the cumulative experience of planning, performing and reflecting enables knowledge to know what really works and what doesn't (Davenport & Prusak, 1998: 8-9). In design, the principles of knowing what works, usually constitute an implicit knowledge embedded in designers. Indeed, that's because those principles are usually not coded, which creates difficulty for designers' past experience to be shared or tested in different circumstances (Kalman, Miller & Jacobs, 1994: 26). Nevertheless, the experience of designers in planning, performing and reflecting about what should happen and analysing what does happen provides designers with a valuable implicit knowledge to know what works in the development of a product concept (Teixeira, 2000: 3).

Design Knowledge can be increased by the design experience through among others comparisons, recognising familiar patterns, making connections and building up a body of knowledge of what works. With research and experience increasing the design knowledge, scholars have started to draw up a structure of design knowledge.

3.6.4.3 The structure of Design Knowledge

This section focuses on contributions on the structure of Design Knowledge. Although drawing up such a structure is difficult because much of Design Knowledge is personal and thus tacit, three illustrative contributions are discussed: a taxonomy of the domains of design skill and knowledge (Friedman, 2000a & 2000b), a composite typology of knowledge used in innovation (Faulkner, 2002) and a generalised information structure (Burnette, 2006).

The first contribution is a taxonomy of the domains of design skill and knowledge (Friedman, 2000b: 7 – 9 & 2000a: 11). The taxonomy identifies four areas. Domain 1 involves skills for learning and leading. Domain 2 is the human world. Domain 3 is the artefact. Domain 4 embraces the environment. Table 3.10 provides more detail on the contents of each domain.

Each of these areas requires a broad range of skills, knowledge, and awareness. No one can know all these fields in depth. So while these are necessary domains of design knowledge, no one designer can be expected to master all these areas of knowledge and skill. When design involves more skill and knowledge than one designer can hope to provide, most successful design solutions require several kinds of expertise. It is then necessary to use expertise without being an expert in each field. As seen earlier, teams or networks can be built to engage the talent required for each problem.

The taxonomy offers a broad overview of these skills, knowledge, and domains of knowledge that might be required for successful design practice. The specific choice of skills needed in any project depends on the problem to be solved. A designer must therefore know something about these areas. The central issue is understanding the range of issues they involve and the relationships between and among them. This is not a true taxonomy in the sense that the categories are neither comprehensive nor mutually exclusive. One field is a domain of skills and knowledge while the others are domains of substantive content. Nevertheless, the taxonomy offers a useful framework for considering fields of design knowledge (Friedman 2000a: 11 & Friedman 2000b: 7 – 9).

Domain 1: Skills for learning and leading	Domain 2: The human world	Domain 3: The artefact	Domain 4: The environment
Problem solving	The human being	Product development	Natural environment
Interaction method	Human behaviour	Methodology	Ecology
Coaching	Information	Market research	Evolution
Mind mapping	semantics	Innovation research	Environment impact
Research skills	Knowledge creation	Problematics	Built environment
Analysis	Physiology &	Product generation	Cityscape
Rhetoric	ergonomics	·creating new	Economy
Logic	Research &	products	Social web
Mathematics	methodology	·transforming old	Infrastructure
Language	The company	products	Traffic
Editing	Organisational mana-	Product regeneration	Telecommunication
Writing	gement & behaviour	·correcting	Airports
Presentation Skills	Business economics	problems	Food distribution
public speaking	Company culture	·improving product	Human ecology

<p>small group information graphics</p>	<p>Leadership administration future planning process management change management process skills Company functions governance logistics production marketing finance</p> <p>Society Trends Legal issues Media Social economics Communication</p> <p>The world World trade European Union USA Asia Cross cultural issues Political economics</p> <p>Theory Basics Culture theory Sociology of knowledge Reception theory History of design Sociology of taste Content analysis World history Paradigm analysis Models</p>	<p>positioning re-engineering (lean production)</p> <p>Design Product Design ergonomics product semantics product graphics functionality Graphic design visual ergonomics typography corporate design Behavioural design information design knowledge design process design</p> <p>Manufacturing Technology Operations Statistical quality control Logistics Process management</p>	<p>Architecture Informal buildings Usage Architecture as idea Architecture as corporate identity Profile architecture</p> <p>Interior Furniture Interior as corporate identity Psychology Function Social structure The shape of work The shape of play The shape of private life</p> <p>Installation Philosophy of space Culture theory Art ideas Inquiry</p>
---	---	---	---

According to Friedman (2000b: 11), the nature of design as an integrative discipline places it at the centre of several large fields (Figure 3.2) In one regard design is a field of thinking and pure research. In another, it is a field of practice and applied research. These applications can be directed at solving specific problems. The model Friedman (2000a: 11 & 200b: 11) proposes for the field of design can be envisioned as a circle of six fields. A horizon bisects the circle into fields of theoretical study and fields of practice and application. Six triangles represent general domains of design. The domains above the horizon are (1)

Natural Sciences,
(2) Humanities and Liberal Arts,
(3) Social and Behavioural Sciences, and below the horizon
(4) Human Professions and Services,
(5) Creative and Applied Arts, and
(6) Technology and Engineering.

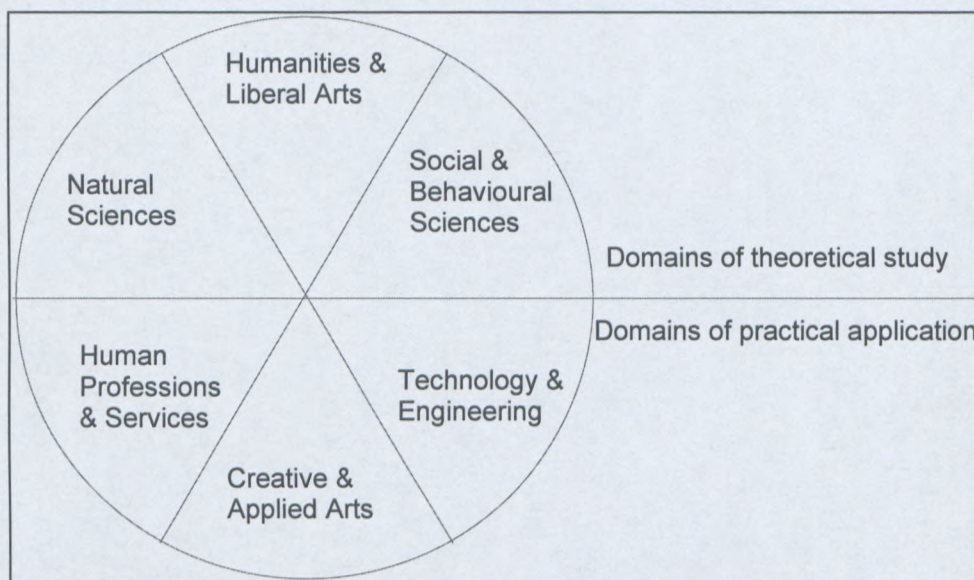


Figure 3.2 Model of the fields of design (Friedman 2000a: 11)

Design is a field that may involve any or all of these domains, in differing aspects and proportion depending on the nature of the project at hand or the problem to be solved. The placement of the domains across from one another suggests dynamic relationships among specific fields of theory and application. The domain of the natural sciences is closely linked in dynamic interaction with technology and engineering, the domain of humanities and the liberal arts with the creative and applied arts, the domain of social and behavioural sciences with human professions and services.

The model distinguishes between and among domains for the purpose of explanation. The reality of design places both design practice and design theory at the centre of the model. For any given project, a differently shaped territory inscribed on the model will represent design. This shape is often fuzzy or ambiguous. This territory may engage any or all of these domains in different degrees and proportions (Friedman, 2000a: 11 & 2000b: 7 – 9).

The second contribution, a composite typology that groups 15 different types of knowledge used in industrial innovation, is proposed by Faulkner (2002: 157). This typology is grouped under five headings based on the fact that according to Faulkner (2002: 145), science can be distinguished from engineering in terms of five distinct cognitive and epistemological features.

- (a) Knowledge related to the natural world. This includes theories and knowledge of the properties of materials. The domains of science and technology are both present. Theory includes the theoretical tools used in engineering, and experimentation, whereas the category properties of materials encompasses properties of artefacts and of nature.
- (b) Knowledge related to design practice. Design-related knowledge constitutes a vital aspect of technological innovation. First, design criteria are drawn up on the basis of the dual requirements of the companies and the potential users. Second, more detailed specifications are then produced on the basis of technical considerations. Third, alternative concept designs are considered and one is eventually selected. Finally, the detailed design of the product is elaborated.

To this, various types of design concepts are added. Fundamental operating principles are the principles that make a particular artefact work, for example the fixed-wing aircraft that flies because of Cayley's principle that one can make a surface support a given weight by the application of power to the resistance of air. Normal configurations are the arrangements and shapes commonly taken to be the best embodiments of operating principles; they represent the framework of normal design. Such knowledge is intrinsically technological rather than scientific and is often taken for granted, having been absorbed from earlier engineering. The role of creative ideas in both concept design and detailed design is acknowledged everywhere. Good ideas rarely emerge in a vacuum.

The categories of design instruments encompass structured procedures, ways of doing things, thinking and judgemental skills, for example the ability to balance conflicting design requirements. The role of skills or competence in all aspects of design is self-evident. Practical considerations imply knowledge, drawing more on experience than skill. They include the vital elements of user experience of operation, shop floor experience of construction or production, and the rules of thumb from previous design experience.

- (c) Knowledge related to experimental R&D. Experimental and test procedures are accepted ways of setting up experiments and tests. Research instrumentalities are knowledge and skills related to the techniques and artefacts used in the course of experimental R&D. It includes the ability to use research instruments effectively. The nature of general and specific research competence is self-evident, as is the category of experimental and test data. The latter is perhaps the most tangible knowledge output of R&D. Data often relate to both properties of materials and to operating performance.
- (d) Knowledge related to the final product. Product ideas rarely emerge in a single step from a single source but rather coalesce over a period of time. Knowledge about the operating performance of the product is vital and is obtained through pilot production, direct trials and user experience. Knowledge about the operating performance or materials is obtained from suppliers and users, and

from experience. Production competence ideally contributes to early design, as well as to later detailed design through pilot production.

- (e) Knowledge related to knowledge. This category captures the facility to find out things that are necessary to Product Design but that are not known to those immediately involved. In the course of search activity and problem solving, external contacts are widely used to locate facilities, literature and other contracts in particular specialisms (Faulkner, 2002: 157 – 159).

The composite typology of knowledge used in innovation by Faulkner (2002: 158) is summarised in table 3.11

Table 3.11 Composite typology of knowledge used in innovation (Faulkner, 2002: 158).	
<p>Related to natural world</p> <ul style="list-style-type: none"> Scientific and engineering theory Laws of nature; theoretical tools Properties of materials Nature and artificial materials <p>Related to design practice</p> <ul style="list-style-type: none"> Design criteria and specifications Understanding of user requirements Demands of company and technology Specifications of components Design concepts Fundamental operating principles Normal configurations Creative ideas Design instrumentalities Design competence General design competence Competence in specific product area Practical experience 	<p>Related to experimental R&D</p> <ul style="list-style-type: none"> Experimental and test procedures Research instrumentalities Ability to utilise experimental techniques and equipment Ability to interpret test and experimental results Research competence General research competence Competence in particular specialism Experimental and test data <p>Related to final product</p> <ul style="list-style-type: none"> New product ideas Operating performance Performance of components or materials Pilot production, field trials, and so on User experience Production competence

While the first two contributions concentrate more on the knowledge used by the design process, the third contribution concentrates on how the knowledge produced by the design process can be generalised.

The third contribution is a generalised information structure that is proposed by Burnette (2006) and is related to different kinds of information and the roles they play in the processes of design and science. The same core roles are involved whether used to create a poem, a painting, an automobile or a scientific experiment. Consistent reference to these core roles during design can build knowledge capability in the same way that the pattern of disclosure based on scientific method has helped to establish knowledge in science. Both processes employ the same kinds of information for different purposes: design to create, science to explain. It is this common framework of operational distinctions that affords the opportunity to integrate design and its assessment.

The basic kinds of information used in both science and design and the roles they play are characterised by Burnette (2006) as follows:

- (a) Directive information: Both science and design require that attention and effort are purposeful and focused towards recognisable goals. Design begins with recognising a need or desire to be met. A scientific experiment begins by framing the problem and establishing the purpose of the work.
- (b) Descriptive information: Both science and design must identify what is considered. Design requires identification of the information to be considered and the resources to be employed in creating something new. Science reporting always identifies the issues and variables being addressed.
- (c) Relational information: Both science and design require the purposeful structuring of information.
- (d) Contextual information: Any discipline depends on its context of application for meaning. Designers must adequately represent the conditions for which a design is developed to those who must understand or use it, in order to ensure that it fits the context of use. The circumstances and constraints under which a scientific experiment is conducted must also be described for its results to be understood and replicated.
- (e) Procedural information: Proficiency in both design and science is dependent on effective procedures. In science, the sequence, conduct and control of research procedures are reported as the basis for critical review and confirmation. The use of computers during design now makes it possible to simulate, record, improve and support design procedures.
- (f) Empirical information: Achievement in both science and design requires the critical assessment of information obtained through the process involved. The findings that result from scientific research are always documented and subjected to critical review. Evidence for the usability or effectiveness of a design, traditionally available only after a design had been physically produced, can now be obtained and evaluated throughout its development via computer-based simulations.

(g) Reflective information: Future potential in any discipline rests on integrating newly acquired knowledge with that from prior experience or other sources. The scientific researcher always interprets research findings and their implications. To learn from experience, designers must also consider the consequences and implications of what they do.

These seven domains can be used like a language to establish, convey and guide interpretation of information on any object, at any level and for any purpose by individuals or groups acting informally or through formalised procedures. No matter in which context they are translated, the core types of information contribute to a competent expression at some level of consideration in a manner analogous to the way the components of a sentence (i.e. noun, verb, adverb etc.) contribute to the expression of thought (Burnette, 2006). The information structure outlined above can be used to organise information, to create what does not yet exist, as well as to explain what does. It is a potent tool for the information age.

The basic principle is that designers, seen as knowledge workers in the new economy, use and produce knowledge and contribute their knowledge to an organisation's knowledge for productive use (Teixeira, 2000: 6). In organisations, knowledge often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms (Davenport & Prusak, 1998: 5). Embedding design knowledge into organisational knowledge, the design knowledge's contribution to productive use happens through embedding the design activity into the routines, processes, practices, and norms of organisations to identify business opportunities and create new products or improve existing ones to add or create new value for organisations (Teixeira, 2000: 6).

This section discussed three contributions towards adding structure to Design Knowledge, namely a generalised information structure, a composite typology of knowledge used in innovation, and a taxonomy of the domains of design skill and knowledge. In view of the fact that this Design Knowledge can contribute to a sustainable competitive advantage, it follows that the strategic implication of Design Knowledge should be discussed next.

3.6.4.4 Strategic design knowledge

With their ability to assimilate knowledge from other non-design disciplines, designers can get close to the customer and proactively design new products for future customer needs. A designer can thus produce Strategic Design Knowledge. The role of market research and the importance of anticipating the future are also discussed.

Design can add knowledge to a company's strategic management decision-making process by looking towards the future and conceptualising new products for as yet unmet customer needs. Against this background Zaccai (2006) advocates rethinking design. Many designers spend too much time looking

for ready-made design assignments and not enough time uncovering unmet user needs. They tend to abdicate this role to market researchers. Designers have an ambivalent relationship with market research. The use of market research in Product Design is concerned with exploring, testing and validating the design and development of new products and the improvement of existing products. With the company's objectives in mind, market research seeks to verify the latent needs of potential customers. By providing a greater insight into customers' needs, market research may help to discover fresh ideas for new Product Design. There is consensus that market research can make new Product Design more effective (Bruce & Cooper 2000: 51).

Despite the contributions of market research, it has its limitations, such as its inability to reduce the perception of risk. One of the major reasons for undertaking market research is to improve or support marketing decision-making with a view to reducing marketing risk and uncertainty. This has been termed the market research payoff. By investing in market research, the payoff should be a reduction in risk of a new product's failing. There is, however, a contradiction that lies at the heart of the research payoff debate when more information does not necessarily further reduce uncertainty and thus the perception of risk. Instead, it may, through bringing to light information that challenges a company's understanding of a situation, produce more uncertainty (Bruce & Cooper 2000: 40).

Market research also has limited potential to be a source of new ideas. Although market research is important to the design process, people are unable to forecast their future needs. Akio Morita, former chairman of Sony, states that their intention is to lead the public with new products. The public does not know what is technically possible, but they do (Marzano, 1999:23). Zaccai (2006) adds that the skills of designers are particularly useful in the development of revolutionary innovations. Traditional market research alone cannot specify unrecognised needs, and therefore limits innovation, to its evolutionary form. Designers can deepen research, allowing it to uncover unarticulated or emerging user needs leading to discontinuous development. The designer's intuition, combined with futures and trends research, can help to avoid me-too solutions.

If designers are to develop innovative future products, they have to really understand what customers want. What customers want, are not products, but benefits. Designers therefore need to shift their focus from products to benefits. Designers need to think not of a product creation process but of a customer benefits creation process, with the customer at the start and the end of the process. This means designers have to understand as much as they can about their potential customer. Designers need to find out what it is that makes products attractive enough that people want to pay money for them, and for these products rather than all the others on the market. By understanding customers, designers can set up a process which will allow them to create and present products and services that the customer will find attractive and desirable, as well as useful and easy to use (Marzano, 1999: 22).

In addition, designers need to do more than just find products that satisfy customers. Marzano (1999: 22) asks whether being 'customer-driven', 'customer-focused', 'customer-oriented' and so on, are

really all a company needs to be to become the customer's first choice? It would be so easy if designers could just ask people what they find attractive. However, what really delights people is when you give them something nice that they had not expected. It may be something that they did not expect simply because they had never thought of it; or if they had thought of it, they never believed it would be possible. So if designers cannot ask customers about their ideal future, they need to find ways of looking ahead and seeing the future for them.

A good example of looking ahead is that of Apple Computer Inc. Apple's success story comes from their prediction that everyone would like to have an own computer. The problem was that people would find using the computer difficult. So Apple developed its graphical user interface, giving the company an excellent reputation for user-friendliness. Another example is that of Motorola mobile phones. Motorola foresaw that people would like real person-to-person telecommunication rather than place-to-place communication. So they learned about digital compression, miniaturisation, batteries and flat screen technology, and they developed their customer interface and brand familiarity to be able to sell this idea (Marzano, 1999:23).

Thinking about the future in terms of benefits, competencies and the customer interface allowed companies not just to create successful products but also to create new worlds of possibilities – worlds in which they took the lead. In order to get ahead, designers therefore need a well-articulated vision about tomorrow's opportunities and challenges, based on a thorough understanding of trends in a wide variety of fields. But it is not enough just to collect information. The crucial step is to integrate that information into a process of building knowledge about the future. What is needed, according to Woudhuysen (2006: 1) is futures and trend research. This approach is less speculative than futurology or imagineering. Anyone performing futures and trend research must adopt a systematic, numerate and critical approach. In the world of design futures and trend research there must be a strong observational and visual component: images need to be combined with statistic, charts, diagrams, and incisive recommendations about what to do and when to do it. This approach relies on a number of established disciplines, such as technology forecasting, socio-economic forecasting, market forecasting, Delphi panels, scenario planning and ethnography.

Two of the many examples cited by Woudhuysen (2006: 7 – 8), are Web services by Microsoft and the Nokia 2110 GSM handset. Microsoft predicted the move towards Extensible Mark-up Language, or XML, and under its .Net strategy remade all its products to be able to handle web services. Microsoft gained a first-mover advantage over rivals AOL Time Warner, IBM, Sun Microsystems, SAP and BEA Systems. In February 2002, Microsoft released its web-service tools so that other software developers could create services based on .Net technology. In 1994, Nokia, amidst a very uncertain climate for mobile phones in Europe, launched its 2110 model. Nokia's forecast reflected a global, more consumer based usage for mobiles. The 2110 simplified the layout of alphanumeric keys into four rows, located function keys in a kind of flower or emblem above them and topped it all off with a display not seen before. In 1995 the 2110 helped Nokia raise mobile phone sales from 6.3bn Finnish marks to

10.7bn. By 1996 mobile phones such as the 2110 were worth more to Nokia than all its other operations put together, even though they accounted for little more than a third of its staff.

Companies and designers often have to take the lead, based on their informed intuition of what people want. Designers are contributing to the strategic management of a company by anticipating the future market segmentation and differentiated market positioning for a product and/or service. They focus on the needs of the markets or what the product as a whole should be, rather than be confined to the appearance of the product (Brown & Van Patter, 2004: 2). In referring to future human needs, Grinyer (2002:6) refers to the example of Philips. According to him, Philips looks at where the human need might be and then develops new materials or technology around real human needs. Intertwined in all this is the idea of foresight. This approach is one that allows Philips to find new customers and non-traditional products by ascertaining people's unarticulated needs. Needs they have or will have in the near future but cannot describe. Understanding such latent human needs means that the emotional reaction can be anticipated and successful technology applications identified. This will allow the human reaction to new scientific developments to be understood.

To be successful, future innovative products must take into account opportunities provided by new technology and materials on the one hand, but they must not lose sight of the customer on the other. If designers lose touch with the values, beliefs and needs of the market place, it may be difficult to get new products accepted. If companies do not have an integrated project team, problems are likely to occur even before product launch. It is clear that new technologies alone are not going to provide a competitive edge in the new economy. The customer's values, beliefs, and above all, emotions, are going to play an increasing role in future Product Design. Holmberg and Ridderstrale (2000: 38) say that it is time to build competitiveness on emotions and imagination. What are needed are *economies of soul*. The best and worst things in life are associated with strong feelings. The company that aspires to be competitive in future cannot deprive itself of the strengths associated with economies of soul. Scale and skill economies will still matter, but unless the resources that make people mad, sad and glad can be put to good use, knowledge is not used effectively.

In relation to customers, the new trend means focusing on the extended experience. From a strict price/performance view it will not really matter which vacuum cleaner, TV set, VCR or microwave someone buys. They are all more or less equally good. Getting that stuff right only buys a ticket to take part in the game. In the future, a company will win by appealing to the feelings and fantasies of the customer. Otherwise, one will deal with a demanding customer on a purely economic basis, which will inevitably result in zero profits, as a company will compete globally with an infinite number of other similar firms. In the age of affection the only way to create real profits is to attract the emotional rather than the purely rational consumer. Most customers already are, or at least could be, driven by a rationale that extends far beyond the purely economic one. Alberto Alesi, CEO of the Eponymous Company says people have an enormous need for art and poetry that industry does not yet understand. Alesi can charge up to \$80 for a toilet brush. Someone just does not pay such a ridiculous sum

of money because Alesi's toilet brush has superior functionality: you buy something more – an extended experience (Holmberg & Ridderstrale, 2000: 40). The user-focused design approach means that designers should predict human experiences and then design products that satisfy these unarticulated needs (Popovic, 2000: 3).

Although designers can conceptualise future products, these are not necessarily meaningful products. Marzano (1999: 22), Managing Director of the Philips Design Group, is concerned about the design of meaningful products. The problem is that actions that seem to promise improvements in the future can have unexpectedly mixed results. Mass production and relentless industrial progress promised greater welfare for more people. Although they certainly brought many benefits, they also produced pollution on a scale that is only now starting to be understood. Similarly, in agriculture and food production, the efficient way of working that has done so much to relieve hunger, limit disease and save time, has also been responsible for over-worked soil, unhealthy fast food, and mad cow disease. If designers and manufacturers are to help in the attainment of a sustainable society, they have to genuinely pay attention to consumers, as well as the bigger picture.

By anticipating future needs and products, design can produce knowledge that is important for the strategic decision-making of a company. In this process the challenge for designers is to discover the new relevant benefits and qualities – the qualities that products and services will need to have if they are to fulfil the aspirations and dreams of those who use them. Product Design will mean anticipating future customer needs. As this increases uncertainty, and therefore risk, it is inevitable that an element of entrepreneurship will be present.

3.6.4.5 Strategic Management, Product Design and Entrepreneurship

Companies can only survive in the new economy if they display an entrepreneurial flair in their strategic management. This section indicates how Product Design can contribute towards an entrepreneurial attitude in strategic management.

Product development is all about taking calculated risks and entrepreneurship. Product development provides the innovation necessary to improve competitiveness, but with it also comes a certain amount of uncertainty. This uncertainty needs to be, as far as humanly possible, quantified and become part of the strategic decision-making. The previous section indicated that Product Design is about creating products for the future. Customer needs are constantly changing and so companies have to address the need of future customers as well as those of their current ones. New technologies are another driving force in innovation and these must be harnessed to meet new needs and to create products. Consequently it is about a calculated risk. At the start of a new project, the outcome cannot be certain. Firms have to choose between a number of potentially lucrative ideas. The dilemma is the risk of rejecting the right idea or accepting the wrong one in the early phase.

Design, innovation and entrepreneurship are intrinsically linked. According to Grinyer (2002: 6), design can be the key driver of entrepreneurial spirit, and an entrepreneur can drive design values as a strategic business tool. For Grinyer (2002: 6), innovation is that human application of technology which Sony, amongst others, exploited to develop small, lightweight, low-powered radios. This innovation opened a door to completely new types of products that could be designed around miniaturised components that had not existed before. The Walkman is the most famous of these products. As technology has advanced, it has evolved as a portal to a service through the Internet where the Walkman is an access point to MP3 music files.

In true entrepreneurial spirit, Product Design can contribute to finding new business opportunities. There will be dramatic added emphasis on finding new business opportunities in the 21st century, according to Lorange (2000: 151). How to accelerate the ultimate utilisation of such opportunities will also become central, not in the least owing the fact that traditional product life cycles will be increasingly shorter, calling for a much more accelerated recovery of investment. The classic business position, where one's strategy is based on an established market share and a consequent stable generation of funds, will be the exception rather than the rule. Rather, the issue will be on finding new opportunities and expanding them ultra-fast, so as to enjoy a typically short period when one is the sole supplier of a particular product or service on a worldwide basis. When competition enters, it is time to move on, sooner rather than later, to other pioneering projects. More than ever, it will be a liability to be extensively bogged down in more mature business positions (Lorange, 2000: 151). This is the same perspective as achieving a temporary monopoly in the new economy that Holmberg and Ridderstrale (2000: 35) refer to or the *bubble of value* made famous by Clem Sunter.

Emphasis will be put on seeing business opportunities that are entirely new, serving the customer in radical new ways. As a strategic advantage is typically short-lived, it is therefore of the utmost importance to be able to generate as many viable new business ideas as possible. Testing of these ideas must follow quickly, so that the most promising can be developed and marketed. These rapid expansion efforts must take place ultra-fast, in order to quickly establish a strong and exclusive global monopoly position, to be able to recover one's investment and more. Strategy is thus no longer an issue of defending established status quo positions in order to maintain a competitive advantage. Rather it will be increasingly important to focus on experimentation and rapid expansion (Lorange, 2000: 151).

In the new economy, finding new business opportunities becomes more important than distributing the wealth of existing businesses. Rather than focusing their efforts on forces that impede the wealth creation from products, companies should concentrate on finding new sources of value. By the time most of the profit margin of an innovation had been eroded through market pressures, the company should have discovered new opportunities in the form of new products and applications to start the process all over again (Ghoshal, Bartlett & Moran, 2000: 125). The best organisations concentrate on products and services that will be needed by large numbers of customers in the future. They position

themselves to provide products or services that take care of some future human need. They work double time, handling current commitments while anticipating future needs (Farren, 2000: 104 – 105).

Product Design and an entrepreneurial mindset are thus very closely linked. In the design process, knowledge is generated which is important for the strategic decision making of a company. Designing is the key to the intelligent application of information to meet human needs and wants. It is as fundamental to this age of abundant information and almost unlimited technology as scientific method was to the natural history stage of inquiry and the age of industrial development. This is because designing provides an operational framework through which to realise what *could* exist that is similar to that through which science establishes information regarding what *does* exist. Design is only now being recognised as a productive discipline, yet this capacity to think and act in ways that are practical, constructive and fulfilling is often inadequately valued and developed. The issue is how to foster and support the development and use of Product Design in the years ahead (Burnette, 2006).

In summary, this section described how design produces knowledge. Design Knowledge is increased by research and the experience of the designer. This section also discussed attempts to structure the Design Knowledge, as well as Design Knowledge's contribution to the strategic management of a company. Finally the links between Product Design, Strategic Management and Entrepreneurship were explored. This also concludes the section that discussed Product Design as an example of Knowledge Creation Management through its ability to use and produce knowledge. The final section will explore this topic further by presenting a conceptual model of the above.

3.7 Product Design as a Knowledge Creation Management Tool (Conceptual Model)

This study demonstrates that Product Design can play an important role in the new globalised knowledge economy. Not only does Product Design react favourably to integrating existing knowledge by assimilating knowledge from other disciplines; Product Design can also produce knowledge through making Product Design a part of a company's Knowledge Creation Management. In this way Product Design can generate knowledge that can improve a company's competitiveness and is thus important for the company's strategic decision-making. To conclude this theoretical overview, a conceptual model depicting Product Design as a Knowledge Creation Management Tool is being put forward. See also Figure 3.3. A discussion of the different elements follows.

3.7.1 Start of the Product Design process

The Product Design process starts with acquiring knowledge on various aspects in preparation for the actual Product Design process. Any design starts with a **Product Design brief**. The design brief

defines the nature of the problem to be solved and is a formal instruction by the client to the designer. The importance of the brief cannot be overemphasised. An inadequate brief may mean that the client does not know what they want, but it certainly means that the designers are misinformed about what is required. Zaccai (2006) states that often one of the most important processes of Product Design is actually done well before a designer is involved. What should be designed, and what characteristics the product should have, are often predetermined. This limits the designer's role in the innovation process. The designer should therefore be involved as early in the process as possible in order not to be limited in his/her quest for more effective Product Design results. The brief that requires the design of a watch, is much more limiting than a brief requesting the design of a time piece.

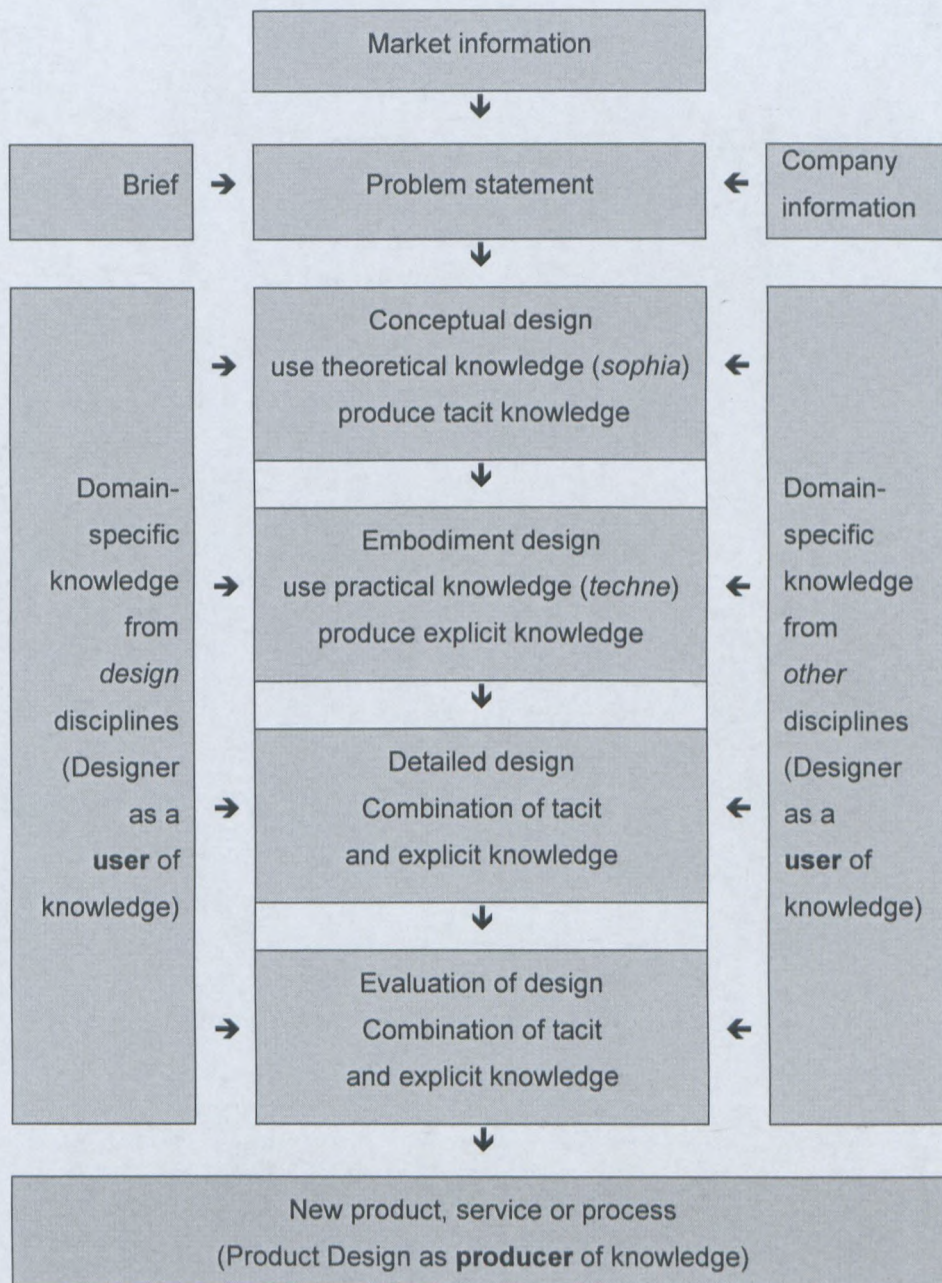


Figure 3.3 Product Design as a Knowledge Creation Management Tool (conceptual model)

The brief usually, but not always, derives from **market research**. Designers should acquaint themselves with as much market information as possible, such as the target market, expected benefits of the product, and the ultimate positioning of the product. The relevant market information can come from exercises such as market screening or a gap analysis of products in the market and can have many forms, for example reports on sales figures and future trends in sales, reports on product information that could include information of competitors' products, reports on new technologies and reports on trends in consumer behaviour.

There is a natural interaction between the designer and the market. The origin of a product can be either based on market information or on the creativity of the designer. On the one hand, the designer could follow the market by reacting to market information and deliver a product for which there is a known demand. This usually leads to incremental or continuous development and involves less risk. On the other hand, the designer could lead the market by anticipating future trends and deliver a product for unmet or as yet unknown consumer needs. This usually leads to radical or discontinuous development and involves a higher degree of risk taking. The differences between these approaches relate to the push and pull marketing strategies. Theoretically the answer is not an either/or but both. A new product should satisfy a known need in the market, but at the same time be radically new.

Apart from the brief and market information, the designer should be *au fait* with certain **company information**. Much of it could be included in the brief, but it is the responsibility of the designer to understand the relationship of the new product to the rest of the company. The designer should understand the strategic direction of the company knowing which aspects are fixed (for example, the main purpose of the product) and which are open to creative design. When evaluating creative options for a new product, the designer should know what options would strategically fit with the desired future position of the company. Detailed company information is also required such as the existing infrastructure and the possibilities of renewing or adding to the structure to consider the implications of a new product on the existing infrastructure such as production, distribution and sales capabilities. In the example of the time piece, the client could be a retail chain selling teenage clothing and accessories aimed at upmarket young people. As they subcontract their production, they are not limited to certain equipment. A maximum retail selling price of R1000 is, however, imposed.

When research on the above is completed, it can be condensed into a **problem statement**. This describes the problem in detail or alternatively describes the ideal product. Such a statement could also include technical specifications translating the marketing and business requirements into more precise technical parameters. As always in the process, close co-operation between the designer and the client is necessary. At this stage the designer may consult with the client as some of the information gathered subsequent to receiving the brief, may alter the brief. Once agreement is reached, the actual Product Design process can begin. The problem statement in our example could be: Design an upmarket time piece for young adults that could be produced by any subcontractor, but would sell for less than R1 000.

3.7.2 The Product Design process

With all the preparation done, the following three processes then run concurrently. The designer uses or increases his/her domain specific **knowledge of the design process** to guide the process and make sure that it arrives at the desired end – a new product, service or process. The designer also uses or increases his/her domain specific **knowledge of non-design disciplines**. The Product Design process then proceeds as follows:

- (a) **Conceptual Product Design:** The stage in which alternative solutions and Product Design variants for satisfying the specifications are generated and selected for further development. This is generally considered the highest level of design, involving the most senior designers. Typically it involves the production of sketches, drawings, mock-ups or models to test basic feasibility. In this process the designer uses theoretical knowledge or *sophia* and generates mainly tacit knowledge as the conceptualisation happens in the minds of the designer.
- (b) **Embodiment Product Design:** The stage in which one or more Product Design concepts are translated into layout drawings and/or prototypes or full-scale mock-ups. This is used for technical development and testing and for evaluation by management and/or customers for financial and market acceptability. Detailed costing can now be done and an exact quote given to the customer. In this process the designer use skills or practical knowledge also known as *techne* and generates mainly explicit knowledge, as the tacit knowledge of the previous process is being formalised and expressed.
- (c) **Detailed Product Design:** The stage in which the design chosen from the embodiment stage is developed and optimised in detail. The materials are specified and after final technical and market testing, the product design is engineered for ease of manufacture and maintenance. Detailed working drawings and specifications or computerised instructions are given. The output is therefore mainly explicit knowledge represented in detailed technical drawings and/or reports.
- (d) **Evaluation of Product Design:** It is imperative that designs are evaluated. Evaluation of Product Design can occur in many forms and at various levels. Short term evaluation could be the assessment of a concept against a brief, product testing, or test marketing. Long term evaluation could include feedback from customers, sales personnel, marketing managers, or an analysis of sales figures.

3.7.3 Outcome of the Product Design process

The outcome of the design process is a new product, service or process. Knowledge is produced in the process that can be incorporated into the strategic and functional management of the company.

Although the main task of the designer is completed, it is essential that the designer remain involved in the manufacturing, distributing and selling until it is time to upgrade or terminate the product and so start the process all over again.

3.8 Conclusion and research aim

This study claims that competitiveness can be improved by using Product Design as a Knowledge Creation Management Tool. Chapter two documented how the benefits of design were researched and published. This chapter, unfortunately, also concluded that the benefits of design, despite various efforts, are still not being used as widely as it could be. Chapter three then proposes an alternative view by providing a theoretical framework of how competitiveness can be improved through the application of Product Design as a Knowledge Creation Management tool. More specifically, Product Design can improve competitiveness when it is fully integrated into the business management of a company.

In order to substantiate this claim, an overview of the business management landscape is provided, with an indication of the position of design. The business management landscape is currently dominated by globalisation and Knowledge Management. Inside businesses, globalisation has led to a change in management style and between businesses, it has led to increased competition. The increased competition has led to increased product and service offerings, which has increased customer expectations, and which in turn put pressure on companies to continuously innovate in order to stay in business.

Reacting to this cyclic pressure, businesses revert to their core functions and outsource everything else. Outsourcing has led to boundaryless organisations operating in a network. Against this background, Knowledge Management has become necessary, mainly as a result of the loss of competencies because of the outsourcing and as a result of the need to manage the flow of information in the network. Knowledge Management is also seen by many as an approach to increase competitiveness by rediscovering the resource based theory and by managing the intellectual capital of a business. Competitiveness can then be improved by increasing knowledge and this is done by becoming a learning organisation. A learning organisation can create knowledge. This need to create knowledge in order to remain competitiveness has become known as the *knowledge creation imperative*.

It is subsequently claimed in this study that one way of increasing knowledge could be by using Product Design as a Knowledge Creation Management Tool. Product Design is the ideal catalyst for knowledge creation as design is both a user of knowledge of other disciplines, as well as a producer of knowledge through the design process. A conceptual model of such a product design approach was constructed, indicating the flow of knowledge.

The reality, however, is that managers do not use design as widely as it might be. During this overview, mention was often made of design being used by various big companies. However, the use of design seems to be lacking in medium and small businesses. Some scholars claim that it is mainly as a result of a poor understanding of the benefits of design. The next step is therefore to explore how this misunderstanding can be overcome. The **overall aim of the research** was thus formulated as follows: *What should managers know about Product Design in order to use it as a Knowledge Creation Management Tool?* The next chapter explains the research methodology employed to achieve the aim of the research.

Chapter Four

Research Methodology

4.1 Introduction

The problem is how to increase competitiveness by using design. In response to the problem, and based on previous research, there is good reason to believe that design can contribute to businesses. Distinguished and refereed business journals have published articles and many scholars have concluded that design can contribute to the competitiveness of a company. In contrast, business managers do not use design as widely as it might be. Some say that it is mainly as a result of a poor understanding of the benefits of design. This raises the question of what managers need to know in order to manage the design resource as part of the strategic management of a company. This places the problem in the realm of Knowledge Management.

The overall research aim for this study was formulated as: *How can the competitiveness of businesses be improved through the application of Product Design as a Knowledge Creation Management tool?* This aim was achieved by reaching six objectives:

(a) *Evidence in the literature that product design can improve competitiveness:* Chapter Two, representing a survey of knowledge in the field to date, indicated that although product design could improve competitiveness, it is not used as widely as it might be. Some authors blame a poor understanding of the benefits of design.

(b) *The use of product design as a Knowledge Creation Management tool:*

Chapter Three provided an overview of management practices in the twenty-first century, emphasising globalisation, outsourcing, networking and the resultant need for Knowledge Management. The chapter also showed how Knowledge Creation Management can improve competitiveness, but a new approach is needed. A conceptual framework depicting this new approach, of focusing on Knowledge Creation Management by using Product Design, was then developed.

(c) *What managers should know about Product Design in order to use it as a source of knowledge creation:* This objective investigates what can be done to remedy the poor understanding of the

Table 4.1 Summary of research methods used

First objective	Literature survey
Second objective	Conceptual framework
Third objective	Questionnaire survey Focus groups
Fourth objective	Content analysis
Fifth objective	Testing the framework
Sixth objective	Model depicting contribution to theory and practice

benefits of design. The first part of Chapter Four describes how this investigation was done by means of a quantitative study using a questionnaire survey. The questions were based on the framework developed in the fourth objective. This was discussed by two focus groups who agreed in the main with the results of the questionnaire.

(d) *The education of future managers by tertiary institutions to use Product Design to increase competitiveness through Knowledge Creation Management:* The literature confirmed that Product Design could be a source of new knowledge, which in turn could increase competitiveness. To improve competitiveness, managers should be educated to use this new approach as depicted by the framework. The question is: Are they? The second part of Chapter Four describes how this objective was investigated by a qualitative analysis of the course content at South African tertiary institutions.

This chapter therefore concerns itself with explaining the methodology used in the investigation of the third and fourth objectives. The first section provides a general background to scientific research and introduces the principles of validity and reliability. The second section describes the questionnaire survey. This section explains the principles and application of judgement sampling, the principles of doing a survey through a questionnaire and the decision taken in compiling the questionnaire. The third section explains the procedures adopted by a focus group discussion to verify the result. The fourth section addresses the course content analysis. This section introduces qualitative research, the case study method and the decisions taken during the analysis of the course content. The results of all three methods are portrayed in Chapter Five.

4.2 Scientific research

4.2.1 Scientific inquiry

What makes a research or an inquiry scientific is the fact that a specific methodology is used. The methodology describes and analyses the methods used in the conducting of scientific inquiry (Garbers, s.a.: 9). The critical factor that separates social research from other ways of knowing about the social world is that it uses a scientific approach. Social research is more than a collection of methods and a process for creating knowledge; it is a process for producing new knowledge about the social world by using the scientific approach. Research methodology is what makes social sciences scientific. During research, scientists gather data, which are the empirical evidence or information that one gathers carefully according to rules or procedures. The data can be quantitative (expressed in numbers) or qualitative (expressed as words, pictures, or objects) (Babbie & Mouton, 2001).

Research, using the scientific method, displays six characteristics which distinguish it from other methods of inquiry:

(a) It is generated by a question.

- (b) It necessitates clarification of a goal.
- (c) It entails a specific programme of work.
- (d) It is aimed at increasing understanding by interpreting facts or ideas and reaching some conclusions about their meaning.
- (e) It requires reasoned argument to support conclusions.
- (f) It is reiterative in its activities (Walliman, 2001: 11).

Scientific research has many approaches. One approach is exploratory research, which is used in this study. When a researcher conducts an exploratory study, the aim is to find out more about a topic. Exploratory research is appropriate, according to Erwee (1996: D4), when the research objectives include:

- (a) Identifying problems.
- (b) Developing a more precise formulation of a vaguely identifying problem.
- (c) Gaining perspective regarding the character of the problem situation.
- (d) Establishing priorities regarding the potential significance of various problems or opportunities.
- (e) Identifying and formulating alternative courses of action.
- (f) Gathering information on the problem associated with doing conclusive research.

Finding out what managers need to know about design, is similar to its objectives (a), (b), (c), and (d). The recommendations are in line with objective (e).

Exploratory research has a less rigid approach to methodology. As far as the methodology of exploratory research is concerned, there is no formal or structured research design, according to Erwee (1996: D5). The design is best characterised by its flexibility and lack of structure. It is thus often better to use several data-gathering techniques to answer a research question. Using a variety of techniques has the benefit that it may provide different perspectives on the situation (Bouma, 2001: 182). Van der Merwe (1996: 282 – 283) suggests using a combination of quantitative and qualitative methods. Quantitative research, where the results are expressed in numbers, aims at testing theories, determining facts, statistical analysis, demonstrating relationships between variables, and prediction. Qualitative research, where the results are expressed in words and pictures, aims at the development of theories and understanding.

This section has shown that the methodology used and the research approach determines whether an inquiry can be scientific. One such research approach is exploratory research with a relatively flexible methodology including both quantitative and qualitative methods. This study followed such an exploratory research approach, combining quantitative and qualitative research. The qualitative research comprised a questionnaire that investigated the third objective: what managers should know about designing new products. The quantitative research comprised an analysis that investigated the fourth objective: the applicability of the education of future managers with regard to designing new products,

or, alternatively, using innovation as a source of new knowledge creation. The combined approach need to satisfy certain criteria to be scientific, one of which is the validity of the research.

4.2.2 Validity

One of the most critical issues that precede data collection is validity. Validity refers to the correctness or credibility of a description, conclusion, explanation, interpretation or other sort of account. Validity refers to the design of research to provide credible conclusions: whether the evidence that the research offers can bear the weight of the interpretation that is put on it. What has to be established in order that the report's conclusions can be believed is that the arguments embodied in the report are valid, meaning that the data measure or characterise what authors claim, and that the interpretations follow from them. The structure of a piece of research determines the conclusions that can be drawn from it and, more importantly, the conclusions that should not be drawn from it (Bouma, 2001).

Validity is a goal rather than a product. Validity is relative: it has to be assessed in relationship to the purpose and circumstances of the researcher. Walliman (2001: 132) states that when the premise of an argument is related to the conclusion in such a way that the conclusion must be true if the premise is true, then the argument is said to be valid. Different types of validity can be identified:

- (a) *Description*. The main threat to valid description, in the sense of describing what one saw and heard, is the inaccuracy or incompleteness of the data. Data need to be recorded. Audio or video recording of observations and interviews and verbatim transcriptions of these recordings largely solves this problem.
- (b) *Interpretation*. The main threat to valid interpretation is imposing one's own framework or meaning, rather than understanding the perspective of the people studied and the meaning they attach to their words and actions. The most important checks on such validity threats is to attempt, seriously and systematically, to learn how the participants in the study make sense of what is going on, rather than pigeonholing their words and actions in the researcher's own framework.
- (c) *Theory*. The most serious threat to the theoretical validity of an account is not collecting or paying attention to discrepant data, or not considering alternative explanations or understandings of the phenomena the researcher is studying (Maxwell, 1996: 89).

There are two specific validity threats, namely bias and reactivity.

- *Researcher bias*. Two important threats to the validity of qualitative conclusions are the selection of data that fit the researcher's existing theory or preconceptions and the selection of data that stand out to the researcher. It is, however, impossible to deal with these problems by eliminating the

researcher's theories, preconceptions or values. This impossibility is one aspect of what has been called the inherent reflexivity of qualitative research.

- *Reactivity*. The influence of the researcher on the setting or individuals studied, is a problem generally known as reactivity. Eliminating the actual influence of the researcher is impossible and the goal in a qualitative study is to use it productively. What is important to understand is how the researcher influences the data and how this affects the validity of the inferences that can be drawn from the study (Maxwell, 1996: 90).

The design of the questionnaire in this study maximised the validity and minimised the threats of bias and reactivity. The validity of the questionnaire survey was established by obtaining a list of issues from designers, then verifying these issues with designers in interviews, discussing the final questionnaire with designers, and finally conducting a pilot study in which designers could comment on the composition of the questionnaire. The self-administered questionnaire was completed without the presence of the researcher. The questions were graded on a Likert scale, which further reduced subjectivity in the interpretation. In respect of sampling, the researcher carefully selected the groups, and then individuals in each group completed the questionnaire voluntarily. The final decision to participate was thus made by respondents who selected themselves.

This section has shown that any research should have a high degree of validity. The research project should be designed to provide credible conclusions from which valid interpretations can be made. Although validity can be threatened by bias and reactivity, the design in this study minimised these influences as far as possible.

4.3 Questionnaire survey

The third research objective was achieved by a survey, using a questionnaire. This section provides a background explaining how a survey is used to measure attitudes, often with Likert scales. The section also indicates how one of the most popular ways of conducting a survey is by means of a questionnaire, which is then discussed. Thereafter this section explains the actual procedures followed when using this questionnaire, starting with the sampling procedure, followed by an explanation of the decisions taken in the course of this research.

4.3.1 Using questionnaires

The survey is the most widely used data-gathering technique. Surveys give the researcher a picture of what many people think or report doing. A survey researcher asks people, called respondents, questions in a written questionnaire or during an interview and then records the answers. The researcher does not manipulate a situation or condition; people simply answer questions. In survey research, the

researcher asks many people numerous questions in a short time period. He or she typically summarises answers to questions in percentages, tables, or graphs. The survey researcher follows a deductive approach. He or she begins with a theoretical or applied research problem and ends with empirical measurement and data analysis (Bouma, 2001: 68 – 70).

Surveys produce quantitative information about the social world and describe features of people. They are used to explain or to explore. The survey asks people about their beliefs, opinions, characteristics, and past or present behaviour. Surveys are appropriate for research questions about self-reported beliefs or behaviours (Neuman, 1997: 228).

A survey provides information on the attitudes of people. Most researchers (for example Oppenheim, 1996: 174) seem to agree that an attitude is a state of readiness, a tendency to respond in a certain manner when confronted with certain stimuli. Attitudes, like many other determinants of behaviour, are abstractions – though they are real enough to the person who holds them. It would be possible to argue persuasively that in the final analysis everything in life depends on people's attitudes. We become particularly aware of the strengths and persuasiveness of attitudes when we try to change them. Attitudes have many attributes. Apart from their content – what the attitudes are about – an attitude also has intensity. It may be held with greater or lesser vehemence. The attribute of intensity can be very important in understanding how attitudes function.

Although attitudes are not always easy to measure, it can be done. After studying the literature on the subject, the researcher must begin with a series of in-depth interviews, the essential purpose of which is two-fold:

- (a) to explore the origins, complexities, and ramifications of the attitude areas in question, in order to decide more precisely what it is that the researcher wishes to measure (conceptualisation) and
- (b) to obtain vivid expressions of such attitudes from the respondents, in a form that might make them suitable for use as statements in an attitude scale (Oppenheim, 1996: 178).

Attitudes can be measured by using attitude scales. Attitude scales consist of items – usually attitude statements – with which the respondent is asked to agree or disagree. Attitude scales are relatively overt measuring instruments designed to be used in surveys. They are not designed to yield subtle insights in individual cases and should not be used as clinical instruments. Their chief function is to divide people roughly into a number of broad groups with respect to a particular attitude. They are techniques for placing people on a continuum in relation to one another, in relative and not in absolute terms (Walliman, 2001: 77 – 81).

No amount of statistical manipulation will produce a good attitude scale unless the ingredients are right. The most advanced scaling techniques and the most error-free procedures will not produce an

attitude scale worth having unless there have been a good deal of careful thought and exploration, many in-depth interviews, repeated conceptualisations and unless the attitude statements have been written with the necessary care. The traditional methods of attitude measurement are best viewed and evaluated in relation to the linear-scaling model. The model has the following requirements:

- (a) Uni-dimensionality or homogeneity – the scale should be about one thing at a time, as uniformly as possible.
- (b) Reliability – the indispensable attribute of consistency.
- (c) Validity – the degree to which the scale measures what it set out to measure.
- (d) Linearity and equal or equal-appearing intervals – to make quantitative scoring possible (Oppenheim, 1996: 188).

One example of an attitude scale is the Likert scale. Likert scales are widely used and very common in survey research. They were developed in the 1930s by Rensis Likert to provide an ordinal-level measurement of a person's attitude. Likert scales are called summated ratings or additive scales because a person's score on the scale is computed by summing the number of responses the person gives. Likert scales usually ask people to indicate whether they agree or disagree with a statement. While Likert scales need a minimum of two categories, it is usually better to use four to eight categories. A researcher can combine or collapse categories after the data is collected (Bouma, 2001: 73 – 74).

Likert scales are a very good method for measuring a person's attitude, but there are disadvantages. Likert's primary concern was with uni-dimensionality – making sure that all the items would measure the same thing. He also wanted to eliminate the need for judges, by getting subjects in a trial sample to place themselves on an attitude continuum for each statement. Attitude scales rely for their effectiveness on the co-operation and frankness of the respondents. This may have its disadvantages. A respondent may try to fake or give a great many *uncertain* responses. Fear, misunderstanding, the desire to place oneself in a more favourable light, social taboos, dislike of the research and other motives may all play a part in distorting the results (Babbie & Mouton, 2001).

When using a survey to conduct research, there are also some other general considerations that have to be borne in mind. Some of these considerations are:

- (a) The main type of data collection instruments which will be needed, such as interviews, postal questionnaires, content analysis of records, observational techniques.
- (b) The method of approach to respondents (after their selection through the sampling procedures), stated purpose of the research, length and duration of the questionnaire, confidentiality and anonymity.
- (c) The build-up of question sequences or modules within the questionnaire, and the order of questions and scales or other techniques within a general framework.
- (d) For each variable, the order of questions within each module, using approaches such as funnelling.

- (e) The type of question to be used: for example 'closed' questions with pre-coded answer categories versus free-response questions (Oppenheim, 1996: 101).

One of the most popular ways of conducting a survey is by means of a questionnaire. According to Erwee (1996: E18) the questionnaire remains the most widely used data-collection method in social research today primarily because of convenience and economy. A questionnaire can be defined as a formalised schedule for collecting data from respondents (Erwee, 1996: E1). Self-administered questionnaires are one of the most frequently used methods. A self-administered questionnaire is an instrument used to collect information from people who complete the instrument themselves (Bourque & Fielder, 1995: 3).

There are two types of self-administered questionnaires, best described as the ends of a unidimensional continuum. At one end are questionnaires that people answer in the presence of the surveyor or other supervising personnel. At the opposite end of the continuum are questionnaires completed by the respondent outside the presence of the surveyor or other monitoring personnel. Questionnaires sent through the mail provide the most common example of unsupervised administration (Bourque & Fielder, 1995: 3). Lately electronic questionnaires have become possible as a result of the technological advances in information technology. According to Bourque and Fielder (1995: 7), when a questionnaire is administered completely unsupervised, it is imperative that the questionnaire be completely self-sufficient, or able to stand alone. In such situations no member of the research staff is available to answer questions or ensure that the correct person completes the questionnaire or, indeed, that anyone completes it.

When completely unsupervised questionnaires are used, it is imperative that a pilot investigation is held to test whether the questionnaire can stand alone. According to Sapsford and Victor (1996: 103), a pilot investigation is a small-scale trial before the main investigation, intended to assess the adequacy of the research design and of the instruments to be used for data collection. Another important purpose of a pilot, is to devise a set of codes or response categories for each question which will cover, as comprehensively as possible, the full range of responses which may be given in reply to the question in the main investigation. For this to work effectively, the pilot sample must be representative of the variety of individuals which the main study is intended to cover. It is therefore better to construct a purposive sample for a pilot study so that the full range of individuals and their possible responses are covered (Sapsford and Victor, 1996: 103).

Some principles of good question writing, according to Bouma (2001: 69 – 71), are:

- (a) Clarify exactly what it is you want to know.
- (b) Be direct and simple when asking questions.
- (c) Only ask questions that are directly related to the project.
- (d) Make sure that each question is clear and elicits a simple response of fact.
- (e) Discourage respondents from giving vague, general answers.

- (f) Be sure that respondents are willing to answer your questions.
- (g) Avoid informal terms and abbreviations.
- (h) Avoid asking questions that raise more than one issue.
- (i) Try not to use colourful or emotional language.
- (j) Do not word questions in such a way that the respondent is placed in an impossible situation.
- (k) Examine your questions for assumptions that may be wrong.
- (l) It is always a good idea to trial the questionnaire.

A questionnaire has a specific order or sequence. A questionnaire has opening, middle, and ending questions. After an introduction explaining the survey, it is best to make opening questions pleasant, interesting, and easy to answer so that they help a respondent to feel comfortable about the questionnaire. Questions in the middle are organised into common topics. Placing questions on the same topic together and introducing the section with a short introductory statement can orientate respondents. Question topics should flow smoothly and logically, and be organised to assist respondents' memory or comfort levels. Do not end with highly threatening questions, and always end with a *thank you* (Neuman, 1997: 245).

Once the data is collected, it needs to be coded and analysed. Data coding means systematically reorganising raw data into a format that is machine readable, i.e., easy to analyse using computers. Researchers use a coding procedure and a codebook for data coding. The coding procedure is a set of rules. Most computer programs designed for data analysis need the data in a grid format. In the grid each row represents a respondent, subject, or case. A column or set of columns represents specific variables (Neuman, 1997: 295). The response category of *Other (specify) ...* is often included in the codes for closed questions as a way of avoiding a complete foreclosure of the researcher's options (Sapsford & Victor, 1996: 103).

Analysing the data can be done through various statistical techniques. When most social researchers look at a variable they are usually interested in the central tendency, that is to say, in the location of most people or the typical person on that scale. The *measures of central tendency* tell where the centre of the distribution lies. There are three main measures of central tendency: the mean, the median and the mode (Wright, 1997: 11).

- (a) The mean, which is the arithmetic average of observations, is by far the most common.
- (b) The median, which is the middle observation. Half the observations are smaller and half are larger.
- (c) The mode of a distribution, which is the value of the observations that occur most frequently. It is commonly used when you want to show the most popular value (Fink, 1995: 17 – 19).

The *measures of dispersion* indicate how spread out the distribution is. The range is the difference between the highest and the lowest value, sometimes called the maximum and the minimum. The range only tells the extreme scores of a variable's distribution. The most common measure of dispersion that uses information from all the scores is the standard deviation. It is a measure of the

distance of the scores from the mean in the sample (Wright, 1997: 29 – 30). The smaller the number is, the more similar are the answers. It is therefore an indication of how strongly the respondents agree on the answer. A small standard deviation is an indication of strong unanimity between the answers at the central point while a high standard deviation indicates strong dispersion of the answers around the central point.

This section introduced surveys as the most popular data gathering technique and the questionnaire as one of the most popular ways of conducting a survey. A survey can measure attitudes and the Likert scale is a well-used example, although not without disadvantages. A self-administered questionnaire can be very efficient, but should be properly drawn up and tested during a pilot study. Once the data is collected, it needs to be coded and analysed through various statistical techniques. The process of applying a questionnaire begins with the first step, which is to establish a sampling procedure.

4.3.2 Sampling procedure

As it is impossible to capture data from everybody involved in a certain area, it is necessary to select a certain sample of that which is representative of the population. In statistical analysis considerable care is taken to select a sample from a parent population in such a way that no bias is introduced to the sample. The implication of the notion of *no bias*, is that the examples in the sample are not selected in a way that would reflect the characteristics of the parent population inaccurately.

The procedures for achieving no bias are varied, the most straightforward of which is the simple random sample. The assumption behind this procedure is that if the instances for inclusion in the sample are selected in a way that excludes any possibility of biased selection, the characteristics of the sample will reflect those of the parent population within some range of certainty that may be estimated using the assumptions of probability theory. By this procedure the sample is typical of the parent population, or, in common terminology, it is a representative sample (Mitchell, 2000: 175 –176).

Although simple random sampling with perfect representativity is the ideal, it is not always possible. Perfect representativity can be obtained by a probability sample. A probability sample is representative of a population if all the elements in the population have an equal chance of selection in that sample. Each population element has thus a known nonzero probability of selection (Bouma, 2001:124). In qualitative studies with large sample sizes random or probability sampling is a valid and often appropriate procedure. However, simple random sampling is a poor way to draw a small sample, owing to the high likelihood of chance variation. Most of the advantages of randomisation depend on a reasonably large sample size to make such variations unlikely. Sometimes other sampling procedures need to be considered (Walliman, 2001: 233).

Most sampling in qualitative research is purposeful sampling. This is a strategy in which particular settings, persons or events are selected deliberately in order to provide important information that cannot be obtained as well from other choices (Maxwell, 1996: 70). Purposeful sampling can also be described as judgement sampling. For preliminary investigations and for some parts of the pilot work, researchers sometimes draw a judgement sample. Purposive sampling is an acceptable kind of sampling for special situations. It uses the judgement of an expert in selecting cases or it select cases with a specific purpose in mind. It is used in exploratory research. The terms *purposeful sampling*, *purposive sampling* and *judgemental sampling* are often used by various authors to denote the deliberate, purposeful selection of individuals based on the judgement of the researcher to participate in a particular study (Babbie & Mouton, 2001).

There are situations in which purposeful sampling is the only feasible way to proceed, for example, in attempting to learn about a group that is difficult to gain access to, or a category of people who are relatively rare in the population and for whom no data on membership exist. A researcher may use purposive sampling to select members of a difficult to reach, specialised population. This method of sampling really means that accurate parameters for the population are lacking, but it is based on the assumption that the investigators have done their best to obtain as wide a spread of individuals as possible (Oppenheim, 1996: 43).

There are at least two possible goals for purposeful sampling, according to Maxwell (1996: 71):

- (a) The first is achieving representativeness or typicality of the settings, individuals or activities selected. Because random sampling is likely to achieve this only with a large sample size, it usually makes more sense in a small-scale study to deliberately select cases, individuals or situations that are known to be typical. A small-scale sample that has been systematically selected for typicality and relative homogeneity provides far more confidence that the conclusions adequately represent the average members of the population than does a sample of the same size that incorporates substantial random or accidental variation.
- (b) The second goal that purposeful sampling can achieve is the opposite of the first – to adequately capture the heterogeneity in the population. The purpose here is to ensure that the conclusions adequately represent the entire range of variation, rather than only the typical members or some subset in this range. This process resembles that used for stratified random sampling; the main difference is that the final selection is purposeful rather than random.

In achieving the third objective through the questionnaire, the sampling method used was purposive or judgemental sampling, as random sampling was not possible. The aim of the questionnaire centred on the opinions of designers. A random selection of designers involved in Design Management was not possible as such a list is neither available nor likely to be created. Designers were thus purposefully selected. The selection criteria were qualified designers or knowledgeable people in the area of design

management. It was deemed that the two groups mentioned below are all knowledgeable about design and therefore meet the criteria for purposive sampling.

Two groups were selected: the Design Management electronic newsletter and the PHD-Design discussion list. The first group consisted of recipients of an electronic newsletter on Design Management over the previous two years. The questionnaire was sent electronically to the list of 474 email addresses. As the recipients of the newsletter either requested that their names be added to the list, or did not request the removal of their names if a copy of the newsletter was sent to them, it was reasonable to assume that they were interested in Design Management.

The second group was identified as members of the PHD-Design discussion list. The list hosted commentary from scholars and practitioners in design. Subscription is free and contributions are sent via email to all subscribers. This list draws together researchers in design, and includes many who are knowledgeable about Design Management. An announcement was posted to the list, inviting everybody interested in Design Management to complete the questionnaire, which was hosted on a website.

Respondents in the two groups ultimately selected themselves, as participation was voluntary, further increasing the validity of the research (Wellman, *et.al.* 2005: 69). The respondents also came from a very homogenous population, everybody being designers. Authors on research methodology (for example Wellman, *et al* 2005: 72 and Walliman, 2005: 279) agree that if the population is very homogenous, a small sample will give a fairly representative view of the whole.

Purposive sampling is not without its risks. There is the risk that the sample will represent only a particular sector of the population and that only roughly. The trade-off between purposive sampling and selecting a more homogeneous sample is that you have less data about any particular kind of case, setting or individual within the study and will not be able to say as much in depth about typical or modal instances. The result is that one cannot safely generalise from such a sample. Purposive sampling is a device for generating insights, anomalies, and paradoxes, which later may be formalised into hypotheses that can be tested by quantitative social science methods (Neuman, 1997: 207).

If a purposive sampling is studied, only tentative generalisations may be made. The conclusion drawn from a comparison of a few typical rural schools with a few typical urban schools might be phrased in this way: *The results of this study comparing three rural and three urban schools have revealed the following six major differences. While it is not strictly possible to generalise from this sample to all rural and urban schools, we think it is likely that these differences will be found in other instances* (Bouma, 2001: 122).

This section indicated the necessity of sampling and then explained the sampling procedure used in achieving the third objective. Purposive or judgemental sampling was the most feasible, although not

without its risks and limits, for example, its generalisation ability. Information was obtained from this sample by way of a questionnaire, which is the topic of the next section.

4.3.3 Research steps taken

Whereas the previous section refers to the general use of a questionnaire, this section provides an overview of the decisions taken in developing the questionnaire used in this study. It first describes how the questions were set and then the research process.

Prior research: The first problem was what questions to ask in order to establish what managers should know about product design. The decision was made to ask designers. Prior research was thus done to provide a source of data (Maxwell, 1996: 43). This was done via an open-ended question, sent to qualified designers who are staff members of the Faculty of the Built Environment and Design at the Cape Technikon. The question was: *What would you like business managers to know about design in order for them to be able to integrate it into their business strategy? Please make a list of issues. It can be as long as you like.*

In this prior research, judgemental sampling was used. Designers at the Cape Technikon were selected, because of their accessibility for follow-up interviews. It was envisaged that a number of interviews would be held to clarify certain issues. Interviews were indeed necessary as the responses were slow and often very vague. Four in depth interviews, apart from numerous informal discussions, were held to clarify the issues. From this preliminary research a list of issues was collated that designers felt were important. These issues were then reworded into questions and a questionnaire developed.

Two interesting terms were developed in the process. A broad term was needed, which could refer to the outcome of more than one design process. The term *design application* was formulated and defined as referring to the application of the result of the design process, e.g., a new or improved product, an advertisement or a shop/office interior. In line with knowledge management, the term *design information* was used in the questionnaire and defined as the information contained in the design application. This approach sees the design application as a bundle of information, e.g., the information reflected in the drawings, technical specifications, or scale models.

Research process: The decisions taken in each step were thus as follows:

The design and planning phase

- (a) Decide on type of survey, type of respondent and the population. It was decided to use a self-administered questionnaire. Respondents were identified as qualified designers and managers who are knowledgeable about the design process.
- (b) Develop the survey instrument/ questionnaire. The issues established through the prior research were taken as the basis of the survey. Other information, such as demographics, was included in order to ensure validity and representativity.
- Write questions to measure variables. The demographic information was phrased in six questions and numbered Question 1.1 to 1.6. The issues raised during the prior research process were formulated as 43 questions. The questions were grouped into six topical sections and numbered Question 2.1 to 7.4.
 - Decide on response categories. All the issues were graded on their importance using a four-point Likert scale. The categories were *totally unimportant*, *unimportant*, *important* and *totally important*. The first two categories can be added together to provide the total response for "unimportant" and the last two can be added for a total response of "important".
 - Organise question sequence. The questionnaire was organised in seven sections:
 - Section 1: Demographic information, six questions.
 - Section 2: Contribution of design, seven questions.
 - Section 3: Integration of design, seven questions.
 - Section 4: Process of design, sixteen questions.
 - Section 5: Presentation of design, five questions.
 - Section 6: Implementation of design, four questions.
 - Section 7: Risk analysis of design, four questions.
 - Design questionnaire layout. Two columns were used. The questions were on the left and the four response categories were on the right.
- (c) Plan a system for recording answers. The answers of the respondents were entered into an Excel spreadsheet, from which the statistical analysis was made. Rows one to seven counted the number of responses that equal one to seven respectively. (Row 1 counted all the ones, row 2 counted all the two's etc.) Although there were only four intervals on the Likert scale, Question 1.4 (industry) had seven categories. Row eight summed the total of the responses. Rows nine and ten calculated the average and standard deviation respectively. Row eleven was kept open and rows

12 and 13 were used as headings corresponding to the numbers of the questions. Each row, from 14 – 174, represented one of the 160 respondents. Column B – AX represented the answers to the questions. The Excel spreadsheet is attached as Annexure D.

(d) Pilot test the instrument. The final questionnaire was first discussed with designers and then 35 were distributed to designers of the Faculty of Built Environment and Design as a pilot test. A note was attached to each questionnaire inviting comments. Fourteen (or 40%) of these questionnaires were returned, six with comments, and interviews were held with a further four respondents. As a result changes were made to the categories in the demographic section and definitions were added to two terms, design application and design information. The final questionnaire is attached as Annexure A.

(e) Draw the sample

- Define target population. The target population was qualified designers or people knowledgeable about design management.
- Decide on type of sample. Judgement or purposive sampling was used based on the above as selection criteria.
- Develop sampling frame. List members of the electronic Design Management newsletter and the PHD-Design discussion list.

(f) Select sample. The sample was selected electronically.

The data collection phase

(g) Locate and contact the respondents. An email was sent to all the list members of the Design Management Newsletter, and an announcement was posted on the PHD-Design discussion list. The questionnaire was attached to the first email as an MS Word document. The questionnaire was also posted on a website for easy access.

(h) Make introductory statements or provide instructions. The questionnaire contained an introduction and instructions.

(i) Ask questions and record answers. The answers were returned electronically to the researcher. In the end 46 respondents (29%) completed the MS Word document and 114 respondents (71%) completed the questionnaire online.

(j) Thank respondents. The questionnaire contained a thank you note and provided the option to enter an address should the respondent wish to receive a copy of the result. In total 44 respondents provided email addresses.

(k) End data collection and organise data. The data was entered into the Excel spreadsheet and the statistical calculations were done. Coding was developed for the first question. The options were numbered sequentially. In the case of gender, it was one to two and in the case of industry, it was one to seven. The full coding is attached as Annexure B. As Questions 2 to 7 contained Likert-scale intervals, no coding was necessary. Annexure C contains a questionnaire with a summary of the results for each question filled in. The full Excel spreadsheet, showing all the calculations, is attached as Annexure D.

4.4 Qualitative research

4.4.1 Introduction to qualitative research

Qualitative research involves the studied use and collection of a variety of empirical material such as case studies, personal experience, introspection, life stories, interviews, artefacts, cultural texts and productions. Accordingly, qualitative researchers deploy a wide range of interconnected interpretive practices, hoping always to get a better understanding of the subject matter at hand (Denzin & Lincoln, 2000: 3). The word *qualitative* implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally measured in terms of quantity, amount, intensity, and frequency (Denzin & Lincoln, 2000: 8).

The qualitative research approach differs from the quantitative research approach in many aspects. According to Neuman (1997: 29), in qualitative research, for example, a case study analysis, a researcher examines many features of a very few cases in depth. The data are usually more detailed, varied, and extensive. It differs from quantitative research where a researcher precisely measures a common set of features on many people or units. According to Van der Merwe (1996: 282), qualitative research aims at the development of theories and understanding, while quantitative research aims at testing theories, determining facts, statistical analysis, demonstrating relationships between variables, and prediction.

Case studies have become one of the most common ways of doing qualitative inquiry, but they are neither new nor essentially qualitative. Most case study inquiries are a combination of qualitative and quantitative research (Stake, 2000: 437). The case study method, as an example of the qualitative research approach, can answer the question: *What is going on here?* It is usually an exploratory study in which no hypothesis is tested. The researcher simply wants to know what is going on inside the entity (Bouma, 2001: 91).

Case studies are often described as exploratory research as they are used in areas where there are few theories or a deficient body of knowledge. While hypothesis-testing research deals with the general and the regular, case studies are directed towards understanding the uniqueness and the

idiosyncrasy of a particular case in all its complexity (Welman & Kruger, 1999: 190). Qualitative research is designed to provide an impression; to tell what kinds or types of *something* there are. Case studies are therefore not usually appropriate for testing causal relationships. This is due to the fact that several variables are operating, and the case study design is not structured to isolate the influence of any individual variable (Bouma, 2001: 92).

Qualitative data are in the form of text, written words, phrases, or symbols describing or presenting people, actions, and events in social life. Except for the occasional content analysis study, qualitative researchers rarely use statistical analysis. This does not mean that qualitative data analysis is based on speculation or on vague impressions. It can be systematic and logically rigorous, although in a different way from quantitative or statistical analysis. Qualitative researchers sometimes use variables, but more often they use general ideas, themes, or concepts as analytic tools for making generalisations. Qualitative analysis often uses nonvariable concepts. A qualitative researcher analyses data by organising it into categories on the basis of themes, concepts, or similar features (Neuman, 1997: 418, 421).

4.4.2 Study of textual material

The course content analysis is a specific example of content analysis, using textual material. The approach to use textual material can be quantitative, which counts frequencies of themes, phrases or ideas or the approach can be more qualitative, using the text as a window on some aspect of life (Bouma, 2001: 182). Content analysis is a technique for examining information, or content, in written or symbolic material. When studying textual material, different types of texts have to be understood in the context of their conditions of production and reading. Words are spoken to do things as well as to 'say' things. Once words are transformed into a written text, the gap between the author and the reader widens and the possibility of multiple reinterpretations increases. The text can say many different things in different contexts (Hodder, 2000: 704).

In content analysis, a researcher first identifies a body of material to analyse and then creates a system for recording specific aspects of it (Neuman, 1997: 31). In the recording process a researcher organises the raw data into conceptual categories and creates themes or concepts, which is then used to analyse data. The crucial requirement in such an approach, according to Silverman (2000: 826), is that the categories are sufficiently precise to enable coders to arrive at the same results when the same body of material is examined. Neuman (1997: 421) suggests two forms of coding:

- (a) *Open coding*: During open coding, a researcher focuses on the data themselves and assigns code labels for themes. The researcher locates themes and assigns codes or labels to condense the mass of data into categories. This is done by looking for critical terms, key events, or themes, which are then noted.

- (b) *Axial coding*: During axial coding the researcher focuses on the initial coded themes more than on the data. Axial coding stimulates thinking about linkages between concepts or themes. It reinforces the connections between evidence and concepts.

Coding has many advantages, but also disadvantages. One of the disadvantages of coding schemes used in text-base analysis is that, because they are based on a given sets of categories, they furnish a powerful conceptual grid from which it is difficult to escape. Although this grid is very helpful in organising the data analysis, it also deflects attention away from uncategorised activities. The problem is, however, not simply overlooked categories, but how analysts coin and apply whatever categories they do use. Analysts' ability to categorise can indeed be treated as a research topic rather than a research resource (Silverman, 2000: 825).

Like all research methods, case studies also need a key variable. The key variable represents that characteristic or attribute in the situation that is the focus of the research and the basis of the problem or question. In explanatory research it is that aspect of the situation that needs investigating (Kervin, 1992: 67). The key variable in this analysis is the level of education in creativity or innovation.

In the evaluation of textual material the interpreter has to deal simultaneously with three areas of evaluation, according to Hodder (2000:711):

- (a) The interpreter has to evaluate and identify the context within things that had similar meaning. The notion of context is always relevant when different sets of data are compared and where a primary question is whether the different examples are comparable, and/or whether the apparent similarities are real.
- (b) The interpreter has to evaluate and recognise similarities and differences. The interpreter argues by showing that things are done similarly, that people respond similarly to similar situations, within its boundaries. The assumption is made that within the context similar events or things had similar meaning. But this is true only if the boundaries of the context have been correctly identified.
- (c) The interpreter has to evaluate the relevance of general or specific historical theories to the data at hand. Observation and interpretation are theory laden, although theories can be changed in confrontation with material evidence in a dialectical fashion.

This section showed how a researcher can identify a body of material and analyse it by creating a system of recording specific aspects. A coding process can assist researchers to evaluate textual material.

4.4.3 Applicability and generalisability

Another question that arises from the methodology used in case study analysis is that of applicability. The question *To whom do your conclusions apply?* can be answered in a narrow sense and in a broader sense. On the one hand, the conclusions are limited to the sample studied and to the population of which it is representative. This is the narrow interpretation of a conclusion. The narrow interpretation of the applicability of conclusions is based on the limitations imposed by the sampling procedure selected (Bouma, 2001: 214). The conclusions regarding the data apply to those from whom the data was collected, or to the larger population of which they are a representative sample.

On the other hand, research is done to gain some understanding about larger issues. Some of the conclusions refer to the implications of the research findings for those larger issues. This is the broader sense of the applicability of the conclusion. In drawing conclusions, the researcher moves from the narrow conclusions derived from the findings of the study to the implications of those findings for the larger issues. It is in this sense, that conclusions have a broader applicability (Bouma, 2001: 214).

In qualitative research, when drawing the implications, a much more tentative style of expression is adopted such as *It may well be that ...*, or *Additional research is required ...* (Bouma, 2001: 214). In drawing conclusions, the first step is to restate the empirical finding. This part of the conclusion applies narrowly and strictly to those studied or the population of which they are a representative sample. Then the implications of the empirical findings for the more general issues are discussed. In this the findings are related to a broader context and made more generally relevant.

Closely linked with the question of applicability is the question of generalisability. Qualitative researchers usually study a single setting or a small number of individuals or sites, using theoretical or purposive rather than probability sampling, and they rarely make explicit claims about the generalisability of their accounts. According to Stake (2000: 439), the search for particularity in case studies competes with the search for generalisability. What should be said about a single case is quite different from what should be said about all cases. Each case has important atypical features, happenings, relationships, and situations. Pursuit of understanding of those atypicalities not only robs time from the study of the generalisable but also diminishes the value, to some extent, that is placed on demographic and policy issues.

This does not mean, however, that generalisations cannot be made at all. It is important to distinguish between internal and external generalisability. Internal generalisability refers to the generalisability of a conclusion within the setting or group studies, whereas external generalisability refers to its generalisability beyond that setting or group. Internal generalisability is an issue for qualitative case studies where the descriptions, interpretations and theoretical validity of the conclusions all depend on their internal generalisability to the case as a whole (Maxwell, 1996: 96).

External generalisability is difficult as qualitative studies often serve to illuminate cases that are atypical, but can be done in the following circumstances:

- (a) Qualitative studies often have face generalisability: there is no obvious reason not to believe that the results apply more generally.
- (b) The generalisability of qualitative studies usually is based, not on explicit sampling of some defined population to which the results can be extended, but on the development of a theory that can be extended to other cases.
- (c) There are a number of features that lend plausibility to generalisations from case studies or non-random samples, including respondents' own assessments of generalisability, the similarity of dynamics and constraints to other situations, the presumed depth or universality of the phenomenon studied, and corroboration from other studies. All of these characteristics can provide credibility to generalisations from qualitative studies, but none permit the kinds of precise extrapolations to defined populations that probability sampling does (Maxwell, 1996: 97).

On the one hand, qualitative research has, as far as applicability and generalisability are concerned, a limited scope, where the findings only refer to the sample population or a closely representative group. On the other hand, qualitative research has also a broader scope beyond this group, but then implications and generalisations should be stated tentatively.

4.5 Focus group research

The third research objective, what managers should know about product design, was achieved by a questionnaire survey. This investigation was supplemented by two focus group discussions that in the main agreed with the results (Fern, 2001: 13). Focus groups are normally associated with a qualitative methodology and can therefore not provide hard quantitative data that can be subject to statistical or numerical analysis. They are used to gather data relating to the feelings and opinions of a group of people who are involved in a common situation. A focus group is thus defined as a carefully planned discussion, designed to obtain the perceptions of the group of members on a defined area of interest (Langford & McDonagh, 2003: 2).

A focus group consists of a group of people, usually between six and twelve, who agree to meet with the researcher to discuss issues raised by the researcher. The researcher facilitates the discussions, ensuring that the discussion stays on the topic, but does not express views on the topic. The focus group allows the researcher to identify certain issues (Bouma, 2001: 181 – 182). Focus groups are generally used two ways within the qualitative paradigm. The first is to obtain individual responses from everyone in an effort to save time and money. The second is to use the group to find information

you would not otherwise be able to access. These focus groups tend to allow a space in which people may get together and create meaning among themselves, rather than individually (Babbie & Mouton, 2001: 292).

As in any research method, validity and generalisability must be ensured in focus group research. Focus group validity refers to the validity of the inferences drawn from the study. External validity refers to generalisability and representativeness. Judgemental or purposive sampling does not affect the representativeness of a focus group. The representativeness of any effect is thought to depend on a study's internal validity. Internal validity establishes the ground rules for the detection of empirically generalisable effects. The existence of some set of responses uncovered by focus groups is generalisable to some larger population, if three conditions are present: First, the sample of respondents recruited for the focus group must be representative of the relevant population of respondents. Second, the number of characteristic responses expected should be relatively small, i.e., less than twelve. Third, the respondents must be recruited independently of one another (Fern, 2001: 123 – 125).

The participants of a focus group discussion should be chosen carefully through purposive sampling, as opposed to random sampling for surveys, by selecting participants belonging to specific groups. The participants need to be reasonably knowledgeable about the topic, and should be interested in talking about it. The recruitment should be decided upon in close conjunction with the objectives of the research (Bruseberg & McDonagh, 2003).

In response to the above, it was decided to use purposive sampling for both focus groups. For the first experienced product designers were invited and for the second experienced marketing managers were invited. The results can therefore be generalised, as the three conditions mentioned by Fern have been met; First, the samples were recruited from representatives of the intended population. There was, in actual fact, a close resemblance to the questionnaire respondents in terms of the biographical information of the product design focus group. Second, the respondents were limited to discuss the results of the questionnaire. Third, the respondents were recruited individually by way of a personal invitation.

A key benefit of focus groups is that researchers interact directly with participants. The interviewer can explore the responses given to questions or comments and thus discover more about individuals' perceptions and views. They can probe the accuracy of comments and ask follow-up questions to clarify or qualify responses given. While the above could be said to apply to all interview techniques, focus groups have the additional advantage in that group members can react to and build upon the responses and comments of others. This synergistic effect often leads to the emergence of information or creation of ideas that would otherwise not have occurred (Langford & McDonagh, 2003: 2). This synergistic effect was observed during the discussion of the second question in the focus group. Group members built on one another's suggestions.

Focus groups can be incorporated with a variety of other research methods. To reduce the risk of incorrect conclusions being drawn, it is common to carry out several different research methods in parallel, or to confirm other research findings. A common method is to follow up a questionnaire survey with a focus group discussion to confirm the results (Bruseberg & McDonagh, 2003). In both focus group discussions, the objective was to compare the opinions of the focus group with the results of the questionnaire survey. Whereas both groups agreed with most of the results, they did differ in a few instances.

4.6 Course content analysis

The fourth research objective, whether future managers are educated by tertiary institutions to use Product Design to increase competitiveness through Knowledge Creation Management, was achieved by analysing the course content of future managers, using a case study method. This section explains the process used in the course content analysis. It first provides an overview of qualitative research, followed by a discussion on the study of textual material, and finally attends to the applicability and generalisability of qualitative research.

This section indicates the decisions taken for the contents analysis. The sampling method used was purposive sampling. All the tertiary institutions in South Africa were selected for the following reasons:

- (a) Application of theory: It is in accordance with the theory on case study analysis where a typical case is selected to study in depth. It further corresponds with the theory on exploratory research.
- (b) Accessibility: The South African institutions are more accessible for follow-up interviews.
- (c) Understanding: The courses at South African institutions are familiar to the researcher and will therefore increase the validity of the conclusions.
- (d) Applicability: Although the questionnaire survey accepted opinions from all designers, the immediate recommendations will be aimed at educating managers on the benefits of design at South African institutions.
- (e) Generalisability: The findings of this research can therefore only be generalised for South African tertiary institutions. Further research is needed to generalise the findings beyond South Africa's borders.

As the number of institutions is only 34, it was feasible to contact all of them to participate in the analysis. Information was obtained through a combination of personal visits and interviews, email questions and responses and their official websites. The course(s)/subject(s) most likely to contain the

study of creativity or innovation was identified. Although the institutions were also contacted for further information, not all of them responded. Only those institutions which supplied sufficient information for a fair representation, for example at least the names of all the relevant subjects, were included in the analysis.

In this manner, usable information was obtained from 13 of the 19 universities (or 68%) and from 10 of the 14 technikons (or 64%) with regard to diploma courses, including seven technikons with regard to the BTech degree. As the technikons offer National Diplomas (first three years), the designations are uniform. Differences could exist in the content, where a maximum of 30% can be changed, and in the year of study the subject is offered. Some technikons also offer a BTech degree in the fourth year of study. In this course a wider range of subjects was present.

4.7 Summary

This chapter discussed the methodology used to achieve the third and fourth research objective. After questionnaires in general were discussed, the decisions made with regard to the questionnaire used to achieve research objective three were discussed. An overview was also provided with regard to the qualitative research and the principles involved in studying textual material. Applicability and generalisability within a qualitative research environment, were also discussed. The methodologies used for the two focus group discussions and the gathering of information for the course content analysis were explained. The results of the three research methods are portrayed and analysed in the next chapter.

Chapter Five

Results and Analysis of Data

5.1 Introduction

This chapter reflects the results and analysis of the data of the third, fourth and fifth research objectives. The third objective, what managers should know about product design, in order to use it as a source of knowledge creation, was investigated by a questionnaire. The questionnaire was based on the new approach as depicted in the proposed framework. Afterwards two focus group discussions agreed in the main with the results. The fourth objective, whether future managers are educated by tertiary institutions in South Africa to follow the new approach of the framework, in other words to use Product Design to increase competitiveness through Knowledge Creation Management, was investigated by a qualitative analysis of the course contents at South African tertiary institutions. The final section of this chapter discusses the results of the testing of the framework, indicating that the new approach of the framework can be applied in practice. The detail results for all of the above are captured in annexures.

5.2 Results of the questionnaire

5.2.1 Background information

In total 160 completed questionnaires were received, of which 155 could be used. Given the fact that the population is very homogenous and that the standard deviation is very small, this number is deemed sufficient to make conclusions about designers that is fairly representative of the whole (Waliman, 2005: 279).

The distribution of the age group of respondents was bell shaped, with 30% between 30 and 39 and 57.5% between 30 and 49. In the gender distribution, males outnumbered females by about 3 to 2, which was a fair reflection of the industry. As for their professional time, about three-quarters (75.8%) of the respondents were involved in design, by either designing or teaching design, and about one-quarter (24.1%) were involved in management by either managing or teaching management. The Industry involvement of the most respondents (40.9%) were involved in design with the second most (33.1%) involved in education. A further analysis indicates that of the 51 respondents who indicated that they were involved in education, 38 (75.5%) indicated in Question 1.3 that they were involved in teaching design to design students and six (11.8%) indicated that they taught design to management students. When these 44 respondents are added to the 63 who indicated that they were involved in design (Question 1.3 #1), it means that a total of 107 (69.5%) of the respondents are either involved in design or teaching in design. As far as the highest professional qualifications are concerned, 11 of the

respondents had a doctorate and 47 a Master's degree. The most respondents originated from South Africa (52 or 33.8%), followed by the United States of America (24 or 15.6%), and then the United Kingdom (21 or 13.6%). Respondents from the other countries were fewer than 6% per country. Given the above background information, it can safely be concluded that the survey has substantial credibility and as such sufficient validity.

5.2.2 Contribution of design

Question two asked how important it was for a manager to know about the contribution that design could make to a business. There was strong support among the respondents that the following are important to know:

- (a) the importance of the role a design application can play in business solutions,
- (b) the importance of case histories on the impact of design on business,
- (c) the importance of design providing a competitive advantage on the strategic level
- (d) the importance of design providing a competitive advantage on the functional level.
- (e) The importance of design providing a competitive advantage on the project level.

Although the majority of respondents indicated that the difference between the various design disciplines was important, it was, however, not statistically significant. In similar fashion, the responses to knowing which design discipline is best suited to solve a problem, was also not statistically significant. It can therefore be concluded that designers are of the opinion that managers should understand the contribution design can make, but managers do not need to know the detail about design.

The importance of the role of the design application is not only strongly supported, but had a low standard deviation which indicates a fair amount of consensus. The importance of case histories received the second highest average and is also strongly supported, but a higher standard deviation indicates a greater degree of difference of opinions. It can thus be concluded that designers do not feel that it is important for managers to know about the different design disciplines or which discipline is best suited for a specific problem. What is significant, though, is that the opinions on these two issues differ quite considerably as indicated by the high standard deviation. Some feel strongly about this being important, but others feel equally strongly that it is not important. On the whole, question 2 was successful to identify some issues around the contribution of design to a business, which designers feel are important for managers to know.

5.2.3 Integration of design

Question three asked how important it was for managers to know about the integration of design with certain business processes.

The highest support was from respondents that felt strongly that design should be included as early as possible in the development process. The second highest support was of respondents that felt strongly that design is an integrated team effort between designers and managers. Almost all the respondents felt that design information should be integrated with the marketing information. Not everybody agreed on the level of importance, though. The respondents who indicated *important* were almost equally divided between *important* and *totally important*. Respondents also strongly support that design information should be integrated with the financial processes of the company, but it was not as strongly supported as the previous question. Other processes that also received strong support to be integrated with design are human resources processes, the manufacturing processes and the service delivery processes of the company.

When analysed with Microsoft Excel's Pivot Tables, 24 (15.6%) respondents indicated *totally important* to each one of the five questions, while 106 (68.8%) respondents indicated *totally important* or *important* to each one of the five questions. This indicates that many respondents felt strongly that it was important for managers to know how to integrate design with the information of the various processes of a company.

The integration of design received much support from the respondents. All seven issues were indicated as important. It is significant that the importance of an early integration received not only the most support, but also had the highest consistency of opinion. The importance for managers to know how to integrate design information with the company's human resources information received the least support from the respondents. The opinions on this issue were the most divided. This confirmed the earlier conclusion that designers are of the opinion that managers do not necessarily need to know about design itself, they only need to know how to manage it, or integrate it with the company's processes.

5.2.4 Process of design

Question four asked how important it was for managers to know about certain design processes. Interesting results were returned. Some questions received strong support in the affirmative, while others received equally strong support in the negative.

Out of the sixteen issues in the design process, only six were indicated as important. The most support was received for the view that managers should know that design is a multi-disciplinary approach. The second most support was received for the view that managers should understand design's significance to achieving a company's long term goals. This was closely followed by the view that managers should also understand the short term effectiveness of design. Another group that was also indicated as important was that managers should know how to write a brief, as well as be knowledgeable about the presentation and implementation of design.

The respondents were very clear that it is not necessary for managers to know about certain design processes. Designers felt it was not necessary for managers to know about the importance of design concepts, the psychology of creativity, the execution of a brief, analysing the design problem, setting design objectives, gathering information, conceptualising, analysing design applications and selecting the preferred design. All of these design processes were either indicated as unimportant or did not receive sufficient support to be classified as important on a statistically significant basis.

The contribution of the standard deviation to the analysis was once again significant. The trend continued that design processes that were supported were done so with a high coherence of opinion (small standard deviation), while the opinions in the issues that were not supported differed the most (high standard deviation). The importance of design as multi-disciplinary approach not only received the most support, but also had the highest coherence of opinion (st dev = 0.44). The most coherent opinions among the not-supported issues was the importance of selecting a design discipline (st dev = 0.97).

The trend referred to earlier, continued. Designers only expect manager to know how to integrate design, i.e. the fact that design is a multi-disciplinary approach, how to write a brief and to understand the difference design can make in the short and long term. The design processes that are integral to the design discipline itself were not indicated as important for managers to know about.

5.2.5 Presentation of design

Question five asked how important it was for managers to know about the presentation of a design. A very clear pattern was returned in the results.

A strong majority of respondents felt that it was important for managers to know about the alternative reality the designer is presenting, the popularised drawings, as well as written report(s) accompanying the design. A smaller majority of respondents felt that it was important for managers to know about working drawings. A majority of respondents felt that it was unimportant for managers to know about detailed information on design drawings.

Once again the highest coherence of opinion went to the importance of managers to understand the alternative reality, which received the most support. The importance for managers to understand working drawings, although deemed important, received the least amount of support, with the highest inconsistency of opinion.

When the responses to Section 5, on the presentation of the design, are listed, an interesting pattern emerged. There was a trend that the more technical the presentation, the less important the respondents felt they were for managers to know about. The correlation coefficient (r) between the two sets of data is -0.919 . Considering that correlations are expressed as a factor between -1.0 (strong

negative), 0.0 (weak) and 1.0 (strong), it is clear that this is a very strong negative correlation, meaning that the more technical the presentation, the less important respondents felt they were for managers to know about. Once again, this confirms the trend that designers felt managers only have to know what design can do for them; they do not need to know the technicalities of design.

5.2.6 Implementation of design

Question six asked how important it was for managers to know about the implementation of the design application. All four questions were deemed to be important.

A majority of respondents felt that it was important for managers to be involved in an ongoing basis in the implementation of the design application, that managers should know that the design application were to be implemented as an integral part of the overall business strategy, and that the implementation of a design application could involve expertise from other fields.

The respondents felt the strongest about the importance for managers to know that the design application is to be implemented as an integral part of the overall business strategy. The importance of the managers being involved on an ongoing basis, received the least amount of support. It is, however, important to bear in mind that the differences are only significant on the 10% confidence level and not on the 5% confidence level. The dispersion of the opinions seems not to vary much and falls between a standard deviation of 0.50 to 0.53. It can therefore be concluded that all four matters are deemed important, but that the order of importance is not very significant.

5.2.7 Risk analysis of design

Question six asked how important it was for managers to know about the implementation of the design application. All four questions were deemed to be important.

A strong majority of respondents felt that it was important for managers to know that integrating a design application is a calculated risk, that the designer cannot guarantee an increase in sales, that the designer becomes a partner in the risk and that proper research can lower the risk.

The respondents felt that all four issues were important. With the mean and standard deviation very close to one another, the only valid deduction is that each issue is in the main equally important for the respondents.

5.2.8 Two observations of the responses to the questionnaire

The result of the questionnaire survey will be summarised and concluded in the next chapter in paragraph 6.4. At this stage, however, two general observations can be made:

- (a) There is a tendency throughout the responses to all the questions that designers do not expect managers to know about the design discipline itself. They only expect managers to understand the contribution design can make to the success of their organisations.
- (b) An interesting relationship was observed between the average (mean) and the standard deviation. The correlation between the two was calculated at -0.9479 , which is a very strong negative correlation. This means that the lower the average (indicating that the issue is unimportant), the higher the dispersion of opinions. The reverse is also true that the higher the average (indicating that the issue is important), the lower is the dispersion of opinions. When respondents indicated an issue as unimportant the disagreement was very high and when respondents indicated an issue as important the agreement was very high.

These results were discussed in a focus group, the topic of the next section.

5.3 Results of the first focus group discussion: Product designers

This section discusses the results of the first focus group discussion with product designers. The focus group was convened for two purposes: to discuss the results of the questionnaire and to make suggestions on the curriculum of a course that would familiarise management students with design.

The biographical background of the attendees resembled that of the respondents to the questionnaire. Sixteen people were invited of whom seven attended. Five completed the sheet requesting background information. There was representation of all the age groups, apart from under 20 and over 60. The males dominated and there was a good spread of qualifications except for three-year bachelor's degrees and doctoral degrees. As for experience, two members had more than 20 years' experience with four years being the least amount of experience. The average experience was 11.8 years. In general, these results are consistent with the results of the background information of the respondents to the questionnaire.

Table 5.1 Results of the background information of the attendees of the first focus group discussion

1 Age group		2 Gender	
Under 20		Female	1
20 – 29	2	Male	4
30 – 39	1		
40 – 49	1		
50 – 59	1		
60 and above			
3 What is your highest professional qualification?		4 How many years are you involved in product design?	
Three-year diploma	1	20 / 22 / 8 / 5 / 4, ave 11.8 years	
Three-year Bachelor's degree			
Four year Diploma	1		
Four year Bachelor's / Honours degree	2		
Master's degree	1		
Doctorate			
5 Name (optional)		6 Company (optional)	
Lee-Ann Swanepoel Bart Verveckken Etienne Rijkheer Daniel Jillings Terry Erasmus Plus two others		This Way Up Product Design HOD, Product Design Department Cinelichtafrika Greg Gie Designs Olgear	

5.3.1 Procedure of the meeting

The meeting, scheduled to start at 17:00, got underway at 17:30. The facilitator welcomed everybody present and explained the background and purpose of the research. The agenda of the meeting was explained, which consisted of two questions:

- (a) What are your opinions of the responses to the various questions?
- (b) What, in your opinion, should be included in a course for management students to orientate them about the design discipline?

Everybody was invited to make opening comments. One of the comments made was that only one category, describing the issue that was statistically accepted as important, was not sufficient. Statistical testing should also been done between very important and important.

Another comment suggested that managers should understand more of what designers are doing, i.e., the whole design process. Managers would then better understand what they pay for. Design must be put in a way that managers can understand the process involved. In many aspects managers should know what they are dealing with. Although the process of designing a new product is related to other design disciplines, it is also different from the more intangible design disciplines, such as interior or graphic design.

Managers need to understand the broad parameters of design and when to let go. They must not be involved in the design activity. They must know how to write a brief and then let go. Managers are not the designers / creative people – they must leave that to the designer.

The group then reached consensus to focus on what managers need to know about product design, without misleading the managers. There is common knowledge among all design disciplines, but this group will focus on product design. The role of graphic design is well known. People see advertisements and they relate to the design behind them, but interestingly when they see products, they do not think about the design process behind them.

5.3.2 First question: opinions of the results of the questionnaire

The group then proceeded and a summary of point one (background information) was discussed. Comments were made on the high ratio of men (3 to 2), but the group was satisfied that it was a fair reflection as it is a male-dominated industry. Questions were asked about the representativeness of designers. The facilitator explained that 70% of the respondents were either involved in design or taught in design. The rest of the respondents were knowledgeable about the design process. The meeting expressed its satisfaction that it indeed reflected the *voice of designers*.

The group accepted the results of **Question 2.1**, referring to the importance of the role a design application could play in business solutions.

The group accepted the results of **Question 2.2**, referring to the importance of case histories about the impact of design on business. Concern was expressed that there was not much published South African case studies on product design.

The group accepted the results of **Question 2.3**, referring to how design could provide a competitive advantage on the strategic, functional and project level of a company. The group agreed that these results should be indicated as very important, especially the role of design on the strategic level. It is important that a company has a clear idea of its strategic direction and where it wants to go. There should be continuity between the strategic direction of a company and the design of its products. The designer cannot design products if he/she does not know what the strategy is and how it will be executed. Although the survey did not indicate a difference between the responses, the group was of

the opinion that 2.3.1 (strategic level) was more important than the other two, 2.3.2 (project level) and 2.3.3 (project level).

The group accepted the results of **Question 2.4**, referring to the differences between the design disciplines, and **Question 2.5**, referring to which design discipline is best suited to solve a problem. The group agreed that it was not so important for managers to understand the finer distinctions of the design discipline, as long as they understood the importance of design and how to interact with designers.

The group accepted the results of **Question 3.1**, referring to the importance that managers should know that design is an integrated team effort between company employees and designers. The group agreed that this should also be indicated as very important. Comments were made that it saves redoing many steps. Product design is not about drawing pretty pictures. Design is a proposal that can be executed. That involves a whole process and everybody needs to work together during that process.

The group accepted the results of **Question 3.2**, referring to the importance that managers should know that design should be included as early as possible in the development process. The group agreed that this should also be indicated as very important.

The group accepted the results of **Question 3.3** as a whole, referring to the importance of design being integrated with the work flow processes of the company. Comments were made on 3.3.1 (marketing), that the designer should know how and to whom the product will be marketed. The manager must understand the importance of a clear understanding of the target market and communicating this to the designer. Market information is important to designers, especially when a new product is developed. The designer should receive as much information as possible about the new market. The discussion continued on the need for managers to communicate clearly about the product's target market.

The group discussed the results of **Question 4** as a whole, referring to the different elements in the design process. An analogy was made with a dentist. When a patient arrives at a dentist, she indicates exactly where the pain is and the dentist knows precisely what to do. That is often not so in design. Managers are often vague about what they want and do not understand what is involved in producing a new product design. Managers do not know what they are paying for – it is more than just the drawings that are presented to them. Designers felt that they spent too much energy trying to get managers to understand their discipline, rather than focusing on the specific design itself.

Reference was made to entrepreneurs who started a business with a product that sells well. After a while the business has grown and the product reaches a stage where it becomes dated. The entrepreneur will then prescribe to the designer what he wants. The entrepreneur should let go,

concentrate on running the business, and trust the designer to develop new products. Sometimes the entrepreneur forces his way on the designer and will not accept a well-designed product.

The group differed from the results of Question 4. The results indicated that the earlier parts of the design process are not important. The group felt that it was important for managers to know about, for example, the psychology of creativity. Managers should understand how the process works. It is important that managers know what a designer can do (and cannot do). The group felt that the results of question four were not consistent with the results of Question 3.1 (design is an integrated team effort) and 3.2 (design should be included as early as possible in the development process). The group reached consensus that managers must understand the whole design process, which is more than merely knowing about the design process.

Managers should understand how a designer operates and understand how they arrive at the design solution. They should understand the creative process that the designer went through and the fact that the designer often makes connections which other do not see. That does not mean that the designer expect creativity from the manager. It was agreed that everybody is creative, but everybody's creativity is not equally developed. The group were convinced that Question 4 should be dealt with as one question and that the response should be a 100 per cent yes. Design is an overarching approach and cannot be fragmented.

The group accepted the results of **Question 5** as a whole, referring to the importance of managers in understanding the presentation of design. When prompted about the *alternative reality the designer is presenting*, the group felt that it should rather be *another reality*, which is not necessarily an alternative to what the manager's reality is. On a point of clarification the group understood the present reality as that of the existing product range and the new reality as that of the new product proposed by the designer. Opinions were expressed that design is only an extension of the reality of the manager. Design is concretising the manager's reality. The manager must therefore take ownership of the design. The designer needs to spend a lot of time with the client to understand what the client wants. Only then can the designer successfully design a product for him/her. The group agreed that it was not always that important for the manager to understand the technical symbols, as long as the manager understood the bigger picture.

The group accepted the results of **Question 6** as a whole, referring to the importance of the manager's knowing about the implementation of the design application. It was mentioned that the manager should understand that he can delegate this. If he does not know how to deal with it, he can get an able bodied person who can do it. Examples of such a person are the factory manager, production manager or any other person to whom the design is important.

The group accepted the results of **Question 7** as a whole, referring to the importance of the manager in understanding the risk involved in the design application. The group felt that design was an

investment proposal. The question was asked, who manages the risk? The group felt that both the designer and the manager should manage the risk jointly. The marketing department should also be involved with market research on the implementation of the design application.

The group also felt that the ongoing managing of the implementation of the design application would depend on the contract between the designer and the manager. Opinions were raised that it would also depend on the budget and capabilities of the persons involved. The group felt that the designer should be involved in the whole process up to full-scale manufacturing. Design is not a hit-and-run. In the case of modular manufacturing, the parts must come together at some stage. Sometimes small changes are needed to ensure a perfect fit between the various components or modules. The designer should make those changes, not the production manager or any other person.

The possibility exists that somebody other than the designer can make changes which they believe will improve the functionality or manufacturability of the product. These changes might, however, completely change the product and deviate from the original design concept. Who is responsible if such a change causes the product to fail because the market does not accept the changed product? The point is that the designer cannot be held responsible for the products if other people make changes. The manager needs to understand the designer's concept and the fact that changes could affect the whole product concept.

5.3.3 Second question: What should be included in a design curriculum for management students?

The group reached consensus on a number of issues. The most important two was, firstly, that it is important that managers remain managers and do not try to become designers. Secondly, however, it is important that managers understand enough of the design process to supply the designer with all the necessary information that the designer requires. Managers need to understand what is important to make design happen.

It is further important that managers should realise what design can offer, especially on the strategic but also on the other levels. Designers experience the problem that they must first sell their discipline, before they can sell their particular services. Managers should know enough about the design discipline so that designers can focus on what their particular offering is about.

It is also important that managers must be able to write a creative brief. It should not be too tight or limiting. If the briefing procedure is very thorough, both parties will understand exactly what their roles and contributions are. Managers should know what the designer can offer and the designer should know what management can offer and their particular situations such as manufacturing capabilities. If the designer is familiar with a manager's limited manufacturing capability, he or she might suggest a different solution that will be possible to be manufactured with the existing equipment.

It is important that managers understand that design should be included from the beginning of the process. Right at the start when a manager starts to think about a new or reworked product, the designer should be present. Once the designer understands what the manager wants, the designer can provide the x-factor – the spark that will give the manager a competitive edge.

It is important that managers understand how to integrate design into a business plan. The manager must understand the role of design and where it slots in, for example, at strategic decision making, at the product development phase, at the manufacturing as well as possible redesign phase.

It is important that managers understand the value of design. Managers must understand what they pay for and how they can get a return on their investment. The group reached consensus that once managers understand the design process, they will know how to interact with designers and they will know what they pay for. Having said that, the group felt that they had come full circle in the discussion, and that it was a good point at which to close the meeting.

5.3.4 Summary of the focus group discussion

The group accepted the results of Section 2, Questions 2.1 to 2.4 (contribution of design). The group differed from the questionnaire when it was agreed that managers' understanding of the impact of the strategic level of a company was more important than the other two levels. The result of Question 2.3.1 should therefore be very important. The group also accepted the results of Section 3, Questions 3.1 to 3.3.5 (integration of design). It was agreed that the result of Question 3.1 (design as a team effort) and 3.2 (design should be included as early as possible) should also be labelled very important. The importance of the integration of design with marketing information (3.3.1) was highlighted.

The group differed with the result of Section 4, Questions 4.1 – 4.6 (process of design). The questionnaire results indicated that the earlier steps in the design process are not important, except for the writing of a creative brief. The focus group felt that the whole design process is important and that this result was inconsistent with the results of 3.1 and 3.2. It was agreed that design is an overarching process and cannot be fragmented.

The group accepted the results of Section 5, Questions 5.1 – 5.5 (presentation of design). The group differed, however, with the term alternative reality and would rather call it another reality. The product that is designed is an extension of the reality of the manager, meaning the existing product range. The importance of a good understanding between the designer and manager was stressed. The group accepted the results of Section 6, Questions 6.1 – 6.4 (implementation of design). It was mentioned that the manager should understand that she can delegate this. The group accepted the results of Section 7, Questions 7.1 – 7.4 (risk analysis of design). The group felt that design is nothing more than an investment proposal. The designer should be involved in the whole process up to full-scale manufacture so that if changes are needed the designer can make them.

Two themes were prominent in the discussion:

- (a) The manager should have an understanding of the whole design process. The manager should understand the contribution of the design discipline, know what to expect from a designer, know what he/she is paying for, know how a designer operates, etc.
- (b) The manager should trust the designer. Words were used such as *know when to let go, do not confine the brief, use broad parameters, etc.*

With regard to elements of a curriculum for management students, the following were stressed:

- The whole design process.
- What the design discipline can offer.
- How to write a creative brief.
- How to include design as early as possible in the development process.
- How to integrated design in a business plan.
- The value of design.

It can therefore be concluded that, with the exception of Section 4, the focus group of product designers agreed in the main with the results of the questionnaire. The group felt that managers should understand the whole design process. When the issue of what designers mean by *understanding the whole design process* was further explored, it was revealed that they only refer to a superficial understanding and not a detailed in depth understanding. This result can, therefore, still be seen as consistent with the results of the questionnaire survey. Another aspect of importance was that the manager should trust the designer. This also confirms the point that only a superficial understanding is needed. The group also made suggestions for a number of topics that should be included in a curriculum about design awareness for management students.

5.4 Results of the second focus group discussion: Marketing Managers

This section discusses the results of the second focus group discussion with marketing managers. The focus group was convened to discuss the questions what marketing managers think they should know about the stages in the design process as outlined in the framework in chapter three. A synopsis of this study to date, as well as a summary of chapter three, were distributed beforehand to the marketing managers to read.

The biographical background of the attendees resembled that of the respondents to the questionnaire. Ten people were invited of whom six attended. All six completed the sheet requesting background information, with one requesting to be anonymous. There was representation of the age groups from

30 years to over 60 years. The males dominated and there was a good spread of qualifications except for three-year diplomas and doctoral degrees. As for experience, one member had more than 20 years' experience with six years being the least amount of experience. The average experience was 12.6 years. In general, these results are consistent with the results of the background information of the respondents to the questionnaire and the first focus group. Table 5.2 provides more detail of the results.

Table 5.2 Results of the background information of the attendees of the second focus group discussion: Marketing Managers

1 Age group		2 Gender	
Under 20		Female	2
20 – 29		Male	4
30 – 39	3		
40 – 49	1		
50 – 59	1		
60 and above	1		
3 What is your highest professional qualification?		4 How many years are you involved in marketing?	
Three-year diploma		10 / 7 / 6 / 25 / 11 / 17, ave 12.6 years	
Three-year Bachelor's degree	2		
Four year Diploma	1		
Four year Bachelor's / Honours degree	2		
Master's degree	1		
Doctorate			
5 Name (optional)		6 Company (optional)	
K van der Walt Marius H Cronje Brad Borchardt Selma Harris Plus on other		Metropolitan / Flower Design Minolta Business Success Solutions Life4me	

5.4.1 Procedure of the meeting

The meeting started at 12:00 with the facilitator welcoming everybody present and explained the background and purpose of the research. The agenda of the meeting was explained, namely what the opinion of the group was about the importance of marketing managers to know about the various stages in the product design process.

Everybody was invited to make opening comments. As the marketing managers were not that informed about product design, some time was spent explaining the product design process and the research in general. The group reached consensus that it is important for marketing managers to know about product design and especially the communication process involved.

A lively discussion followed that lasted until 15:30. Below is a summary of the most salient points made during this discussion.

5.4.2 The individual steps of the product design process

The individual phases of the product design process were then discussed.

Briefing stage: The marketing managers felt strongly that they should be involved during the briefing stage. Given the market manager's immediate exposure to the target market, they know what works. This does not mean it is a one way communication. The group reached consensus that brainstorming could be very important at this stage. The marketing manager contributes information from the market, while the product designer adds creativity, at this stage reacting more intuitive. The group also felt that it is important for the marketing manager to think out of the box at this stage and not be confined by traditional ideas.

The marketing managers also felt strongly that they should be involved as early in the design process as possible. They were of the opinion that it is easier to make changes early on, than trying to fix problems later, once the design has been compromised to a certain degree. During this phase the scope of project should be negotiated. Some products may need only a cosmetic redesign, while others may need a complete new design. It is important that the marketing manager and designer agree on what needs to be done, the time frames, budget, etc. Clear specifications should be set at this stage.

Conceptual design: The marketing managers were unanimous that they do not have to be involved during the conceptual design stage. Once the briefing is done and the product designer has a good understanding of what is required, the product designer is alone responsible for the conceptual design. It is important for marketing managers to know about this stage, but they are not involved. The conceptual design can be done by the designer independently from the marketer. A small discussion focussed on whether the designer should keep to office hours or work on his/her own, but no clear point of view was arrived at.

Embodiment Design: The marketing managers were of the opinion that the designer should then present a small number of alternatives. Once again it was emphasised that a discussion should ensue with everybody allowed to make comments or suggest alternatives. The designer puts new ideas forward, with the marketer reacts according to his/her knowledge of the market. At this stage an

iterative process is required, although it can not be continued for too long. The marketing managers are thus heavily involved at this stage.

Opinions differ on whether a designer should keep within the specifications of the brief. Some felt that it is imperative that the designer should adhere closely to the brief. The advantage is good managerial control, but the disadvantage is less creativity. Other felt that if the designer could come up with a concept that is not strictly within the brief, it should be presented. This is how new really innovative products can be marketed. The advantage is high creativity, but the obvious disadvantage is that adjustments might be required. It is the old adage of high risk – high gain and low risk – low gain. The marketing of really new innovative products is high risk, but can be high can if the market reaction is good.

Detailed design: The marketing managers felt that, depending on the level of technicality, they do not need to know much about this phase. The marketing managers were content that production managers or other specialists, such as engineers, are involved to work out the finer details of the design. The marketing managers were unanimous, though; they should be informed about the progress being made, especially if there are problems. If important decisions are needed about rescheduling or changing some of the important features, the marketing managers felt they should be informed and allowed to participate in the decision making.

Evaluation of design: The marketing managers were of the opinion that they should be very involved in the evaluation of the design, both on the short term when the design is being evaluated against the brief, and the longer term when other information such as sales figures, production schedules and profitability are being discussed. Marketing managers want to play an important role in evaluating the long term performance of the product and ultimate decisions to terminate or redesign the product, when the process would start from the beginning.

In general the group agreed that the managers should be involved or know about the whole design process, but with different level of intensity. A high involvement is required at the briefing stage, with no involvement at the conceptual stage. At the embodiment stage a high involvement is again required with a medium involvement at the detailed design stage. At the evaluation stage, a high involvement is again required. See also table 5.3.

Stages of design	Level of involvement
Brief	High
Conceptual design	None
Embodiment design	High
Detailed design	Medium
Evaluation of design	High

5.4.3 General comments

The group reached consensus on a number of issues. The most important was that communication between the marketing manager and designer is of the utmost importance. The two disciplines are able to compliment one another. In general the marketing manager is more analytical and aware of the economics of the project. The designer is seen to be more emotional and intuitive. The two should therefore co-operate to the benefit of the best product.

The co-operation was also qualified in some instances. It was agreed in general that the more technical the product, for example information technology and life assurance, the lesser the need for co-operation. In these instances the designer would design the product and present it to the marketer. The marketing manager will then revert to other design disciplines such as graphic design in order to communicate a particular look and feel to the market. Examples of such an approach is banks who offer virtually the same products, but with different corporate images.

The group also agreed that some designs are accepted or rejected for the wrong reasons, notable company politics. A good project may be rejected for fear that the designer might outshine his/her superiors and a not so good design may be accepted as it is linked to pet projects of superiors. The role of internal design teams versus independent outside design agencies was also discussed.

One member argued strongly that the marketing manager should be involved in the appointment of the product designer or agency in order to ascertain that the person or agency appointed is able to meet the requirements of the design task. The designer should be a specialist in the area of the particular product design. It is recommended that the designer also knows about the business of the marketing manager, but it is not a requirement. Some members felt that the marketing manager does not have to be a specialist in the specific product area, while others felt that the more the marketing manager knows, the more successful he/she will be in selling the product. The group reached consensus that although product knowledge is important, there is a level of speciality that the marketing manager does not need to know about.

The group agreed that the marketing manager should remain a marketing manager and not become a product designer. That is why there are product designers and their services are required, provided the two disciplines can co-operate successfully.

On this note the group felt they are repeating themselves and the discussion ended.

5.4.4 Summary of the focus group discussion

In the main the focus group consisting of marketing managers, agreed that they should know about the full design process. Their level of involvement can differ from a high level of involvement during the

briefing, embodiment design stage and evaluation of design. Marketing managers see themselves not involved with the conceptual design phase, and depending on the technical level, only involved on an overall level during the detailed design process.

5.5 Results of the two focus groups summarised

The results of the two focus group discussions agreed on many points, and differ slightly on one specific point.

There are a few notable points of agreement:

- (a) Good communication. Both groups emphasised that good communication is essential before, during and after the design process

- (b) Managers should remain managers and not become designers. Although it is important for managers to know about the product design process, they should remain managers and let the two disciplines compliment one another.

- (c) Managers should know about the whole design process. Both groups felt that it is important to understand the whole design process in order to work better together. It must be added that their reference to understanding is only a superficial understanding of the design process and not an in depth understanding of the design discipline. It is, however, here that a point of slight disagreement surfaced.

The one point of slight disagreement was on the conceptual design phase. Product designers felt that marketing managers should have a minimum understanding of this process in order to have a better idea of what they can expect. Marketing managers felt they need not be involved as the product designer can perform this function on his/her own.

The most important aspect of both focus groups were that they agreed with the trend revealed in the questionnaire survey: Managers should know enough about Product Design in order to be able to use it as a tool, but they do not have to know about the detail of the Product Design discipline.

5.6 Results of the content survey

Product design is one source of creativity. Creativity in general will become increasingly important for businesses to survive. Drucker (1988, 1991, 1993 and 1997) is one of the most outspoken authors on the importance of innovation or creativity. Traditionally it was viewed that increasing the creativity in a company should be done by increasing a manager's creativity. One of the great proponents of this point of view is Edward de Bono. It is a long time since De Bono (1994: 36) argued in favour of parallel thinking, which is used by a variety of business people, for example senior executives in such major corporations as Du Pont, IBM, Prudential as well the *Sowetan* in South Africa. This approach entails the six hats method, where there are six metaphorical hats, each of a different colour. The thinker uses one hat at a time and follows, exclusively, the mode of thinking indicated by the hat.

Parallel thinking means laying down ideas alongside one another. There is no clash, no dispute, and no initial true/false judgement. There is instead a genuine exploration of the subject. The emphasis in parallel thinking is on design rather than on analysis. In parallel thinking there is an attempt to reconcile contradictions instead of choosing one and totally rejecting the other. There is a great emphasis on the direct creation of new ideas and new concepts. The process of lateral thinking can be helped by formal techniques and is not just a matter of waiting for ideas to emerge (De Bono, 1994).

It is conventional to view the innovation process as starting with the spark of individual creativity; a clever and original idea adopted by organisational decision makers and implemented as a significant change to products, practices or procedures. This rather simple picture has been increasingly challenged in recent years, both in terms of the limitations of an individualistic account of creativity and the inaccuracy of linear stage models of innovations (King & Anderson, 2002: 12). If an organisation wants to increase the creative production of its members, four methods are suggested by King and Anderson (2002). First, it may introduce procedures to encourage the generation of new ideas. Second, it may train people in the skills required for successful creative performance. Third, it may use selection and assessment processes to recruit creative individuals and allocate people to positions appropriate to their level of creativity. Fourth, it may change its own characteristics in ways which facilitate creativity.

A fifth option could be added to King and Anderson's (2002) method, which is the outsourcing of creative ideas to specialised companies for whom it is their major business. Such a company will combine all four of the elements proposed and their whole business thrust will focus on creativity. *Whatever the approach used, the importance of creativity in today's business cannot be denied.*

In this thesis the first sub-question concluded that creativity could play a role in increasing the competitiveness of a business. The second sub-question concluded that the creative process during product design could add new knowledge to a business and thus increase its competitiveness. In the

questionnaire survey of the third sub-question, some items were identified that are important for managers to know in order to manage the creative output of the product design process. The fourth sub-question now focuses on whether future managers are educated by tertiary institutions to use product design, or alternatively creativity or innovation, to increase competitiveness through knowledge creation management. In short, do future managers learn about creativity or innovation during their undergraduate studies?

In order to investigate the fourth sub-question, a content analysis was undertaken which focused on the names of the subjects studied by undergraduate future managers in South Africa. This information was compiled through a combination of personal visits and interviews, email questions and responses and the institutions' official websites. The information represents the course content and not the structure of courses, for example, information about prerequisite subjects and electives are omitted. Usable information was obtained from 13 of the 19 universities (or 68%) and from 10 of the 14 Technikons (or 64%) with regard to diploma courses, including seven Technikons with regard to the BTech degree. As the Technikons offer National Diplomas (first three years), the designations are uniform.

5.6.1 Universities

The course content of thirteen universities was analysed. The results of the content analysis of South African tertiary institutions' offerings to future managers indicated that there was no reference made in the official name of a subject about the study of creativity or innovation at any one of the institutions. At 7 of the 13 universities (or 54%) there was no reference to creativity or innovation in the official name of a subject. At 6 of the 13 universities (or 46%) universities there was some mention of creativity or innovation as part of a subject, but it was not strong enough to be included in the official name of the subject. One university made mention of new product development. The design discipline was not mentioned in any of the information received.

5.6.2 Universities of Technology

Universities of Technology or Technikons (as most were known until a few years ago) offer a National Diploma, which means that the subjects are standardised for all participating Universities of Technology. The subjects may be offered at different times, but they are all basically the same. A specific University of Technology may not change more than 30% of the prescribed content.

There was no reference made in the title of the subjects about the study of creativity or innovation. Although innovation was studied as part of a subject in Small Business Management, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline, which was offered at most Universities of Technology, was not mentioned in any of the information.

5.6.3 Summary of the content analysis

Creativity or innovation will become increasingly important for businesses to survive. Sources of creativity in a business are procedures to encourage the generation of new ideas, train employees, recruit creative individuals, or changing the company's characteristics to facilitate creativity, or outsourcing to a agency specialising in creative ideas. The fourth sub-question focused on future managers' training to manage these processes.

In none of the universities there was any mention of creativity in the official name of a subject. In 46 % of the universities there was some presence of creativity or innovation as part of a subject. In the Management Faculties/Departments of the Universities of Technology there was no mention of creativity or innovation as the official name of a subject. The design discipline was never mentioned at either the Universities or Universities of Technology.

Based on the above information, it is fair to conclude that although the importance of creativity or innovation was clearly established, the offerings to management students at South African universities did not put much emphasis on creativity or innovation, while the design discipline was totally ignored.

5.7 Results of the testing of the framework

The fifth objective was to test the framework developed in the second objective. This section discusses the results of the fifth object that was to test of the framework. During the academic year 2008, the approach of the framework was followed by eighteen fourth year students in Industrial Design. The design projects were submitted in partial fulfilment of the requirements for the degree Baccalaureus Technologiae in Industrial Design.

In all the projects design students were required to obtain additional knowledge. In most instances, this was explicit knowledge, through for example publications, as well as tacit knowledge through personal experience of the problem of suggested solutions.

The following section will provide a brief overview of each project. Annexure G contains a more detailed description of each project. In all the projects design knowledge was used. The overview below, therefore, only highlights the additional knowledge that was used and then indicates the knowledge that was produced.

- (a) Booyens wanted to design an ergonomic workstation for microscope workers (cytotechnologists). The additional knowledge used was about Cytology, the functioning of a cytology laboratory, including a compound microscope. The knowledge produced was the design of a comprehensive, more user friendly workstation, allowing cytotechnologists to work for longer hours at higher concentration levels.

- (b) Grant wanted to design an electric guitar to increase the mobility of electric guitar players. The additional knowledge used was about sound production, material technologies and the packaging requirements of all the supporting equipment, such as an amplifier, speaker, power cord and adapter.
- (c) Fakier wanted to design an inexpensive sports car for the South African market. The additional knowledge used was about sport car features, manufacturing of a sports car, traffic laws and consumer behaviour. The knowledge produced was a design on how to combine locally available elements and producing an economically viable sports car for the South African market.
- (d) Kankondi wanted to design a dispensing device that could increase the personal hygiene of the visually impaired using public / unfamiliar facilities. The additional knowledge used was about building regulations, features and layout of ablution facilities, medical aspects and definitions of disability. The knowledge produced was a design on a user friendly roll of paper gloves in a dispenser that passes over a sanitising liquid. The gloves are easy to use to clean selected areas in ablution facilities.
- (e) Booyens and Cilton wanted to involve urbanites in a hands-on experience of cultivating their own edible plants while producing fresh healthy food and reduce waste. The additional knowledge used was about Hydroponics systems, growth mediums, cultivation of food and genetically modified crops. The knowledge produced was a design on a small-scale hydroponics system which was developed to successfully grow edible plants within the constraints of the urban environment.
- (f) Felmore wanted to design a device that could monitor septic tanks. The additional knowledge used was about septic tank disposal systems, hygiene and safety, bacteriological reactions and ultrasonic sensors. The knowledge produced was a design of a monitoring device that measures the level in a septic tank and activated an alarm when attention is needed. It also reduces spilling of dangerous substances in the environment.
- (g) Delen wanted to design a sound insulated drumming booth allowing musicians who played loud instruments to practice in densely populated areas. The additional knowledge used was about the physics of sound, soundproofing methods, material properties and structural technology. The knowledge produced was a design of an inexpensive compact sound proof cubicle.
- (h) Opperman wanted to design a product that would more effectively prevent head injury in snow sports, primarily skiing and snowboarding. The additional knowledge used was about consumer

behaviour, skiing as a sport, ski and snowboard related head injuries, protection, material science and the science of impact absorption. The knowledge produced was a design of headgear that is more comfortable to wear, more ergonomic and that will reduce injuries on impact.

- (i) Adendorff wanted to improve bodyboards in order to increase performance and its durability in most conditions. The additional knowledge used was consumer behaviour, such as classification of bodyboarders in terms of sport personality, types of environments the board are used in, characteristics of bodyboards, and material properties. The knowledge produced was a design of an improved bodyboard that increases performance with better durability.
- (j) Momberg wanted to design a mobile animal stretcher. The additional knowledge used was about animal injuries and illnesses, animal behaviour, manufacturing with aluminium, substituting products (make shift stretchers), and different areas in which an animal stretcher is to be used. The additional knowledge produces was a design of a foldable lightweight animal stretcher.
- (k) Raad wanted to design a more sustainable oral hygiene product, and also improve the overall oral hygiene routine. The additional knowledge used was about oral hygiene, consumer behaviour, toothbrushes, toothpaste and dental floss, as well as their material properties and packaging. The knowledge produced was a design of an all in one toothbrush, housing its own toothpaste and dental floss. The parts can be replaced rather than the whole instrument.
- (l) Hugo wanted to design a seating system for passengers in the load area of a bakkie (pick up truck). The additional knowledge used was about the safety of automobile passengers, most common causes of injury to passengers in the load area of a bakkie, road safety and the South African National Road Traffic Act. The knowledge produced was an ergonomically designed and safe seat that is easy to remove when the space is required.
- (m) Voigt wanted to design a water collection point that is more user friendly, minimises water wastage in a hygienic environment. The additional knowledge used was about water distribution, water wastage, and hygiene and sanitation. The knowledge produced was a design of a water distribution point that does not leak and keeps the surrounding area dry.
- (n) Bougas wanted to improve the vaginal speculum so that its operation is efficient and user friendly. The additional knowledge used was elements of Gynaecology, consumer behaviour of gynaecologists and patients, product knowledge of existing specula, material properties of potential new specula and laboratory testing techniques. The knowledge produced was a design of a proposed speculum that eliminates the use of extra tools, such as light sources and lubrication, as well as improving the mechanism.

- (o) Richet wanted to design furniture for single room dwellers in order to optimise space. The additional knowledge used was about consumer behaviour of a single room dweller, utilisation of space and personal environment, domestic ergonomics and lighting. The knowledge produced was ergonomically friendly multi-purpose furniture that supports the lifestyle of modern living.
- (p) Harmse and Snetler wanted to design suitable equipment for public playgrounds, fostering safe play in child development. The additional knowledge used was elements of anthropology, play theories, ergonomics, occupational therapy (in the context of functions of play), safety concerns and consumer behaviour. The knowledge produced was a design of new trendy and safe outdoor playing facilities.
- (q) Odell wanted to redesign the bucket/tub bath to improve bathing and thus personal hygiene. The additional knowledge used was transportation and heating of water for bathing, disposal of dirty water, and personal hygiene, including the bathing process. The knowledge produced was a design of a new bath that makes bathing easier and keeps water warm for a longer time period.
- (r) Momberg wanted to design an infra-red wall light switch that is accessible to people with disabilities. The additional knowledge used was the technology of a touch switch, infra red and radio frequency and its applications, electricity current, stream breakers and different disabilities and its impairments, e.g. spinal cord injury. The knowledge produced was a new switch whereby individuals in a wheel chair would be able to switch the light on by breaking an infra red beam that reaches the floor on a 90 degree angle.

In summary it is clear that each design project used and produced knowledge according to the proposed framework. In all instances design knowledge plus knowledge of a variety of fields were used in order to produce a bundle of knowledge in the form of a proposed design. In each one of the eighteen design projects the flow of knowledge was true to the framework. It can thus be concluded that the framework was tested successfully in practice.

5.8 Chapter summary

This chapter summarised the results and analysed the data of the third, fourth and fifth sub-questions. Through the application of the questionnaire, a selection of issues was identified that the respondents felt were important for managers to know about product design. Two focus group discussions agreed in the main with these results. Managers need to have a general understanding of the design process, but do not need to understand the design discipline in detail.

The content analysis revealed that at tertiary institutions in South Africa the study of creativity or innovation was not deemed important enough to warrant a reference in the official name of a subject, although some subjects contained certain elements of creativity or innovation. It is thus confirmed that managers are not educated to acquire an understanding of design as indicated by the above results.

A framework was proposed how managers could acquire a general understanding of the design process. This framework was tested successfully in practice.

The findings of all the research processes will be concluded in the next chapter.

Chapter six

Conclusions and Recommendations

6.1 Introduction

This chapter reaches the final conclusions and provides recommendations. It summarises the conclusions of the first five research objectives and reaches a final conclusion with regard to the overall research aim which was how the competitiveness of businesses could be improved through the application of Product Design as a Knowledge Creation Management tool. In reaching these conclusions the view of Mouton (1996: 174) should be kept in mind that it is generally accepted in philosophy and science today, that no research findings can be conclusively proved on the basis of empirical research data. At different stages of the scientific research process and for different reasons, the researcher is compelled to make assumptions about specific theories and methodological strategies that are not tested in the specific study. The conclusions drawn are done on the basis of the results in the various research methods as the facts were presented.

6.2 Summary of Findings

In this section the findings will be summarised briefly.

6.2.1 Managers can use Product Design to improve competitiveness

The first objective was to answer the question: Is there evidence in the literature that Product Design can improve competitiveness? This section summarises the knowledge in the field to date, providing a literature review on the contribution of design, and the problems encountered. It also provides an overview of past attempts to examine or solve the problem.

6.2.1.1 Potential contribution of design

Design can contribute towards the competitiveness of a business by way of:

- (a) Creativity: Chapter Two established that design could provide creativity, which can play a complementary role alongside the other business processes. Creativity can contribute towards the competitiveness of a business. In such an environment, design becomes more important, especially in the information-based economy. Three examples of this were presented where design provided creativity, commercial success and where design form part of the characteristics of top

performing companies. Design's contribution to businesses is also evident in history. History has shown that design can influence economies, providing a bigger market share to Germany and Japan. In Britain, the design industry has grown because of stimulation from the government, but when the recession came it shrunk just as fast. The reason was not only the recession, but also the inadequate integration of design into the other business processes. Although the design industry has recovered somewhat, integration remains a problem.

- (b) Innovation: In addition to creativity in general, design can also contribute innovation to a business. Continuous innovation is necessary for a sustainable competitive edge. *Creativity* can be seen as the generation of a new idea and *innovation* as the translation of a new idea into a new company (Apple Computer), a new product (Sony Walkman), a new service (Federal Express's overnight delivery), a new process (one waiting line for multiple services at a bank) or a new method of production (computer-aided design and manufacturing). In this study an *innovation* was defined as the commercially successful use of a creative solution.

Design can be a source of innovation as designers generate new ideas and follow them through to implementation. In fact, providing innovation on a regular basis in designing products or services is the most important contribution design can make. Design thinking is a professional approach at applying creativity in a structured way to solve problems and thus increases the frequency of innovations. Some managers solve problems with a measure of creativity, while there are companies that try to foster a climate for organisational creativity and innovation. Although many brilliant ideas came forward in this way, it occurs in an ad hoc accidental pattern, which is not sufficient in the current level of globalised competition. Few employees are trained to apply creativity consistently as design thinking does. Designers, with a structured approach, have a better chance of increasing the frequency of innovations. There are still no guarantees, but it is an active structured approach and not a passive, wait and hope attitude.

- (c) Commercialisation of designs: Flowing from the innovation, a business must be able to commercialise new designs to generate a profit for the firm as well as provide new benefits to their customers. Studies showed that incremental product innovation is in general commercially more successful than radical product innovation. There are many examples of commercially successful innovations, such as Microsoft and Xootr, and commercially unsuccessful innovations, such as the C5 tricycle. Designs should be successfully commercialised so that it can provide a competitive edge on which the business can capitalise.
- (d) Differentiation: As a result of its ability to innovate, design is the ideal discipline to contribute towards differentiation. With worldwide competition increasing, companies cannot compete if they do not have a competitive edge that offers something different. Design's contribution can thus be a key element in a company's endeavour to compete in a global economy. Global competitiveness for individual companies will naturally also make the national economy more competitive. Design's

ability to provide the innovation for a competitive edge, can thus make a contribution towards South Africa's becoming more competitive in world markets.

Design's contribution toward competitiveness is most visible in the area of product and service development. A company, whose main business is selling products, constantly needs new or redesigned products in order to compete in the market. Research showed indeed that the *design* of the products was indicated as the most important factor in successfully launched new products. In addition, the Product Design process can also be extended to services. The growth of services in the economy has increased the importance of designing services. The design process of services is in the main similar to products, but there are certain differences that must be taken into consideration. The most important difference is the intangibility of services. As a result, companies that provide a service need to have a well-designed corporate identity to communicate their values.

Design's ability to provide innovation for a competitive edge should be followed through and lead to increased economic activity. *Economic activity* was used as a collective noun, which includes various economic indicators. A number of studies have indicated the contribution that design can make to increase the economic activity of a business. For example research indicated that those firms that invest resources and professional expertise in industrial design, in both traditional and new industries, have been commercially more successful than firms that pay less attention to these aspects of design.

It can therefore be concluded that with globalised competition increasing, a company cannot compete if it does not offer something different. Innovation is necessary for such differentiation. Design can be an important source of innovation and can therefore contribute towards establishing a competitive edge. This can be done through designing products, as well as designing services. The result can lead to increased economic activity.

6.2.1.2 Design Management

The process through which design is integrated into the rest of a company's business functions is a part of Design Management. The design input, like any other in a business, needs to be managed. Project Design Management concentrates on the flow of the design activities, from the establishment of a brief through the whole design process up to the manufacturing of the product. Functional Design Management concentrates on a Design Department, which can be an in-house operation, outsourced or a combination of the two, as long as the interface is properly managed. Strategic Design Management concentrates on design's contribution in realising the mission of the company through, for example, the general direction of the innovation programme. From a Managing Director's point of view, design can thus form part of the structure of the company as any other business function.

Only a few companies have incorporated design in their businesses, notwithstanding the advances of Design Management and the fact that the benefits of design are the subject of many publications. As

these companies are the exception rather than the rule, it was concluded that design is not recognised sufficiently. Some of the reasons lie in the perceived risk of design, an inability by senior personnel to manage the design process, and a different approach by designers and marketers towards executing their respective responsibilities. The reasons centred around a mutual misunderstanding between designers and other staff members, built on what seems like a lack of sufficient knowledge of one another's contribution to the benefit of the company. The following chapter attempted to improve managers' knowledge of design.

The first research objective was therefore attained as evidence in the literature was presented that design can contribute to the competitiveness of a business. Unfortunately managers do not use design as widely as they might as a result of a poor understanding of the contribution of design. This raises the question of how the understanding of design can be improved.

6.2.2 Managers can use Product Design as a Knowledge Creation Management Tool

In response to the poor understanding of design, the question was asked whether the understanding of design might be improved if design could become a part of the Knowledge Management of a company. The second objective was to indicate that Product Design could be used as a Knowledge Creation Management tool?

6.2.2.1 Globalisation

Knowledge management is a function of the globalised economy. Globalisation came about as a result of economies throughout the world becoming globally interdependent since the end of the second millennium of the Christian era and was accelerated by the technological advances of the Information Communication Technology (ICT).

The effect of globalisation was to inundate consumers with products in an era of abundance, and thereby increasing competition for the limited amount of spending money in the world. In response to the increasing competition, companies are trying to create temporary monopolies by innovating products, processes and services. The result of this is an increase in the standard of offerings to consumers, which continues to raise their expectations in an ongoing circle. Attempts to satisfy customer expectations thus gathered the pace of change in most if not all sectors of the economy and became a very potent source of anxiety for managers and organisations. Such endemic change demands continuous regeneration and development of organisational knowledge.

Globalisation thus caused companies to change consistently. The methods and skills needed to manage organisations are different in the new millennium from the skills needed to be successful in the past. Boundaries are disappearing and the structures of organisations are becoming looser. In

organisations with fewer boundaries, there seems to be a progression towards the externalisation of relations and towards diversified activities. One of the prominent occurrences is that of strategic outsourcing which resulted in network organisations. The cellular structure was introduced as a way of managing an increasing number of network organisations.

6.2.2.2 Knowledge Management

The trend towards the network organisation, combined with the loss of skills during excessive downsizing, triggered the rise of Knowledge Management. Knowledge Management gained popularity through the approach by Peter Drucker (1993) that organisations will be more competitive as a result of their knowledge, rather than as a result of their physical assets. The basic premise of knowledge management is to draw on the skills and practices used in different disciplines to create winning strategies based on knowledge (Skyrme, 2000: 45).

The foundation of Knowledge Management is that all the factors that lead to superior performance are improved when better knowledge is made available and used competently, through the efforts of knowledge workers. A company that uses knowledge can turn that knowledge into an important source of strategic competitive advantage by generating greater value through the use of its intellectual capital. Managing of intellectual capital has led to the knowledge-based view of the firm that considers knowledge to be the most strategically significant resource of the firm. It follows therefore that to increase competitiveness, a business has to increase its knowledge. Knowledge can be increased through a learning organisation. Three processes in a learning organisation by which knowledge is increased, are learning through experience, the sharing of knowledge, and communities of practice. In these processes learning is essentially about creating new knowledge in order to improve competitiveness. *This became known as the knowledge creation imperative.*

6.2.2.3 Product Design as knowledge creation management

Product Design is presented as one of the best ways to generate new knowledge required by the new economy. This new knowledge was traditionally generated by Research and Development (R&D), but in the new economy R&D(design) is required. Design, as innovation, combines theoretical and technical information and is therefore the ideal knowledge creator. In the process of creating new knowledge, design uses and produces information. Design *uses* knowledge by integrating knowledge from other disciplines to develop, for example, smart products. This integration is done through design research and other techniques that generate and add to the design knowledge.

Design *produces* knowledge through the design process. This process can be explained as an innovation value chain (Young, 2001). One of the unique features of such a process is designers' ability to go beyond market research and anticipate consumer behaviour. This anticipation leads to

potential products for the future, and inherently encompasses an element of entrepreneurship. Design produces knowledge through making Product Development part of a company's Knowledge Creation Management. In this way design can generate knowledge that can improve a company's competitiveness and is thus important for the company's strategic decision making. A conceptual model depicting a holistic design approach was proposed consisting of different elements.

The design process starts with acquiring knowledge on various aspects in preparation for the actual design process. Any design starts with a *design brief*. The brief usually, but not always, originates from *market research*. The origin of a product can be either in the creativity of the designer (push innovation) or based on market information (pull innovation). The designer should be *au fait* with certain *company information*. Much of it could be included in the brief, but it is the responsibility of the designer to understand the relationship of the new or redesigned product to the rest of the company. When research on the above is completed, it can be condensed into a *problem statement*. This describes the problem in detail or alternatively describes the ideal product.

In the design process the designer uses or increases his/her domain-specific *knowledge of the design process* to guide the process and make sure that it arrives at the desired end. The designer also uses or increases his/her domain-specific *knowledge of non-design disciplines*. The design process incorporates existing knowledge and proceeds as follows:

- (a) *Conceptual design*, the stage in which alternative solutions and design variants are generated. In this process the designer use theoretical knowledge or *sophia* and generates mainly tacit knowledge.
- (b) *Embodiment design*, the stage in which one or more design concepts are translated into layout drawings and/or prototypes or full-scale mock-ups. In this process the designer use skills or *techne* and generates mainly explicit knowledge.
- (c) *Detailed design*, the stage in which the design chosen from the embodiment stage is developed. Detailed working drawings and specifications or computerised instructions are given. This can be referred to as a bundle of knowledge.
- (d) *Evaluation of design*, the stage in which the design is evaluated by assessment of a concept against a brief, product testing, or test marketing.

The outcome of the design process is a new or redesigned product, service or process. Knowledge is produced in the process that can be incorporated into the strategic and functional management of the company.

The second research question was thus also attained. Design can be used as a Knowledge Creation Management tool. In this regard a conceptual model was proposed, which indicated design as both a user and a producer of knowledge. This raises the question of what managers should understand about design in order to use it as a Knowledge Creation Management tool.

6.2.3 What managers should know about New Product Design

The second objective concluded that managers have a poor understanding of the benefits of design. As a result, the third objective investigated what managers should understand about Product Design in order to use it as a source of knowledge creation. This investigation was done through a questionnaire survey and a focus group discussion. This section concludes these findings.

6.2.3.1 Questionnaire survey

Section One outlined the background information and represented a wide spectrum of respondents. The age distribution was close to the bell-shape. In the gender distribution the males outnumbered the females by about 3 to 2. The distribution of the professional time showed that about three-quarters of the respondents were involved in design and about one-quarter in management. With regard to industry involvement, almost 70% of the respondents were either involved in design or taught in design. Respondents were well qualified with more than 72% holding a four year diploma or postgraduate qualification. The respondents spend their professional time mainly in 22 countries with most respondents originating from South Africa, then the USA and then the UK respectively. The results can therefore be interpreted with confidence, although caution is advised in the generalisability.

Section Two centred on the importance of managers knowing about the potential contribution of design to business. Respondents felt that the role that the design application could play in business solutions, case histories, and the competitive advantage design could play on the strategic level, the functional level, and the project level, were important for managers to know. The difference between design disciplines and which design discipline is best suited to solve a problem, did not receive enough support.

Section Three centred on the importance of managers knowing about the integration of design with business. All the issues listed were regarded by the respondents as important. They were:

- Design should be included as early in the development process as possible (most support).
- Design is an integrated team effort between company employees and designers.
- Design information should be integrated with the workflow process of the company, which includes (placed in order of support) marketing, manufacturing, service delivery, finances, and human resources.

Section Four centred on the importance of managers knowing about the design process. In general, the issues early on in the design process (for example the psychology of creativity) did not receive much support, with the writing of a creative brief a significant exception. The importance of design as a multi-disciplinary approach received the strongest support, while the respondents also felt that presenting a design, the implementation of a design, the short-term effectiveness, and long-term significance were important for managers to know about.

Section Five centred further on the importance of managers knowing about the presentation of the design application. A very strong negative correlation indicated that respondents felt that the more technical the information in the design presentation, the less important they were for managers to know about. The respondents felt that it is important for managers to know about (in order of support) the proposed alternative reality the designer was presenting, popularised drawings, written report(s) accompanying the design, and working drawings.

Section Six centred on the importance of managers knowing about the implementation of the design application. The respondents felt that all four the items listed were important for managers to know. The items were (in order of support): The design application was to be implemented as an integral part of the overall business strategy, the implementation of the design application could be a long-term process, the implementation of a design application could involve many experts from other fields, and the manager should be involved on an ongoing basis in the implementation of the design application.

Section Seven centred on the importance for managers to understand the risk analysis when dealing with design. The respondents felt that all four the items listed were important for managers to know. The items were (in order of support): Integrating a design application is a calculated risk, the designer cannot guarantee an increase in sales, proper research can lower the risk, and the designer carries part of the risk.

In summary, the questionnaire managed to distinguish in a statistically significant manner between certain items that were indicated by the respondents as important for managers to understand and other items that the respondents felt were unimportant. In general, the items that were design specific, such as conceptualisation and the psychology of creativity, were indicated as unimportant and the items close to managing a business, such as the writing of a creative brief and the risk factors, were indicated as important for managers to understand. The items that were indicated as important are included in the proposed curriculum for managers to learn about the design discipline.

6.2.3.2 Focus group discussions

These results were confirmed by two focus group discussions. The focus group with Product Designers confirmed the results of the questionnaire survey, with the exception of Section Four. The group felt that managers should understand the whole design process. Another aspect of importance

was that the manager should trust the designer. The group also made suggestions for a number of topics that should be included in a curriculum about design awareness for management students. The focus group with marketing managers also agreed that the marketing manager should be involved in the whole design process, although the level of involvement during the conceptual design phases is minimal. They felt that it is important for the marketing manager to have an understanding of this phase but they only become involved when there are problems or deviations. The marketing stressed the importance of clear communication during the whole design process.

Weighing up the results of the questionnaire survey and the two focus group discussions, and considering the results of all the other sections, it was concluded that the whole design process should be included in a curriculum, but not in detail. A curriculum should therefore include an overview of the design process, bearing in mind that managers should only have to understand the initial steps of the design process, in so far as it would give them a holistic view of the design process. It was shown that is not necessary to study technical information or the details of the design process.

It can thus be concluded that a combination of the questionnaire survey and the two focus group discussions provided a selection of items indicated as important for managers to understand about Product Design. These items are included in the curriculum.

6.2.4 Managers are not taught about new Product Design

With a selection of what managers need to understand, it is important to establish whether this content forms part of their education at tertiary institutions, especially in South Africa. The fourth research objective was formulated as: Are future managers educated by tertiary institutions to use Product Design to increase competitiveness through Knowledge Creation Management?

Information was received from 13 universities on the subject nomenclature in management, marketing and entrepreneurship offerings. At none of the universities there was any reference to creativity or innovation as an official name of a subject. At 7 of the 13 universities (or 54%), there was no mention of creativity or innovation at all, not even as part of a subject. At 6 of the 13 universities (or 46%), there was some mention of creativity or innovation as part of a subject, but this is not strong enough to be included in the official name of the subject. At the Management Faculties/Departments of the technikons there was no reference to creativity or innovation in the official name of a subject. The design discipline was not mentioned anywhere at either the universities or universities of technology, former technikons.

Based on the information received, it can be concluded that the offerings to management students at South African universities or university of technologies do not put much emphasis on creativity or innovation, while the design discipline is totally ignored. A cautionary note should, however, be

attached, as this conclusion was reached through the information supplied by the tertiary institutions, which consisted of only the subject names. More in-depth research is thus recommended.

6.2.5 *The framework could work*

Design projects of eighteen fourth year design students were analysed according to the proposed framework. All eighteen projects indicated clearly how the Product Design process used and produced knowledge. The framework was thus successfully tested as a means to assist managers to acquire a sufficient understanding of Product Design.

6.3 General Conclusions

The **first** objective concluded that evidence in the literature does exist that Product Design can improve competitiveness in a business, but that it is not always used as widely as it could be. Traditional approaches to integrate Product Design with the decision making of a business has only had limited success. A new approach is therefore necessary. The **second** objective indicates that that such a new approach can be found in the use of Product Design as a Knowledge Management Creation tool in order to increase competitiveness. This, however, requires that business managers should have a certain understanding of Product Design. A framework was developed that will assist managers to acquire such an understanding. The **third** objective established that managers should have an overall understanding of the design process, but not necessarily an in depth understanding of the design discipline. The **fourth** objective established that future business managers are not educated at South African tertiary institutions to understand enough about Product Design in order to use it to increase competitiveness. The **fifth** objective tested the framework successfully in practice that it could assist managers to acquire the understanding needed. This finding leads to the recommendation in the next paragraph, which is also the achievement of the **sixth** objective.

6.4 Recommendation: How managers can be taught about Product Design

The findings of the third, fourth and fifth objective indicated that a curriculum is necessary which can provide management students with an understanding of the design discipline. This section reaches the sixth objective by making recommendations on the contents of such a curriculum. The outcome of the curriculum is that business managers will have a sufficient understanding of Product Design so that they could increase competitiveness by using it as a Knowledge Creation Management tool.

6.4.1 Background to recommendations

Two clear viewpoints are heard with regard to Design Management Education and are well presented by Griffiths (2002). One audience wants to raise the professionalism of their design consultancy or in-house design team. Standard offerings from business schools are viewed with suspicion since design is rarely visible in the course material and the faculty is not able to connect with credibility to a design-aware audience. On the other hand, design schools may be perceived to lack the depth of business knowledge when they include business topics within their courses. A second audience, not necessarily with a design background, wants to develop an in-depth knowledge of design as a business resource and the capability to argue for its proper and professional management in a business context. Avenues open today are either design-led, for example an MBA in Design Strategy, or business-led, for example an MBA in Design Management.

This study would like to propose that design becomes part of a business and is managed on the same basis as any other business function such as marketing, finances, or human resources. Sometimes these functions are managed by specialists, for example, when a Marketing Manager holds a qualification in marketing. The same can happen with the design function, where a qualified designer can be responsible for the design function. Any one of the above two approaches formulated by Griffiths (2002) will fit perfectly in such a structure.

The problem is more acute at the general management level. For General Managers (or Directors or Chief Executive Officers, *etcetera*) to manage a business with its specific functions, they need to have a sufficient understanding of the most important issues and the vocabulary of each individual function. This is at the heart of many management training programmes, such as the MBA. *Similarly, General Managers must have a sufficient understanding of the most important issues of design and its vocabulary.*

- On a practical level, someone needs to be able to manage the design process on the same basis as they would manage any other business process. This can be referred to as *Operational Design Management*.

- On a functional level, someone needs to be able to manage a design department, whether in house, outsourced or a combination. This level can be referred to as *Functional Design Management*.

- On a more analytical level, someone needs to be able to manage design as a strategic resource as part of the decision-making process, on the same basis as they would all the other strategic resources. This can be referred to as *Strategic Design Management*. Design should be a holistic part of the process of formulating, implementing, and evaluating cross-functional decisions that enables an organisation to achieve its objectives.

In order to be competitive in the new millennium, with outsourced and networked organisation, **managers tend to manage competencies; they do not necessarily possess them.** This is especially true in the area of Knowledge Creation Management. It is therefore recommended that

managers, who find it difficult to be creative or to concentrate on innovation, because they need to concentrate on managing a business, will do well to contract the services of a professional designer. A designer can pay all his/her attention to the creation of new knowledge. The role of a General Manager in an organisation is to co-ordinate the various business functions, which are often handled by functional managers. As these functions are becoming more specialised and are often outsourced in the new millennium, managers are appointed who can pay their full attention to a specific function.

The General Manager may be the best Human Resources Manager, but if she attends to all the human resource issues, it is most likely that she will neglect her role as General Manager. That role is primarily to pay attention to the Strategic Management of the organisation. Specialists are appointed, or often contracted in, to devote all their attention to a specific function of the business. In a similar way, designers must be appointed, or contracted in, to pay all their attention to the design function of the business. They will be the innovation specialists in the same manner as the company makes use of marketing, finances, human resources and production specialists. In the new millennium, managers are compelled to co-ordinate competencies, rather than to possess them. One reason is the level of specialisation of the competencies needed, for example, information technology, the South African labour laws and sophisticated production equipment.

In order to increase competitiveness, good managers are people who have a sufficient understanding of the business functions which enable them to synergistically co-ordinate them. Managers do not need to be specialists in all or most of them. *The question remains whether all the resources spent on trying to make managers more creative cannot be better utilised to educate managers on how to integrate the contribution from talented creative people for maximum effect in their businesses.* The question can therefore be asked whether it is not best to obtain the services of a specialist designer rather than to make use of the manager who is already burdened with other business functions and who cannot pay proper attention to the knowledge creation function. Against this background, a curriculum on Design for Managers is proposed.

6.4.2 Curriculum: Design for Managers

A curriculum is proposed which could provide managers with a sufficient understanding to manage design as they would manage any other business function. On the basis of the argument in the previous paragraph, the curriculum is divided into Project Design Management, Functional Design Management and Strategic Design Management.

The outcomes of the curriculum can be formulated as follows:

After studying Project Design Management, a student should be able to:

- Describe the role of design in business.
- Describe the design process.
- Write a creative brief.

- Understand a design presentation.
- Implement a design application.

After studying Functional Design Management, a student should be able to:

- Integrate design in a company's management structure.
- Effectively source design.
- Manage the design linkage/interface.
- Overcome barriers to the integration of design.
- Manage designers.

After studying Strategic Design Management, a student should be able to:

- Describe the importance of the strategic role of design.
- Write a strategic brief.
- Use design as a source of sustainable competitive advantage.
- Minimise the risk of implementing a design.

A proposed curriculum that can achieve these outcomes is portrayed in Figure 6.1.

Proposed Curriculum

Design Awareness

(Design for Managers)

1. Project Design Management

1.1 Introduction

Increased globalised competition leads to increased customer expectations.

The imperative to increase competitiveness and Product Design's contribution to creativity and innovation.

1.2 The role of Design in business

An overview of the role of Product Design, including Product Design's importance for a business, design as a system of creativity, Product Design in history, and illustrated by three examples, namely Czech Republic, Strathclyde study, and design part of top performing companies.

The role of Product Design in innovation, including the process of invention, design and innovation, Product Design's role in price and non-price factors, Product Design's role in push and pull innovation, Product Design's role radical and incremental innovation, commercialisation of Product Design and the innovation value chain.

The role of Product Design in competitiveness, including the importance of a competitive edge, differentiation as competitive edge, contribution of Product Design to global competitiveness, and illustrated by three examples: Europe's 500 project, Five Scandinavian small and medium-sized firms, automobile industry.

The role of Design in Product Development, including the importance of product development in a company engineering design and industrial design in product development, specifications in product development, international markets in product development, managerial and organisational success factors for product development, and the ten hypotheses for successful new product development.

The role of Design in Service Development, including importance of service design, similarities between Product Design and service design, differences between Product Design and service design, and the early stages of service design.

The role of Product Design in increasing economic activity, including effective design associated with increased economic activity, design in big companies can increase economic activity, and design in small and medium-sized companies can increase economic activity.

·Illustrative case studies

(Can be integrated with text)

Freeplay self-powered radio [South African, unpublished]

Freeplay Flashlight [South African, unpublished]

Capula Candles [South African, unpublished]

Cadbury's P.S. Chocolate

SL Magazine

Xootr

Linn Products

Psion

Bang & Olufsen

Miyake and Comme des Garçons

IBM Thinkpad

1.3 The Design Process

Product Design as a Knowledge Creation Management Tool

Explanation of the conceptual model (figure 3.3)

Important aspects for managers to understand:

- Writing a creative brief [2.14.3 and 2.14.4]
- Design as a user and producer of knowledge
- Supplying the information the designer needs

1.4 Presentation of design

The different ways in which design can be presented, e.g., drawings, models, prototypes.

An introduction to popularised drawings, working drawings and the written reports accompanying the design.

1.5 Implementation of the design

Manager must be involved on an ongoing basis in the implementation of the design application.

Design application is to be implemented as an integral part of the overall business strategy.

Implementation of the design application could be a long-term process.

Evaluating the short-term effectiveness of design (goals, criteria).

Evaluating the long-term significance of design (goals, criteria).

2. Functional Design Management

Place of design in a company's management structure, which includes the integration of design as early as possible and multi-disciplinary teams, such as the rugby approach.

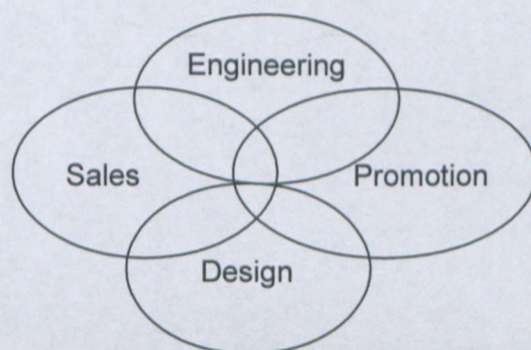


Figure 2.1 The rugby approach

Sourcing design, such as in-house, external or combination.

Managing the design linkage/interface.

Barriers to the integration of design, such as the lack of recognition [2.16.2], and the lack of communication.

How to manage designers.

3. Strategic Design Management

Importance of the strategic role of design, including the strategic brief, the broadening the strategic role of design, the integration of the strategic role of design, a sustainable competitive advantage based on the strategic role of design, and competing in foreign markets based on the strategic role of design.

Risk management of the design process, including the calculated risk of integrating a design application, Product Design as an investment decision, the fact that a designer cannot guarantee an increase in sales, the designer carries part of the risk, and proper research can lower the risk.

4. Case studies for analysis and discussion (Capita Selecta)

SL Magazine

Cadbury's P.S. Chocolate

Prudential Corporation

Master Lock

Philips Group

Figure 6.1 Proposed Curriculum

6.5 Application to the Industry

This curriculum aims to provide business managers with sufficient understanding to manage Design as one of the business functions, along with any of the other business functions. It differs from traditional Design Management curricula offered at other universities in the world. Traditional Design Management curricula offered at, especially United Kingdom institutions, aim at equipping a candidate to become head of a design department. The content of these curricula are therefore around 50% design and 50% management. While this provides a more in depth knowledge in design for business

managers, it is often criticised that the candidate is not sufficiently equipped to become either a designer or a manager. The candidate has only received 50% of the curricula of each profession.

The proposal in this thesis accepts that designers are designers and managers are managers. It is also one of the recommendations of the design focus group. Business Managers manage a wide variety of functions in a business without having an in depth knowledge in that specific function. Traditionally a manager who has specialised in one area, e.g. marketing or production, is promoted to a general manager position. Such a manager then acquires sufficient knowledge from the other areas outside his specialisation through a general management course such as an MBA programme or other Masters in Business study. It is at this level where such a managers acquires sufficient knowledge of the other areas in order to manage them. This thesis proposes that Design Management is then included in the array of subjects studied at this stage.

The application of the curriculum can be fourfold:

- (a) As a subject in a general management course
- (b) As a short course for managers such as short courses on human resource management, marketing or project management.
- (c) As a short course to equip marketing managers specifically to understand what a Product Designer, trained at a design institution, can contribute.
- (d) As an in-house programme for any management level wanting or needing to know more about Product Design as practised by designers trained at design institutions and how this could increase their business's competitiveness.

The final time frame and contents should be adjusted according to local circumstances. In any curriculum there are always small adjustments as the presentation would like to use more appropriate case studies, etc. The availability of practising Product Designers could add to the variety and may also differ.

6.6 Contribution to theory

This thesis indicated how Product Design can be used as a Knowledge Creation Management tool in order to increase competitiveness in a business. By equipping a business manager with the necessary understanding about Product Design, it allows him/her better integration of Product Design in the management of a business. Using Product Design is a consistent way in which business managers can create new knowledge.

One of the contributions to theory is to propose Product Design as a consistent source of new knowledge. Most sources of new knowledge in a business have some element of inconsistency that would disqualify it as a consistent source of knowledge creation. The theoretical model in chapter three proposes the tried and tested design process as a consistent source of new knowledge creation.

The second contribution to theory is the proposal that Design should form part of any manager's education. Design Management should have the same status as for example Human Resources Management, Financial Management or Production Management. This implies that Design Management should form part of the business management education on par with other subjects. In order to achieve that, a new curriculum is proposed.

Managers can obtain a functional knowledge of Product Design by following the proposed curriculum. How such a curriculum fits conceptually in the business management theory, is graphically portrayed in Figure 6.2. Globalisation impacts on individual companies in many ways. Some of these factors are political, technological, cultural, socio-economic, legislative, and environmental. The managerial ethos and increased competition further impact on individual companies. All these factors have an influence on the profitability of the company. Profitability can be increased by Product Design and Knowledge Management, and can still further be increased by using Product Design as Knowledge Creation Management. Such an increase in profitability is, however, conditional on the fact that managers have a functional understanding of the Product Design process.

This model (see figure 6.2) embodies the achievement of the sixth objective of the research.

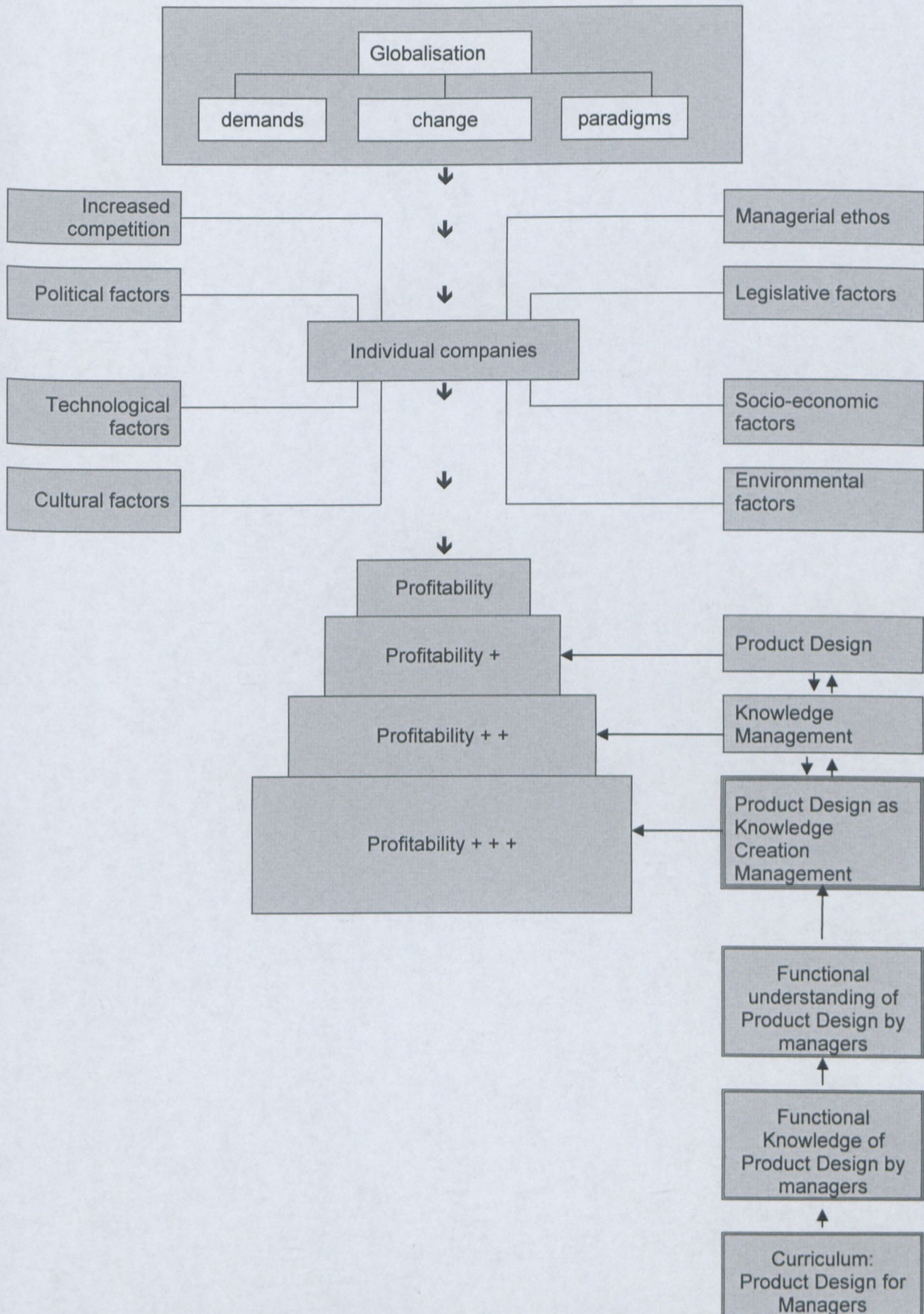


Figure 6.2 Summary of the need for a curriculum on Product Design for Managers

6.7 Application of the framework

The question arose how can the framework be used to contribute towards the systemisation of the knowledge prevalent in Product Design. Product Designers use knowledge from different areas to design a product. The question is how this knowledge can best be used to optimise the design process?

The vast amount of knowledge gained during design projects can very easily be disorganised. As seen from the design projects of the 18 fourth year students, knowledge is gained from a very wide variety of backgrounds. Most often when a product is being designed, design knowledge is not sufficient. The Product Designer needs to gather knowledge from a related field in order to best design a product. The problem is that this gathering of knowledge can be very haphazard and a company, or a person, may not know what has been done in order to build on previous work.

The framework could assist a design agency to systemise the using and producing of knowledge in that agency as a whole. This knowledge is both explicit and tacit. Some of it is very formal and is written up, for example where subject matter such as gynaecology, electricity, and road safety. Some of this knowledge is tacit, for example the student who went to experience bathing problems in an informal settlement. The framework contributes towards the systemised keeping of this knowledge in order that future product designers may benefit from it.

The framework could also assist a particular designer with the conceptualisation of the different types of knowledge used and produced when completing a design project. Product Designers know they need other information, but could acquire this in a very informal way. With the framework pointing out the formal processes, it would assist Product Designers to understand the process and lead to work more systematically in acquiring the necessary information.

In practice the framework can assist in keeping the information on record. After each design project is completed, the designer can use the steps in the framework to write up the knowledge gained during the project. The framework breaks the process down in different steps and makes it easy to identify the internal and external knowledge gained in the design process. This makes it easier for the Product Designer to identify the knowledge gained in each step. Not only does it assist the designer to gain better insight in the process, but when written down, can be used to assist other designers as well.

Another practical application of the framework is the managing of design projects. Once it is clear who gains what knowledge during a design process, it is easier to assign future design projects. One practical application is the creation of specialist areas. If the knowledge gained is properly systemised, certain designers, or groups of designers, can specialise in certain areas or related fields.

A final and very important application of the framework is that it assists managers to understand the design process. Managers are able to comprehend the process flows and understand the impact of design knowledge and knowledge gained from other fields as required by a specific design project.

6.8 Further research

As with all research, not all the possibilities could be covered. Areas that need further research are:

- The offerings of tertiary institutions within and outside South Africa could be investigated further for their applicability to teach management students about Product Design as a Knowledge Creation Management tool. International comparisons will lead to very interesting results and could enhance the proposed curriculum.
- The issues that were identified as important for managers to know could be further refined. Once a list of issues is identified, it could be investigated further by asking respondents to choose which one is the more important of two alternatives.
- The sources of creative ideas that were commercialised could be investigated further.

6.9 Summary

This chapter concluded that evidence in the literature suggested that managers could use Product Design to improve competitiveness, but that it was not used as widely as it might be. In addition, a conceptual model was drawn up which indicated how design could be both a user and producer of knowledge. This raised the question of what managers should know about design and as a result of a questionnaire survey, a selection of items was drawn up and confirmed by two focus group discussions. A framework was developed and tested successfully to assist managers to acquire the understanding needed.

Further investigation showed that in the education of these managers, creativity and innovation did not receive sufficient attention. In response a curriculum was developed which could provide managers with an effective understanding of design in order to increase a company's competitiveness by managing design as part of the knowledge creation management of a company. This then achieves the overall research aim of how the competitiveness of a business could be improved through the application of Product Design as a Knowledge Creation Management tool.

References

- Adler, J.N. & Bartholomew, S. 1998. Managing globally competent people. (In Keys, J.B. & Fulmer, R.M. (eds.) 1998. *Executive learning and organisational learning*. New York: International Business Press, pp 49 – 71.)
- Ahire, S.L. & Dreyfus, P. 2000. The impact of Design Management and process management on quality: an empirical investigation. *Journal of Operations Management*, 18(5): 549 – 576.
- Ainamo, A. 1998. Design and competitive advantage: the case of Marimekko Oy, a Finnish fashion firm. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: Sustaining competitive advantage*. Chichester: John Wiley, pp 179 – 200.)
- Alexander, J. 1996. Redesigning the national endowment for the arts. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 82 – 90.)
- Allan, G. 1991. Qualitative research. (In Allan, G. & Skinner, C. 1991. (eds.) *Handbook for research students in the social sciences*. London: Falmer Press.)
- Allinson, K. 1993. *The wild card of design: a perspective on architecture in a project management environment*. Oxford: Butterworth.
- Altman, D. 2003a. 308,000 jobs lost in February. *New York Times*, March 8.
URL <<http://www.nytimes.com/2003/03/08/business/08ECON.html>>
- Altman, D. 2003b. Industrial production rises 0.7%. *New York Times*, February 15.
URL: <<http://www.nytimes.com/2003/02/15/business/15ECON.html>>
- Altman, D. 2003c. Slim growth for economy in 4th quarter. *New York Times*, January 31. URL: <<http://www.nytimes.com/2003/01/31/business/31ECON.html>>
- Anders, R. 2000. Defining, mapping and designing the design process. *Design Management Journal*, 11(3): 29 – 37, Summer.
- Anon. 1996. Leading lights: an interview with Stan Davis. *Knowledge Inc.*, 1(4).
- Anon. 2000. Value of British design flourishes. *FX*, December.
- Anon. 2001. US economy in recession. *Cape Times Business Report*

- Anon. 2002a. Budget in a nutshell. *Financial Mail*, February 22: 4.
- Anon. 2002b. Over 60 and overlooked. Marketing to the old. *The Economist*, 364(8285): 51 – 52, Aug 8.
- Anon. 2002c. UN predicts slow and patchy recovery. *Financial Times*, June 27.
- Associated Press, The. 2002a. Economy grew at faster rate in 3rd quarter than first thought. *New York Times*, November 26. URL: <<http://www.nytimes.com/aponline/business/AP-Economy.html>>
- Associated Press, The. 2002b. Greenspan says economy is in a 'soft patch'. *New York Times*, November 13. URL: <<http://www.nytimes.com/aponline/business/AP-Greenspan-Economy.html>>
- Associated Press, 2002c. Jobless rate soars, matches 8-year high. *New York Times*, December 7. URL: <<http://www.nytimes.com/aponline/business/AP-Economy.html>>
- Associated Press, The. 2002d. Unemployment rate rose 5.7% in October. *New York Times*, November 1. URL: <<http://www.nytimes.com/aponline/business/AP-Economy.html>>
- Audretsch, D.B. & Fritsch, M. 2003. Linking entrepreneurship to growth: the case of West Germany. *Industry and Innovation*, 10(1): 65 – 73, March.
- Babbidge, M. 1992. Quality + organisation = client satisfaction. *Design Management*, 16(3): 44, March.
- Babbie, E. 1992. *The practice of social research*. Belmont, CA: Wadsworth.
- Babbie, E. & Mouton, J. 2001. *The practice of social research*. Cape Town: Oxford University Press.
- Bachner, J.P. 1991. *Practice management for design professionals*. New York: Wiley Chapman & Hall.
- Bannon, L.J. & Kuutti, K. 2002. Shifting perspectives on organisational memory: from storage to active remembering. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 190 – 210.)
- Barclay, R.O. & Murray, P.C. 2002. What is Knowledge Management? <http://www.media-access.com/whatis.html>

- Barney, J. 1991. Firm resources and sustained competitive advantage. *Strategic Management Journal*, 17(1): 99 – 120.
- Bateman, T.S. & Snell, S.A. 2002. *Management*. 5th ed. Boston: McGraw-Hill Irwin.
- Bauhain, D. 1990. Managing designers. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 359 – 366.)
- Baxter, M. 1996. *Product design*. London: Chapman & Hall.
- Bayley, S. 2006. From form follows function to process proceeds product.
<<http://www.ddc.dk/UK/publications/kompendier/grundbegr/bailey.html>>
- Bellinger, G. 2006. Knowledge Management – Bah humbug!
<http://www.media-access.com/kmbh.html>
- Berenson, A. 2003. Tight US job market adds to jitters among consumers. *New York Times*, March 01
URL: <<http://www.nytimes.com/2003/03/01/business/01ECON.html>>
- Bernsen, J. 1990. Twelve principles of Design Management. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 85 – 95.)
- Beuker, R. 2001. Braun design: dream real products, make real products. *Design Management Journal*, 12(4): 15-23, Fall.
- Biemans, W. G. 1995. Internal and external networks in product development: a case for integration. (In Bruce, M. & Biemans, W.G. (eds.) *Product Development: Meeting the challenge of the design-marketing interface*. Chichester: John Wiley, pp 137 – 159.)
- Bisseker, C. 2001. It's worse than you thought – unless behaviour changes. *Financial Mail*: 34, June 15.
- Blaich, R. & Blaich, J. 1993. *Product design and corporate strategy: managing the connection for competitive advantage*. New York: McGraw-Hill.
- Blumenthal, D. 2001. "Face of the brand": a design methodology with global potential. *Design Management Journal*, 12(3): 32 – 39, Fall.
- Bouchikhi, H. & Kimberly, J.R. 2000. The customised workplace. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 207 – 219.)

- Bourgeon, L. 2002. Temporal context of organisational learning in new project development projects. *Creativity and Innovation Management*, 11(3): 175 – 183, September.
- Bouma, G.D. 2001. *The research process*. 4th ed. Melbourne: Oxford University Press.
- Bourque, L.B. & Fielder, E.P. 1995. *How to conduct self-administered and mail surveys*. Thousand Oaks, CA: Sage Publications.
- Brandli, L. 2003. In-house creative services vs. total outsourcing. *eBulletin*, Design Management Institute, August.
<<http://www.dmi.org/organisation/dmi/html/publications/news/ebulletin/ebvauglb.htm>>
- Brecher, J., Costello, T. & Smith, B. 2000. *Globalisation from below: the power of solidarity*. Cambridge, MA: South End Press.
- Breu, K. & Hemingway, C. 2002. Collaborative processes and knowledge creation in communities-of-practice. *Creativity and Innovation Management*, 11(3): 147 – 153, September.
- Brown, C. (ed.) 1978. *The international dictionary of new testament theology*. Exeter: Paternoster Press.
- Brown, J.S. & Duguid, P. 2002. Organising knowledge. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 19 - 40.)
- Brown, T. & VanPatter, G.K. 2004. Innovation by Design. Understanding IDEO Now! In *NextD Journal*, issue FOUR, conversation 4.2.
- Bruce, M. 1997a. A dedicated approach to Design Management. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 128 – 136.)
- Bruce, M. 1997b. Developing a brand: Cafecream. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson Publishing Company, pp 145 – 158.)
- Bruce, M. 1998. Introduction. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 11 – 12.)
- Bruce, M. & Cooper, R. 1997a. Design and the organisation. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 3 – 34.)

- Bruce, M. & Cooper, R. 1997b. Marketing and design: a working relationship. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 35 – 59.)
- Bruce, M. & Cooper, R. 1997c. Using design effectively. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson Publishing Company, pp 60 – 108.)
- Bruce, M. & Cooper, R. 2000. *Creative product design: a practical guide to requirements capture management*. Chichester: John Wiley.
- Bruce, M., Cooper, R. & Vazquez, D. 1999. Effective Design Management for small businesses. *Design Studies*, 20(3): 297 – 315.
- Bruce, M. & Morris, B. 1997. Design partnerships practice: Irgo-Pic. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 109 – 127.)
- Bruce, M. & Morris, B. 1998a. A comparative study of design professionals (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 261 – 282.)
- Bruce, M. & Morris, B. 1998b. In-house, outsourced or a mixed approach to design. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 40 – 61.)
- Bruce, M. & Morris, B. 1998c. Sourcing design competencies: Ingersoll-Rand. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 71 – 90.)
- Bruseberg, A. & McDonagh, D. 2003. Organising and conducting focus groups. (In Langford, J. & McDonagh, D. (eds.) *Focus groups: supporting effective product development*. London: Taylor & Francis, pp 21 – 45.)
- Bryman, A. 1990. *Quantity and quality in social research*. London: Unwin Hyman
- Bucciarelli, L. 1994. *Designing engineers*. Cambridge, MA: MIT Press.
- Bull, K.L. 1999. System-operated product development and the craft of integration. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 1 – 10.)

- Burnette, C. 2006. *Design: a universal discipline in the age of information*.
<<http://www.ddc.dk/UK/publications/kompendier/burnette.html>>
- Burns, P. 2001. *Entrepreneurship and small business*. London: Palgrave.
- Burnside, R.M. 1991. Visioning: building pictures of the future. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 193 – 200.)
- Burton-Jones, A. 1999. *Knowledge capitalisms: business, work and learning in the new economy*. Oxford: Oxford University Press.
- Cai, Y. 2001. Design strategies for global markets. *Design Management Journal*, 12(3): 32 – 39, Fall.
- Callaway, W. 1990. New directions in design and management education. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 414 – 422.)
- Carlisle, Y. 2002. Strategic thinking and Knowledge Management. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 122 – 138.)
- Casaleggio, C. s.a. The resource-based approach to strategy. Unpublished article.
- Castells, M. 1996. *The rise of the network society: The information age: economy, society and culture, vol 1*. Oxford: Blackwell.
- Chaaya, M. & Jaafari, A. 2001. Cognisance of visual Design Management in life-cycle Project Management. *Journal of Management in Engineering*, 17(1): 49 – 57.
- Chiu, L.J. 2001. Managing design for global value in Japan. *Design Management Journal*, 12(3): 32 – 39, Fall.
- Choo, C.W. 1996. The knowing organisation: how organisations use information to construct meaning, create knowledge and make decisions. *International Journal of Information Management*, 16(5): 329 – 340.
- Chowdry, S. 2000. *Management 21C*. London: Pearson Education.
- Clark, K. & Fujimoto, T. 1991. Reducing the time to market: the case of the world auto industry. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage, pp 106 – 116.)

- Clipson, C. 1990a. Design as a business strategy. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 95 – 105.)
- Clipson, C. 1990b. Innovation by design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 313 – 322.)
- Clipson, C. 1991. Innovation by design. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage, pp 97 – 105.)
- Conklin, D. & Tapp, L. 2000. The creative web. (In Chowdry, S. 2000. *Management 21C*. London: Pearson Education, pp 220 – 234.)
- Cooke, R.C. 2002. One voice, one force: identity at the USAF. *Design Management Journal*, 13(1): 68 – 73, Winter.
- Cooke, S.D.N. & Brown, J.S. 2002. Bridging epistemologies: the generative dance between organisational knowledge and organisational knowing. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 68 - 101.)
- Cooper, R. 1997. Stirling Cooper: the design process. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 137 – 144.)
- Cooper, R. & Press, M. 1998. *The design agenda: a guide to successful Design Management*. Chichester: John Wiley.
- Cooper, R. & Press, M. 1999. Heroes and villains? The contradictory and diverse nature of Design Management. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 11 – 29.)
- Cooper, R.G. & Kleinschmidt, E.J. 1991. New products: what separates winners from losers? (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 127 – 140.)
- Cowell, A. 2003. Ireland, once a Celtic tiger, slackens its stride. *New York Times*: February 19.
URL: <<http://www.nytimes.com/2003/02/19/business/worldbusiness/191IREL.html>>
- Creating and working with knowledge* (video production). Australia: Ash Quarry productions
- Crook, C. 2003. Flowering economies, weedy leadership. (In Fishburn, D. & Green, S. (eds.) *The world in 2003*. London: The Economist, pp 18 – 21.)

- Cross, R. 1998. Managing for knowledge; managing for growth. *Knowledge Management*, 1(3): 9 – 13.
- Cuffaro, D.F., Vogel, B. & Matt, B. 2002. Why good design doesn't always guarantee success. *Design Management Journal*, 13(1): 49 – 55, Winter.
- Cyert, R.M., Kumar, P.K. & Williams, J.R. 1993. Information, market imperfections and strategy. *Strategic Management Journal*, 14: 47 – 58, Winter special issue.
- Dainty, P. & Anderson, M. 2000. Mindset for managers. (In Chowdry, S. 2000. *Management 21C*. (ed.) London: Pearson Education, pp 95 – 105.)
- Danzig, M. 2002. By design: The Bluelight brand story. *Design Management Journal*, 13(1): 26 – 32, Winter.
- Davenport, T.H. 2006. Coming soon: the CKO (chief knowledge officer).
<http://www.informationweek.com/509/cko.html>
- Davenport, T.H. & Prusak, L. 1998. *Working knowledge: how organisations manage what they know*. Boston, Mass.: Harvard Business School Press.
- David, F.R. 2001. *Strategic Management*. Upper Saddle River, NJ: Prentice Hall.
- Davies-Cooper, R. & Jones, T. 1995. The interface between design and other key functions in product development. (In Bruce, M. & Biemans, W.G. (eds.) *Product development: meeting the challenge of the design-marketing interface*. Chichester: John Wiley, pp 81 – 97).
- Davis, S. & Botkin, J. 1994. The coming of the knowledge-based business. *Harvard Business Review*: 165 – 170, September/October
- Davis, W. 1991a. Alastair Pilkington: inventor of float glass. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 160 – 162.)
- Davis, W. 1991b. Clive Sinclair: the innovator who lacked business flair. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 163 – 165.)
- Davis, W. 1991c. Edwin Land: inventor of the instant camera. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 158 – 159.)

- Davis, W. 1991d. The innovators. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 142 – 149.)
- Davis, W. 1991e. Soichiro Honda: 'supply creates its own demand'. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 150 – 153.)
- Davis, W. 1991f. Steven Jobs: genius in a garage. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 154 – 157.)
- Dear, K. 2001. Equality is the key to a successful marriage. *Design Week*, 16(50): 14, December 13.
- De Bono, E. 1994. *Parallel thinking: from Socratic thinking to De Bono thinking*. Harmondsworth: Viking.
- Decker, M. 1993. Design Management: the mystery and the magic. *Public Relations Quarterly*, 38(3): 5-7.
- Deforge, Y. 1990. Objects in their thousands: progress or evolution? (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 423 – 430.)
- De Geus, A. 1980. Planning is learning. *Harvard Business Review*: 71, March/April.
- De Mozota, B.B. 1990. Design as a Strategic Management tool. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 73 – 84.)
- De Mozota, B.B. 1998. The challenge of design relationships: the converging paradigm. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 244 – 259.)
- Denzin, N.K. & Lincoln, Y.S. 2000. Introduction: the discipline and practice of qualitative research. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 1 – 28.)
- Deogun, N. 1998. Soft drink marketers at Triarc deftly give Snapple back its Buzz. *The Wall Street Journal*, 14: 1, December.
- Desbarats, G. 1994. Industrial Design: high time Cinderella went to the ball. *World Class Design to Manufacture*, 1(5): 14 – 20.
- Design Council(a). 2006. *Design and exports*.

URL: <http://www.designcouncil.org.uk/webdav/servlet>>

Design Council(b). 2006 *The UK design industry – facts and figures*.

URL: <http://www.designcouncil.org.uk/webdav/servlet>>

Devlin, K. 1999. *Infosense: turning information into knowledge*. New York: W.H. Freeman.

Dicey, L. (ed.) 2001. *Advertising performance excellence. AAA Apex award winner 1995 – 2000*.

Parklands, S.A.: Association of Advertising Agencies Ltd.

Doole, I. & Lowe, R. 2004. *International Marketing Strategies. Analysis, development and implementation*. 4th ed. London: Thomson Learning.

Downton, P. 2000. Knowing research: researching, knowledge and designing. (In Pizzocaro, S., Arruda, A. & De Moraes, D. (eds.) *Design Plus Research: Proceedings of the Politecnico di Milano Conference*, May 18-20, 2000. Milano: Politecnico di Milano.

Drucker, P.F. 1988. The coming of the new organisation. *Harvard Business Review*: 45 – 53, January/February.

Drucker, P.F. 1991. The discipline of innovation. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 9 – 17.)

Drucker, P.F. 1993. *Post capitalistic society*. New York: HarperCollins.

Drucker, P.F. 1997. Introduction: Toward the new organisation. (In Hesselbein, F., Goldsmith, M. & Beckhard, R. (eds.) *The organisation of the future*. San Francisco: Jossey-Bass, pp 1 – 5.)

Drucker, P.F. 1999. *Management challenges for the 21st century*. Oxford: Butterworth-Heinemann.

Earl, M. 2001. Knowledge Management strategies: towards a taxonomy. *Journal of Management Information Systems*, 18: 215 – 233.

Earl, M. 2002. What is a chief knowledge officer? (In Kok, A. *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 40 – 55.)

Economic Research Unit. 2001a. *The Economic Monitor*. Old Mutual Asset Managers. First Quarter 2001.

- Economic Research Unit. 2001b. *The Economic Monitor*. Old Mutual Asset Managers. Fourth Quarter 2001.
- Economic Research Unit. 2002. *The Economic Monitor*. Old Mutual Asset Managers. Second Quarter 2002.
- Ehlers, M.B. 2002. International management and globalisation. (In Nieman, G. & Bennett, A. *Business Management: a value chain approach*. Pretoria: Van Schaik Publishers, pp 375 – 389.)
- Eksteen, F.R.L.N. 1997. *Business Management*. Cape Town: Nasou.
- Ekvall, G. 1991. The organisational culture of idea-management: a creative climate of the management of ideas. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 73 – 79.)
- Environmental Management. 2006. Environmental Management
<<http://www.gcis.gov.za/documents/publications/yearbook/environment.html>>
- Eriksson, M. & Parviainen, J. 2002. Knowledge sharing in projective organisations. *European Academy of Management – 2nd conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Erwee, J.A. 1996. *Research design, methodology and techniques: A student's guide to empirical research*. Port Elizabeth: Institute for Planning Research, University of Port Elizabeth.
- Evans, B. 1990. The Japanese corporate approach. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 393 – 405.)
- Evans, R. & Russel, P. 1991. Using the creative process to resolve a strategic conflict over environmental issues at Berol. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 246 – 251.)
- Exon, M. 2002. Tour de force. *Design Week Top 100*, 68 – 69, June.
- Fabrycky, W. 1990. Life cycle design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 231 – 239.)
- Farren, C. 2000. Mastery: the critical advantage. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 95 – 105.)

- Faulkner, W. 2002. Conceptualising knowledge used in innovation: a second look at the science-technology distinction and industrial innovation. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 139 – 169.)
- Fentem, A. & Dumas, A. 1999. Building electronic totems to manage automotive concept development. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 30 – 37.)
- Fern, E.F. 2001. *Advanced focus group research*. Thousand Oaks, CA: Sage Publications.
- Fink, A. 1995. *How to analyse survey data*. Thousand Oaks, CA: Sage Publications.
- Firestone, J.M. 2002. Basic concepts of Knowledge Management. (In Kok, A. *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 13 – 27.) Also available at <http://www.dkms.com/KMBASIC.html>
- Firestone, J.M. 2003. *Enterprise information portals and Knowledge Management*. Burlington, MA: Butterworth-Heinemann
- Foppen, J.W. 2000. Knowledge leadership. (In Chowdry, S. 2000. *Management 21C*. London: Pearson Education, pp 151 – 159.)
- Fortune*. 1997. Most admired companies. March 3.
- Fox, J. 1993. *Quality through design: the key to successful product delivery*. London: McGraw-Hill.
- Freeze, K. 1998. Novo Nordisk A/S: innovative design for diabetics. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances. Sustaining competitive advantage*. Chichester: John Wiley, pp 137 – 157.)
- Freeze, K. & Powell, E. 1998. Design Management lessons from the past: Henry Dreyfuss and American business. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances. Sustaining competitive advantage*. Chichester: John Wiley, pp 205 – 215.)
- Friedman, K. 1999. Philosophies of design. *Ämneskonferens projekteringsmetodik*. (In Ekholm, A. (ed.) Lund: Datorstödd projektering (CAAD), Lunds Tekniska Högskolan. Ämneskonferens projekteringsmetodik, NorFA Research Symposium on Design Methodology, LTH - Lund Technical Institute, Lund University, 25-26 November 1999.)

- Friedman, K. 2000a. Creating design knowledge: from research into practice. IDATER, Loughborough University.
- Friedman, K. 2000b. Design research in a knowledge economy: context, content and continuity. (In Pizzocaro, S., Arruda, A. & de Moraes, D. (eds.) *Design Plus Research: Proceedings of the Politecnico di Milano Conference*, 18-20 May. Addendum to Proceedings.) Milano, Italy: Politecnico di Milano, pp 1-19 [of addendum volume].
- Gagliardi, M. 2001. Alchemy of cultures: From adaptation to transcendence in design and branding. *Design Management Journal*, 12(3): 32 – 39, Fall.
- Galagan, P.A. 1991. *The learning organisation made plain* (interview with Peter M. Senge). *Training and Development*, 45: 42, October.
- Gambardella, A. 1992. Competitive advantages from in-house scientific research: the US pharmaceutical industry in the 1980s. *Research Policy*, 21: 391 – 407.
- Garbers, J.G. c.a. *Investigation into research methodology*. Pretoria: Human Sciences Research Council.
- Gardiner, K. 1990. Design: organisation and management. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 15 – 166.)
- Gbn 2002. Twenty-first century organisations: four plausible prospects.
http://www.gbn.org/public/gbnstory/articles/ex_21st_cen_org.htm
- Gebhardt, M. 2003. SA proudly holds its own against bigger rivals. *Business Report*, 26:2, February.
- Gergen, M.M. & Gergen, K.J. 2000. Qualitative enquiry: tensions and transformations. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 1025 – 1046.)
- Ghoshal, S., Bartlett, C.A. & Moran, P. 2000. Value creation: the new millennium management manifesto. (In Chowdry, S. (ed.). 2000. *Management 21C*. London: Pearson Education, pp 45 – 65.)
- Gibbons, M. & Johnston, R. 1974. The roles of science in technological innovation. *Research Policy*, 3(3): 220 – 242.

- Gierke, M., Hansen, J.G. & Turner, R. 2002. Wise council: a trinity of perspectives on the business value of design. *Design Management Journal*, 13(1): 10 – 17, Winter.
- Glaser, M. 1996. Design and business: the war is over. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 146 – 152.)
- Gold, E. 1995. *The business of Graphic Design: a sensible approach to marketing and managing a Graphic Design firm*. New York: Watson-Guptill.
- Gorb, P. 1990. The future of design and its management. (In Oakley, M. (ed.) *Design Management: A handbook of issues and methods*. Oxford: Basil Blackwell, pp 15 – 25.)
- Gorb, P. & Dumas, A. 1997. Silent design. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 159 – 174.)
- Gornick, N. 2001. *Notes on your research*. Email 09 September, 12:48
- Gotzsch, J. 1999. Design orientation in new product development. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 38 – 60.)
- Greco, J. 1998. Designing for the 21st century. *Journal of Business Strategy*, 19(6): 34 – 37, November/December.
- Grenier, B. 1990. Product evaluation. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 335 – 344.)
- Griffiths, D. Responding to economic downturn: exploiting the value of Design Management education. *DMI eBulletin – Viewpoints.htm*, August 2002.
- Grinyer, C. 2001. Design differentiation for global companies: value exporter and value collectors. *Design Management Journal*, 12(4): 10 – 14, Fall.
- Grinyer, C. 2002. Design, innovation, entrepreneurialism. *ICSID* (6): 6, December.
- Groenewald, J.J.Z. 2001. *Mind your own (design) business*. Cape Town: Flexfin.
- Gulke, W. 2000. *Ten lessons from the future: 21st century impact on business, individuals and investors*. Parklands, SA: @One Communications.
- Gumbel, P. 2003. The holiday's over. *Time*, 161(23): 34 – 35, June 9.

- Gunz, H. 1990. Managing across organisational boundaries. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 167 – 175.)
- Haffajee, F. 2003. Slash attack. Cabinet's employment strategy to cut jobless rate to 12%. *Financial Mail*: 27, February 28.
- Hales, C. 1990. Proposals, briefs and specifications. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 293 – 303.)
- Hamel, G. 1998. Strategy innovation and the quest for value. *Sloan Management Review* 39: 7 – 14.
- Hamel, G. & Prahad, C.K. 1996. Competing in the new economy: managing out of bounds. *Strategic Management Journal*, 17: 237 – 242.
- Hampden-Turner, C. 1996. Designing the infinite game. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 207 – 221.)
- Handscombe, R. 1990. Sustaining competitive Product Design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 381 – 391.)
- Handy, C. 1994. *The empty raincoat*. 2nd ed. Arrow Business.
- Hang, P.T.T. 2002. Design promotion for small and medium enterprises in Vietnam. *ICSID News*, 5(02): 7, October.
- Hardy, T. 2000. Strategic realisation: building fundamental design values. *Design Management Journal*: 65 – 69, Winter.
- Harrigan, K.R. & Dalmia, G. 1991. Knowledge workers: the last bastion of competitive advantage. *Planning Review*: 5 – 9, November/December.
- Hart, S. 1995. Where we've been and where we're going in new product research. (In Bruce, M. & Biemans, W.G. (eds.) *Product development: meeting the challenge of the design-marketing interface*. Chichester: John Wiley, pp 15 – 42.)
- Hart, S.J. & Service, L.M. 1988. The effects of managerial attitude to design on company performance. *Journal of Marketing Management*, 4(2): 217 – 229.

- Hawk, D.L. 1990. New responses in Design Management. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 63 – 72.)
- Hawkins, T. 2003. Missing by a mile. *Financial Mail*: 50, April 11.
- Hertenstein, J., Platt, M. & Brown, D. 2001. Valuing design: enhancing corporate performance through design effectiveness. *Design Management Journal*, 12(3): 10 – 19.
- Heskett, J. 1980. *Industrial design*. London: Thames & Hudson.
- Hill, L.A. 2000. Leadership as collective genius. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 45 – 65.)
- Hodder, I. 2000. The interpretation of documents and material culture. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 703 – 715.)
- Hollins, B. & Hurst, K. 1995. Research into user-friendly specifications for effective Design Management: refining and simplifying the process. *Journal of Engineering Design*, 6(3): 239.
- Hollins, B. & Pugh, S. 1990. *Successful product design: what to do and when*. London: Butterworths.
- Hollins, G. & Hollins, B. 1991. *Total design: managing the process in the service sector*. London: Pitman.
- Holmberg, I. & Ridderstrale, J. 2000. Sensational leadership. (In Chowdry, S. 2000. (ed.) *Management 21C*. London: Pearson Education, pp 33 – 44.)
- Holt, K. 1990. The nature of the design process. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 195 – 205.)
- Holt, K. 1991. What is the best way of organising projects? (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 89 – 96.)
- Hough, J. 2003. International business opportunities. (In Nieman, G., Hough, J. & Niewenhuizen, C. (eds.) *Entrepreneurship: a South African perspective*. Pretoria: Van Schaik, pp 306 – 328.)
- Howard, D. 1993. The impact of competitive structure and technological environment on Design Management: a case study of the UK Touring Caravan Club. *Design Studies*, 14(4): 365-378, October.

Hussey, J. & Hussey, R. 1997. *Business Research*. London: Macmillan Business

ILRIG see International Labour Research and Information Group.

International Labour Research and Information Group. 1998. *An alternative view of globalisation*. Cape Town: ILRIG.

Imcglobal URL: <<http://www.imcglobal.com/cropnut/over3.html>>

Ives, W. 2003. Focus groups in market research. (In Langford, J. & McDonagh, D. (eds.) *Focus groups: supporting effective product development*. London: Taylor & Francis, pp 51 – 62.)

James, J. 2003. Absent minded. *Time*: 42 – 43, March 10.

Janszen, F. 2000. *The age of innovation: making business creativity a competence, not a coincidence*. London: Pearson Education.

Jevnaker, B.H. 1995. Developing capabilities for innovative product designs: a case study of the Scandinavian furniture industry. (In Bruce, M. & Biemans, W.G. (eds.) *Product development: meeting the challenge of the design-marketing interface*. Chichester: John Wiley, pp 181 – 201.)

Jevnaker, B.H. 1998a. Absorbing or creating design ability: HAG, HAMAX and TOMRA. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 107 – 135.)

Jevnaker, B.H. 1998b. Building up organisational capabilities in design. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 11 – 37)

Jevnaker, B.H. 1998c. Introduction. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 1 – 8)

Jevnaker, B. H. 2000. How design becomes strategic. *Design Management Journal*: 41 – 47, Winter.

Johne, A. 1995. Evaluating product development success within a business development framework. (In Bruce, M. & Biemans, W.G. (eds.) *Product development: meeting the challenge of the design-marketing interface*. Chichester: John Wiley, pp 43 – 59.)

- Johnston, D. 1990. Design protection in practice. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 367 – 377.)
- Jones, J. C. 1970. *Design methods: seeds of human futures*. London: John Wiley.
- Jones, P.H. 2002. Knowledge strategy: aligning knowledge programmes to business strategy. (In Kok, A. *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 56 – 66.)
- Jothidas, A. & Gurd, B. 2002. Developing new products through knowledge sharing: the challenges for a transnational. *European Academy of Management 2nd Conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Kalman, T., Miller, J. A. & Jacobs, K. 1994. *Looking closer: critical writings on Graphic Design*. New York: Allworth Press.
- Kantor, R.M. 2000. Kaleidoscope thinking. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 250 – 261).
- Kao, J. 1996. New business: redefining the idea of design. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 9 – 15.)
- Kapor, M. 1996. Designing for democracy in cyberspace. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 194 – 206.)
- Karangu, P., Maranwa, E. & Stettler, M. 2000. *Development co-operation report: Evaluation of ODA to the SMME sector*. Pretoria: Department of Finance, Republic of South Africa.
- Keeley, L. 1996. Transform: reinventing industries through strategic design planning. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 106 – 129.)
- Kennedy, C. 1991. Xerox starts a new strategic direction. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 252 – 267.)
- Kerin, R.A. & Peterson, R.A. 2004. *Strategic marketing problems. Cases and comments*. 10th ed. Upper Saddle River, NJ: Pearson Education.

- Kernohan, D. 1992. *User participation in building design and management*. Oxford: Butterworth-Heinemann.
- Kervin, J.B. 1992. *Methods for Business Research*. New York: HarperCollins.
- Keys, J.B. & Fulmer, R.M. (eds.) 1998. *Executive learning and organisational learning*. New York: International Business Press.
- Kester, D. 2006. *Business attitudes to design*. www.designcouncil.org.uk.
- Kimble, C., Li, F. & Barlow, A. 2000. *Effective virtual teams through communities of practice*. Research paper 2000/9, University of Strathclyde, Glasgow.
- Kincheloe, J.L. & McLaren, P. 2000. Rethinking critical theory and qualitative research. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 279 – 314.)
- King, N. & Anderson, N. 2002. *Managing innovation and change: a critical guide for organisations*. London: Thomson.
- Knackstedt, M.V. 1992. *The interior design business handbook*. New York: Van Nostrand Reinhold.
- Knackstedt, M.V. 1993. *Marketing and selling design services: the designer client relationship*. New York: Van Nostrand Reinhold.
- Kok, J.A. 2002. New structures for the effective dissemination of knowledge in an enterprise. (In Kok, A. (ed.) *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 144 – 149.)
- Kotler, P. 2003a. *Marketing Management*. 11th ed. Upper Saddle River, NJ: Prentice Hall.
- Kotler, P. 2003b. *A framework for Marketing Management*. 2nd ed. Upper Saddle River, NJ: Pearson Education.
- Kotler, P. & Rath, A.G. 1997. Design: a powerful but neglected strategic tool. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 204 – 214.)
- Kotler, P. & Trias de Bes, F. 2003. *Lateral Marketing. New techniques for finding breakthrough ideas*. Hoboken, NJ: John Wiley & Sons.
- Kotter, J.P. 1990. What leaders really do. *Harvard Business Review*: 103 – 111, May/June.

- Kramlinger, T. 1991. Training's role in a learning organisation. *Training*, 29: 46 – 51, April.
- Kretschmar, A. 2003. *The economic effects of design*. Copenhagen: Danish Design Centre.
- Kristensen, T. 1998. The contribution of design to business: a competence based perspective. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 217 – 241.)
- Lahdenpera, P. & Tanhuanpaa, V. 2000. Creation of a new Design Management system based on process optimisation and proactive strategy. *Engineering, Construction & Architectural Management*, 7(3): 267 – 277.
- Langford, J. & McDonagh, D. 2003. Introduction. (In Langford, J. & McDonagh, D. (eds.) *Focus groups: supporting effective product development*. London: Taylor & Francis, pp 1 – 18.)
- Lanigan, M. 1992. *Engineers in business: the principles of Management and Product Design*. Wokingham: Addison-Wesley.
- Law, J.D. 1999. One phone number for Europe: cultural diversity, technology and innovation. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 95 – 106.)
- Lawler, S. 2002. Narrative in social research. (In May, E. (ed.) *Qualitative research in action*. London: Sage Publications, pp 242 – 258.)
- Lay, K. s.a. <<http://www.enron.com>>
- Lechner, C. & Dowling, M. 2003. Firm Networks: External relationships as sources for the growth and competitiveness of entrepreneurial firms. *Entrepreneurship & Regional Development*, 15: 1 – 26.
- Leonardt, D. 2003a. Slump aside, trade deficit hits a record. *New York Times*: February 21. URL: <<http://www.nytimes.com/2003/02/21/business/21TRAD.html>>
- Leonardt, D. 2003b. Oil price jump add to jitters over economy. *New York Times*: March 2. URL: <<http://www.nytimes.com/2003/03/02/business/02ECON.html>>
- Leonardt, D. 2003c. Skeptical economic view takes in more than Iraq. *New York Times*: March 24. URL: <<http://www.nytimes.com/2003/03/24/business/24ECON.html>>

- Leonard-Barton, D. 1996. Designing with the enemy: creative abrasion. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 130 – 144.)
- Levine, S.R. 2000. The value based edu-leader. (In Chowdry, S. 2000. *Management 21C*. London: Pearson Education, pp 83 – 94).
- Levinthal, D.A. & March, J.G. 1993. The myopia of learning. *Strategic Management Journal* Winter special issue, 14: 95 – 112.
- Little, S. 2002. Conclusion: Managing knowledge in a global context. (In Little, S., Quintas, P. & Ray, T. 2002. *Managaing knowledge: An essential reader*. London: The Open University and Sage Publications, pp 368 – 389)
- Little, S., Quintas, P. & Ray, T. 2002. *Managaing knowledge: An essential reader*. London: The Open University and Sage Publications.
- Lockwood, T. 2001. Designing automobiles for global value: Ten market trends. *Design Management Journal*, 12(3): 46 – 52, Fall.
- Lockwood, T. 2004. Design as a business resource. *Design Management Review*, 15(2): 32 – 39, Spring.
- Loots, E. 2001. Globalisation, emerging markets and the South African economy. Paper presented at the International Jubilee Conference of the Economic Society of South Africa, Johannesburg, 14 September.
- Lorange, P. 2000. Ultra-rapid management processes. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 151 – 159.)
- Lorenz, C. 1986. *The design dimension*. Oxford: Basil Blackwell.
- Lorenz, C. 1990. How Ford broke the Detroit mould. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 135 – 144.)
- Lorenz, C. 1991. Baker Perkins: odblall convert. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 182 – 186.)
- Ludlow, C. 1990. The role of communication in corporate identity projects. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 255 – 262.)

- Luo, X., Slotegraaf, R. J. & Pan, X. 2006. Cross functional co-opetition: The simultaneous role of co-operation and comeptition within firms. *Journal of Markeitng*, 70: 67 – 80, April.
- Maclean, L. Links between marketing and design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 273 – 278.)
- Malhotra, S. & Mangrulkar, S. 2001. Branding in the last of the unsaturated markets. *Design Management Journal*, 12(3): 53 – 58, Fall.
- Marais, H.C. & Bondeson, M.J. 1996. Research Management. (In Garbers, J.G. (ed.) *Effective research in the human sciences: research management for researchers, supervisors and master's and doctoral candidates*. Pretoria: Van Schaik, pp 111 – 140.)
- Marzano, S. 1999. *Creating value by design. Vol 1: Thoughts*. 2nd ed. Blaricum, The Netherlands: V+K Publishers.
- Marzano, S. 2000. Suffusing the organisation with design consciousness. *Design Management Journal*: 22 – 27, Winter.
- Maturi, R. 1992. Managing a firm's lifeblood. *Design Management*, 16(4): 30-31, April.
- Mathee, A. 2003. So dryf entrepreneurskap plaaslike ekonomiese groei. *Agenda*: 14 – 16, Junie.
- Maxwell, J. A. 1996. *Qualitative research design: an interactive approach*. London: Sage Publications.
- McKie, L. 2002. Engagement and evaluation in qualitative inquiry. (In May, E. (ed.) *Qualitative research in action*. London: Sage Publications, pp 261 – 285.)
- Media Tenor SA & idea engineers, 2004. *Innovation and corporate reporting*. Published with Financial Mail, 4 June 2004.
- Medina, C. C., Lavado, A.C. & Cabrera, R.V. 2002. Exploring characterisitcs of innovative companies: a case study in Spain. *European Academy of Management – 2nd Conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Medland, T. 1990. The future: design and new technology. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 406 – 413.)

Meier, A. 2001. The death of a nation. *Time*: 23, January 22.

Merriam-Webster's collegiate dictionary. 10th ed. 1993. Springfield, MA: Merriam-Webster.

Meyer, S.A. 2000. Managing within a creative environment. *Design Management Journal* 11(3): 10 – 16, Summer.

Miles, R.E., Snow, C.C., Mathews, J.A., Miles, G. & Coleman, H.J. 2002. Organising in the knowledge age: anticipating the cellular form. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 280-298.)

Mitchell, J. C. 2000. Case and situational analysis. (In Gomm, R., Hammersley, M. & Foster, P. (eds.) *Case study method: key issues, key texts*. London: Sage Publications, pp 165 – 186.)

Mitchell, R. 1991. Masters of innovation: how 3M keeps its new products coming. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 171 – 181.)

Moore, C. 2002. The new heart of your brand: transforming your business through customer experience. *Design Management Journal*, 13(1): 6 – 9, Winter.

Morita, A. 1991. Selling to the world: the Sony Walkman story. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 187 – 191.)

Mouton, J. 1996. *Understanding social research*. Pretoria: Van Schaik.

Msiza, M. 2004. SA's competitiveness improves. *Finance24*.

URL: <http://www.finance24.co.za/economy> (15 October 2004)

Muller, M. 2000. *South African economic diplomacy in the age of globalisation*. Paper delivered at International Studies Association, 41st Annual Convention, Los Angeles, Ca. 14-18 March 2002.

Nasseri, T. 2002. Knowledge leverage: the ultimate advantage. (In Kok, A. (ed.) *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 28 – 31.) Also available at <http://www.brint.com/papers/submit/nasseri.html>

Nayak, P.R. & Ketteringham, J.M. 1991. 3M's little yellow note pads: 'Never mind. I'll do it myself'. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 215 – 223.)

- Nel, J. 2003. E-commerce opportunities. (In Nieman, G., Hough, J. & Nieuwenhuizen, C. (eds.) *Entrepreneurship: a South African perspective*. Pretoria: Van Schaik, pp 330 – 344.)
- Neuman, W.L. 1997. *Social research methods: qualitative and quantitative approaches*. 3rd ed. Boston, MA: Allyn & Bacon.
- Nicholas, R. 2000. You can't kid the kids. *Design Week*, 15(47), November, 24.
- Nicholas, R. 2001. EU-funded project focuses on future. *Design Week*, 16(50), December, 13.
- Nonaka, I. & Takeuchi, H. 1995. *The knowledge-creating company: how Japanese companies create the dynamics of innovation*. New York: Oxford University Press.
- Nonaka, I., Toyama, R. & Konno, N. 2002. SECI, Ba and leadership: a unified model of dynamic knowledge creation. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 41 – 67.)
- Norris, F. 2003. Three years later, investors crave safety. *New York Times*, March 10.
URL: <<http://www.nytimes.com/2003/03/10/business/10LAC.html>>
- Oakley, M. 1990a. Assembling and managing a design team. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 325 – 335.)
- Oakley, M. 1990b. Design and Design Management. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 3 – 14.)
- Oakley, M. 1990c. Preparing for a design project. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 87 – 194.)
- Oakley, M. 1990d. Strategies for design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 431 – 440.)
- O'Connor, W.J. 2000. Good chemistry: client and consultant relationships to uncover the big idea. *Design Management Journal*: 20 – 27, Spring.
- OED see Oxford English Dictionary
- Ollins, W. 1990. Corporate identity. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 176 – 184.)

- Oppenheim, A.N. 1996. *Questionnaire design, interviewing and attitude measurement*. London: Pinter Publishers.
- Ordenez de Pablos, P. 2002. Organisational learning and knowledge strategies: the case of Spanish firms. *European Academy of Management – 2nd Conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Owens, D. 2000. FYI – Design-Oriented Workshop at the Academy of Management Meeting. URL: <<http://www.jiscmail.ac.uk/cgi-bin/wa>>
- Oxford English Dictionary*. 1978. Oxford: Oxford University Press.
- Ozcan, A.C. & Gunaydin, H.M. 2002. Reincarnation of ex-local industries: strategic positioning of design in global enterprises. *European Academy of Management – 2nd Conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Palshoj, J. Design Management at Bang & Olufsen. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 37 – 42.)
- Parker, R.C. 1991. G.T. Culpritt & Son Limited. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 224 – 235.)
- Patterson, A. 2001. *Design Management* e-mail to JISCMail.AC.UK. 22 October 2001, 18:58
- PCTgazette. s.a. Patent co-operation treaty applications for 2002.
URL<<http://pctgazette.wipo.int>>
- Pearson, A.W. 1991. Managing innovation: an uncertainty reduction process. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 18 – 27.)
- Penrose, E.T. 1959. *The theory of the growth of the firm*. Oxford: Basil Blackwell.
- Peteraf, M.A. 1993. The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal*, 14: 179 – 191.
- Peters, T. 1991. Thriving on chaos: facing up to the need for revolution. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 306 – 312.)
- Peters, T. 1996. Design mindfulness. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 16 – 44.)

- Peters, T. 2000. The design + identity 50. *Design Management Journal*: 10 – 17, Winter.
- Phillips, S.E. & McDonnell, J.T. 1999. Empowering the design team: a multimedia design resource to facilitate the capture, retention and reuse of knowledge acquired during product development. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 118 – 130.)
- Pienaar, H. 2003. Suid Afrika se ekonomiese groei vir die 17de kwartaal. *Die Burger*: S1, Februarie 26.
- Pildirch, J. 1991. What makes a winning company? (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 313 – 322.)
- Pitt, M. & Clarke, K. 1999. Competing on competence: a knowledge perspective on the management of strategic innovation. *Technology analysis & Strategic Management*, 11(3): 301 – 316.
- Planting, S. 2004. *New ideas to trigger a boom*. <http://free.financialmail.co.za/innovations>, 4 June.
- Popovic, V. 2000. Product design research and knowledge utilisation. (In Pizzocaro, S., Arruda, A. & De Moraes, D. (eds.) *Design Plus research: proceedings of the Politecnico di Milano Conference*. Milano: Politecnico di Milano, May 18-20.
- Powell, D. 2005. *About: Product Design*. www.designcouncil.org.uk
- Powell, E.N. 1999. *New structures for Design Management in the 21st century*. Call for papers to the 9th International Forum on Design Management Research and Education. Design Management Institute, 8 March.
- Prahalad, C.K. 2000. Emerging work of managers. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 141 – 150).
- Press, M. 1991. *Design Management in the ceramics industry*. Staffordshire University Design Research Centre, research paper, July.
- Prinsloo, C.H., Prinsloo, R.J. & Marais, H.C. 1996. The design and execution of research with a view to implementing the findings. (In Garbers, J.G. (ed.) *Effective research in the human sciences: research management for researchers, supervisors and master's and doctoral candidates*. Pretoria: Van Schaik, pp 178 – 198.)

- Pugh, S. 1995. *Total design: integrated methods for successful product engineering*. Wokingham, England: Addison-Wesley.
- Quintas, P. 2002. Managing knowledge in a new century. (In Little, S., Quintas, P. & Ray, T. 2002. (eds.) *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 1 – 14.)
- Raward, C. 2005. Leading innovation and entrepreneurship in the Australian red meat industry. *Food Australia*, 57(1,2): 18 – 22, January/February
- Ray, T. 2002. Managing Japanese organisational knowledge creation: the difference. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 102 – 117.)
- Reich, R.B. 1991. Entrepreneurship reconsidered: the team as hero. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 62 – 72.)
- Reid, P. 1991. 'If we can do it, any company can!' (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 268 – 276.)
- Reinmoeller, P. 2000. [Research & Development] Design: innovation strategies for the knowledge economy. (In Pizzocaro, S., Arruda, A. & de Moraes, D. (eds.) *Design Plus Research. Proceedings of the Politecnico di Milano conference*. Milano: Politecnico di Milano, May 18-20.
- Reinmoeller, P. & Chong. L-C. 2002. Managing the knowledge-creating context: a strategic time approach. *Creativity and Innovation Management*, 11(3): 165 – 174, September.
- Republic of South Africa. 1996. National Small Business Act (No. 102 of 1996).
URL: <<http://www.policy.org.za/govdocs/legislation/1996/act96-102.html>>
- Richards, T. 1990. Creative problem solving techniques. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 240 – 249.)
- Ridley, T.M. 1990. Design Management on London Underground. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 26 – 32.)
- Roberts, S. & Thoburn, J. 2002. Globalisation and the South African textiles industry. Paper presented at the Trade and Industrial Policy Strategies Workshop on Globalisation, Production and Poverty in South Africa, Johannesburg, 24 June.

- Rodriguez, M.A., Ricart, J.E. & Sanchez, P. 2002. Sustainable development and the sustainability of competitive advantage: a dynamic and sustainable view of the firm. *Creativity and Innovation Management*, 11(3): 135 – 146, September.
- Roellig, L. 2001. Designing global brands: Critical lessons. *Design Management Journal*, 12(3): 40-45, Fall.
- Rogers, D.M.A. 1996. Analog Devices invest in intellectual assets. *Knowledge Inc.*, June.
- Rogers, D.M.A. & Skyrme, D.J. 1992. Harnessing knowledge through socio-technological fusion. Strategic Management Society 12th Annual Conference, London.
- Romer, P.M. 1993. Two strategies for economic development: using ideas and producing ideas. (In Bruno, M. & Pleskovic, B. (eds.) *Proceedings of the 5th World Bank Annual Conference on Development Economics 1993: supplement to the World Bank economic review and The World Bank research observer*, Washington, DC: The World Bank.)
- Roos, J. & Von Krogh, G. 2002. The new language lab – parts 1 and 2. (In Little, S., Quintas, P. & Ray, T. 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 255 – 263.)
- Rose, D. & Sullivan, O. 1993. *Introducing data analysis for social scientists*. Buckingham: Open University Press.
- Rosenfeld, R. & Servo, J.C. 1991. Facilitating innovation in large organisations. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 28 – 39.)
- Roy, R. 1990. Product Design and company performance. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 49 – 62.)
- Roy, R. & Potter, S. 1990. *Design and the economy*. London: Design Council.
- Roy, R. & Potter, S. 1997. The commercial impacts of investment in design. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 175 – 203.)
- Roy, R., Potter, S. & Riedel, J.C.K.H. 1999. The long-term benefits of investment in product design and innovation. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 143 – 154.)

- Rozwell, C. 2002. Focussing the innovation process. Research note 23 January 2002, Tactical guidelines TG-15-0451, Gartner Research.
- Ruotolo, M. 1999. Design Management: a balancing act. *Innovation*, 18(1): 30.
- Ryan, W.R. & Bernard, H.R. 2000. Data Management and analysis methods. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, Ca: Sage Publications, pp 769 – 802.)
- Sakakibara, K. 1998. Global new product development: the case of IBM Notebook Computers. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 91 – 105.)
- Sanchez, R. & Mahoney, J.T. 1996. Modularity, flexibility, and Knowledge Management in product and organisation design. *Strategic Management Journal*, 17: 63 – 76, Winter special issue.
- Sapsford, R. & Victor, J. 1996. Validating evidence. (In Sapsford, R. & Victor, J. (eds.) *Data collection and analysis*. London: Sage Publications, pp 1 – 24.)
- Sasi, V. & Gabrielsson, M. 2002. Finance strategies of globalised firms: a comparison between a Finnish born international and a born global company. *European Academy of Management: 2nd Conference on Innovative Research in Management*, Stockholm, 9 – 11 May.
- Savage, C.M. 1996. *5th Generation Management: co-creating through virtual enterprising, dynamic teaming, and knowledge networking*. Oxford: Butterworth-Heinemann.
- Schrage, M. 1996. Design for facilitation, facilitation for design: managing media to manage innovation. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 46 – 63.)
- Schumpeter, J. 1934. *The theory of economic development*. Cambridge, MA: Harvard University Press.
- Schwartz, W.K. 1991. From idea to implementation: pitfalls along the stony road between idea creation and the market place. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 236 – 245.)
- Senge, P.M. 1990. *The fifth discipline: the art & practice of the learning organisation*. New York: Doubleday.

Senge, P.M. & Kaufer, K.H. 2000. Communities of leaders or no leadership at all. (In Chowdry, S. (ed.) 2000. *Management 21C*. London: Pearson Education, pp 95 – 105).

Service, L.M., Hart, S.J. & Baker, M.J. 1989. *Profit by design*. Scotland: The Design Council of Scotland.

Shirley, S. 1991. Corporate strategy and entrepreneurial vision. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 211 – 214.)

Shorter Oxford English dictionary. 1993. Oxford: Oxford University Press.

Silverman, D. 2000. Analysing talk and text. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 821 – 834.)

Skyrme, D.J. 2000. *Knowledge networking: Creating the collaborative enterprise*. Oxford: Butterworth-Heinemann.

Skyrme, D.J. 2002. Developing a knowledge strategy (In Kok, A. (ed.) *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 67 – 70.)

Skyrme, D.J. & Amidon, D.M. 1997. *Creating the knowledge-based business*. London: Business Intelligence Limited.

Skyrme, D.J. & Amidon, D.M. 2002. The learning organisation. (In Little, S., Quintas, P. & Ray, T. (eds.) *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 264 – 271.)

Slabbert, A. 2007. Misdaad sit SA laag op toerismelys. *Sake Burger*, 5 March 2007.

Smith, J. & Ulrich, K. 2001. Design matters. *Design Management Journal*, 12(3): 28 – 34, Summer.

Smith, J.K. & Deemer, D.K. 2000. The problem of criteria in the age of relativism. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. (2nd ed.) Thousand Oaks, CA: Sage Publications, pp 877 – 896.)

Snoek, H. & Hekkert, P. 1999. Directing designers towards innovative solutions. (In Jerrard, B., Trueman, M. & Newport, R. (eds.) *Managing new product innovation*. London: Taylor & Francis, pp 167 – 180.)

SOED see Shorter Oxford English Dictionary

- Souder, W.E. 1997. Managing relations between R&D and Marketing in New Product Development projects. (In Bruce, M. & Cooper, R. (eds.) *Marketing and Design Management*. London: International Thompson, pp 215 – 238.)
- Stake, R.E. 2000. Case studies. (In Denzin, N.K. & Lincoln, Y.S. (eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, CA: Sage Publications, pp 435 – 454.)
- Stewart, T.A. 1997. *Intellectual capital: the new wealth of organisations*. London: Nicholas Brealey Publishing.
- Stewart, T.A. 2002. Brainpower. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 302 – 313.)
- Stoner, J.A.F., Freeman, R. E. & Gilbert, D. R. 1995. *Management*. 6th ed. Englewood Cliffs, NJ: Prentice Hall.
- Storey, J. 2002. HR and organisational structures. (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 349 – 355.)
- Straker, D. 2002. *Quo vadis nunc: where does an innovative company go next?* (In Little, S., Quintas, P. & Ray, T. (eds.) 2002. *Managing knowledge: an essential reader*. London: The Open University and Sage Publications, pp 356 – 367.)
- Sukazi, J. 2003. SA waking up to outsourcing potential. *Sunday Times Business Times*, July 20.
- Svengren, L. 1993. Case study methods in Design Management research. *Design Studies*, 14(4): 444 – 456, October.
- Svengren, L. 1998. Integrating design as a strategic resource: the case of Ericsson Mobile Communications. (In Bruce, M. & Jevnaker, B. (eds.) *Management of design alliances: sustaining competitive advantage*. Chichester: John Wiley, pp 160 – 178.)
- Tabibian, J. 1996a. Roundtable discussion: reframing design. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 153 – 180.)
- Tabibian, J. 1996b. The twilight of humanism. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 182 – 193.)

- Teixeira, J.C. 2000. The unexplored capabilities of design knowledge: identifying possibilities of how design knowledge can contribute to organizational knowledge. (In Pizzocaro, S., Arruda, A. & de Moraes, D. (eds.) *Design Plus Research. Proceedings of the Politecnico di Milano Conference*. Milano: Politecnico di Milano, May 18-20.
- Thackara, J. 1996. Can we count on connectivity. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 91 – 103.)
- Thackara, J. 1997. *Winners! How today's successful companies innovate by design*. Aldershot: Gower Publishing.
- Thomas, R. 1996. Statistical sources and databases. (In Sapsford, R. & Victor, J. *Data collection and analysis*. London: Sage Publications, pp 1 – 24.)
- Timmons, J. A. 1990. *New venture creation*. 3rd ed. Boston, MA: Irwin.
- Timmons, J.A. 1999. *New venture creation: Entrepreneurship for the 21st century*. 5th ed. Singapore: Irwin/McGraw-Hill.
- Topalian, A. 1990. Developing a corporate approach. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 117 – 127.)
- Turner, B. 1990. Design evaluation. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 345 – 358.)
- Tyabji, H. 1996. Managing the virtual company. (In Kao, J. (ed.) *The new business of design: The Forty-fifth International Design Conference in Aspen*. New York: Allworth Press, pp 64 – 80.)
- Ulrich, D. 1998. Intellectual capital = competence x commitment. *Sloan Management Review*, 39: 15 – 26, Winter.
- Ulrich, D. 2000. Context, capability and response. (In Chowdry, S. 2000. (ed.) *Management 21C*. London: Pearson Education, pp 235 – 249).
- Understanding knowledge work*. (video production), s.a. Australia: Ash Quarry Productions.
- Van der Merwe, H. 1996. The research process: problem statement and research design. (In Garbers, J.G. (ed.) *Effective research in the human sciences: research management for researchers, supervisors and master's and doctoral candidates*. Pretoria: Van Schaik, pp 277 – 291.)

- Venkatesan, R. 1992. Strategic sourcing: to make or not to make. *Harvard Business Review*, 70(6): 98 – 107, November/December.
- Viljoen, A. (ed.) 1998. *Design education in South Africa*. Pretoria: SABS Design Institute.
- Viti, P. & Vidari, P.P. 1990. Design Management at Olivetti. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 33 – 36.)
- Vitrac, J-P. 1990. Prospective design. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 304 – 312.)
- Visser, E. 2002. Packaging on the Web: an underused resource. *Design Management Journal*, 13(1): 62 – 67, Winter.
- Vokrouhlicky, Z. 2001. The Czech Design Centrum: a tool for national competitiveness. *Design Management Journal*, 12(3): 79 – 81, Fall.
- Von Stamm, B. 2006. About: Innovation. www.designcouncil.org.uk
- Wack, P. 1991. Scenarios: uncharted waters ahead. (In Henry, J. & Walker, D. (eds.) *Managing innovation*. London: Sage Publications, pp 200 – 210.)
- Walker, D. 1990a. Design maturity: the ladder and the wall. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 43 – 46.)
- Walker, D. 1990b. Managers and designers: two tribes at war? (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 145 – 154.)
- Walker, D. 1991. Comment: David Walker on the marginalisation of design. *Design*, August 5.
- Walkerdine, V., Lucey, H. & Melody, J. 2002. Subjectivity and qualitative method. (In May, E. (ed.) *Qualitative research in action*. London: Sage Publications, pp 242 – 258.)
- Wallace, C.P. 2001. Hot on Nike's Heels. *Time*: 38, August 20.
- Wallace, R. 2001. Proving our value: measuring package design's Return On Investment. *Design Management Journal*, 12(3): 28 – 34, Summer.

- Walliman, N. 2005. *Your research project: a step-by-step guide for the first-time researcher*. 2nd ed. London: Sage Publications.
- Walliman, N. with Baiche, B. 2001. *Your research project: a step-by-step guide for the first-time researcher*. London: Sage Publications.
- Walsh, V., Roy, R. & Bruce, M. 1988. Competitive by design. *Journal of Marketing Management*, 4(2): 201 – 217.
- Walsh, V., Roy, R, Bruce, M. & Potter, S. 1992. *Winning by design: technology, product design and international competitiveness*. Oxford: Blackwell Business.
- Walton, T. 2002. Exploring the fundamental relationship between design and good business. *Design Management Journal*, 13(1): 6 – 9, Winter.
- Wasserman, H. 2001. Mededingendheid: SA moet hervorm om bly te by. (Competitiveness: S A has to reform to keep up.) *USB Agenda*: 6 – 7, Desember.
- WEF see World Economic Forum
- Weiss, L. 2002. Developing tangible strategies. *Design Management Journal*, 13(1): 33 – 38, Winter.
- Welch, J. 2001. *Jack: straight from the gut*. London: Headline Publishers.
- Welman, J.C. & Kruger S.J. 1999. *Research methodology for the business and administrative sciences*. Johannesburg: Thomson Publishing.
- Welman, J.C., Kruger S.J. & Mitchell, B. 2005. *Research methodology*. 3rd ed. Cape Town: Oxford University Press.
- Wenger, E. 2002. Communities of practice: learning as a social system. (In Kok, A. (ed.) *Kennisbestuur / Knowledge Management*. Pretoria: Van Schaik, pp 150 – 160.)
- Wenger, E.C. & Snyder, W.M. 2000. Communities of practice: the organizational frontier. *Harvard Business Review*, 78(1): 139 – 145, January/February.
- Wheelwright, S.C. & Clark, K.B. 1992. *Revolutionizing product development: quantum leaps in speed, efficiency and quality*. New York: Free Press.

- Wiegman, G. & Koth, H. 2000. *Custom enterprise.com: every product, every price, every message*. London: Pearson Education.
- Williams, M. 2002. Generalisation in interpretive research. (In May, E. (ed.) *Qualitative research in action*. London: Sage Publications, pp 242 – 258.)
- Wilson, B. 1990. Managing the product innovation process. (In Oakley, M. (ed.) *Design Management: a handbook of issues and methods*. Oxford: Basil Blackwell, pp 128 – 135.)
- Wootton, A.B., Cooper, R. & Bruce, M. 1998. *A generic guide to requirements capture*. Salford, UK: University of Salford.
- Worldbank. (s.a.). South Africa data profile. <http://devdata.worldbank.org/external/CPProfile.asp?>
- World Economic Forum. 1999. *The global competitiveness report 1999*. New York: Oxford University Press.
- Worrell, D. 1995. The learning organisation: management theory for the information age or new age fad? *The Journal of Academic Librarianship*: 351 – 357, September.
- World history encyclopedia*. 2001. Bath: Paragon.
- Woudhuysen, J. 2006. *About: Trends*. Design Council. URL: <http://www.designcouncil.org.uk>
- Wray, Q. 2001. More speed bumps in store for economy. URL: <http://www.businessreport.co.za>
- Wray, Q. 2003. Annual growth improves to 3% despite a slower fourth quarter. *Business Report*: 1, February 26.
- Wright, C. 1995. *Successful small business management in South Africa*. Wynberg: Struik.
- Wright, D.B. 1997. *Understanding statistics: an introduction for the social sciences*. London: Sage Publications.
- Yassine, A., Falkenburg, D. & Chelst, K. 1999. Engineering Design Management: an information structure approach. *International Journal of Production Research*, 37(13): 2957 – 2975.
- Young, C. 2001. Reaping value from knowledge and innovation. Research note 26, January 2001, Strategic planning SPA-12-8169, Gartner Research.

Zaccai, G. s.a. Designing the what.

<<http://www.ddc.dk/UK/publications/kompendier/ledelses/zaccai.html> >

Zaccai, G. 2002. Design strategy and Strategic Design at Master Lock. *Design Management Journal*, 13(1): 18 – 25, Winter.

Zack, M.H. 1999. Managing codified knowledge. *Sloan Management Review*, 40(4): 45 – 58, Summer.

Zhou, K.Z., Yim, C.K. & Tse, D.K. 2005. The effects of strategic orientations on Technology- and market-based breakthrough innovations. *Journal of Marketing*, 69: 42 – 60, April.

Annexure A

Improving competitiveness by using design

While economic development is very necessary in South Africa, its economy is not very competitive (currently ranking 42nd out of 47 in the world). There is good reason to believe that design can contribute to businesses as a result of previous research.

The problem is that managers do not use design as widely as they might. Some say that it is mainly as a result of a poor understanding of the benefits of design. *This raises the question what do managers need to know in order to manage the design resource as part of the strategic management of a company.* A **manager** refers to an executive officer in a company charged with a certain responsibility that could include commissioning and paying for design applications.

Please complete the questionnaire below. Your opinion, as a designer, is important to contribute to a better understanding of design by managers. All information will be treated confidentially and will be kept **anonymous**. No information from single stakeholders will be passed on to other people.

Jurie Groenewald [Researcher] (juriieg@ctech.ac.za) Cape Technikon, Cape Town.
Prof André Slabbert [Supervisor] (andres@ctech.ac.za) Cape Technikon, Cape Town.

1 Background information

1.1 Age group		1.2 Gender	
Under 20		Female	
20 – 29		Male	
30 – 39			
40 – 49			
50 – 59			
60 and above			
1.3 Involvement: Do you spend most of your professional time		1.4 Please indicate the industry you are involved in:	
Designing?		Design	
Managing?		Retail	
Teaching design to management students?		Engineering	
Teaching management to design students?		Manufacturing	
Teaching design to design students?		Information Technology	
Teaching management to management students		Pharmaceutical products	
		Education	
		Any other (please specify)	
1.5 What is your highest professional qualification?			
Three-year diploma			
Three-year Bachelor's degree			
Four-year Diploma			
Four-year Bachelor's / Honours degree			
Master's degree			
Doctorate			
Any other (please indicate)			
1.6 Please write down the country in which you spend most of your professional effort			

Listed below are various issues that could be important for managers to know. Please indicate how important you rate each one of the following for managers to know.

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
2 Contribution of design				
How important is it for the manager to know about:	1	2	3	4
2.1 The role a design application can play in business solutions? (Design application refers to the application of the result of the design process, e.g. a new or improved product, an advertisement or a shop/office interior.)				
2.2 Case histories on the impact of design on business?				
2.3 How design can provide a competitive advantage				
2.3.1 On the strategic level (overall strategy of a company)?				
2.3.2 On the functional level (individual departments)?				
2.3.3 On the project level (specific projects)?				
2.4 The difference between the various design disciplines (e.g. product, graphic or interior design)?				
2.5 Which design discipline is best suited to solve a problem?				

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
3 Integration of design				
How important is it for the manager to know that:	1	2	3	4
3.1 Design is an integrated team effort between company employees and designers?				
3.2 Design should be included as early in the development process as possible?				
3.3 Design information should be integrated with the following work flow process of the company: (Design information refers to the information contained in the design application.)				
3.3.1 Marketing?				
3.3.2 Finances?				
3.3.3 Human resources?				
3.3.4 Manufacturing?				
3.3.5 Service delivery?				

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
4 Process of design				
How important is it for the manager to know about:	1	2	3	4
4.1 Design concepts, such as aesthetics or ergonomics?				
4.2 The psychology of creativity?				
4.3 The writing of a creative brief?				
4.4 Various possibilities of how the brief can be executed?				
4.5 The individual steps in the design process, such as				
4.5.1 Recognising the need for design?				
4.5.2 Analysing and formulating the design problem?				
4.5.3 Setting design objectives?				
4.5.4 Gathering relevant information?				
4.5.5 Conceptualising design applications?				
4.5.6 Analysing design applications?				
4.5.7 Selecting an appropriate design application?				
4.5.8 Presenting the chosen design application?				
4.5.9 Implementing the design application?				
4.5.10 Assessing the design's effectiveness (short term)?				
4.5.11 Determining the design's significance (to long-term goals)?				
4.6 Design as a multi-disciplinary approach that can incorporate expertise from other disciplines such as marketing or production?				

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
5 Presentation of the design application				
How important is it for the manager to understand the:	1	2	3	4
5.1 Proposed alternative reality the designer is presenting? (Alternative reality refers to the proposed solution of the problem.)				
5.2 Popularised drawings, e.g., perspective, 3D or exploded drawings?				
5.3 Working drawings?				
5.4 Written report(s) accompanying the design?				
5.5 Detailed information on design drawings, e.g., technical symbols?				

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
6 Implementation of design				
How important is it for the manager to know that:	1	2	3	4
6.1 The manager must be involved on an ongoing basis in the implementation of the design application?				
6.2 The design application is to be implemented as an integral part of the overall business strategy?				
6.3 The implementation of a design application could involve many experts from other fields?				
6.4 The implementation of the design application could be a long-term process?				

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
7 Risk analysis of design				
How important is it for the manager to know that:	1	2	3	4
7.1 Integrating a design application is a calculated risk?				
7.2 The designer cannot guarantee an increase in sales?				
7.3 The designer carries part of the risk, e.g., with regard to future contracts?				
7.4 Proper research can lower the risk?				

Thank you very much for your co-operation. The results of the survey should be available by the end of the year. Please indicate whether you would like to receive a copy of the results.

Please send a copy of the results to:

Annexure B

Questionnaire Coding

1 Background information

1.1 Age group	
Under 20	1
20 – 29	2
30 – 39	3
40 – 49	4
50 – 59	5
60 and above	6

1.2 Gender	
Female	f
Male	m

1.3 Involvement: Do you spend most of your professional time	
Designing?	1
Managing?	2
Teaching design to management students?	3
Teaching management to design students?	4
Teaching design to design students?	5
Teaching management to management students	6

1.4 Please indicate the industry you are involved in:	
Design	1
Retail	2
Engineering	3
Manufacturing	4
Information Technology	5
Pharmaceutical products	6
Education	7
Any other (please specify)	

1.5 What is your highest professional qualification?	
Three-year diploma	1
Three-year Bachelor's degree	2
Four-year Diploma	3
Four-year Bachelor's / Honours degree	4
Master's degree	5
Doctorate	6
Any other (please indicate)	

1.6 Please write down the country in which you spend most of your professional effort

Annexure C

Improving competitiveness by using design

While economic development is very necessary in South Africa, its economy is not very competitive (currently ranking 42nd out of 47 in the world). There is good reason to believe that design can contribute to businesses as a result of previous research.

The problem is that managers do not use design as widely as it might be. Some say that it is mainly as a result of a poor understanding of the benefits of design. *This raises the question what do managers need to know in order to manage the design resource as part of the strategic management of a company.* A **manager** refers to an executive officer in a company charged with a certain responsibility that could include commissioning and paying for design applications.

Please complete the questionnaire below. Your opinion, as a designer, is important to contribute to a better understanding of design by managers. All information will be treated confidentially and will be kept **anonymous**. No information from single stakeholders will be passed on to other people.

Jurie Groenewald [Researcher] (juriieg@ctech.ac.za) Cape Technikon, Cape Town.

Prof André Slabbert [Supervisor] (andres@ctech.ac.za) Cape Technikon, Cape Town.

1 Background information

1.1 Age group	
Under 20	0
20 – 29	34
30 – 39	46
40 – 49	42
50 – 59	28
60 and above	3

1.2 Gender	
Female	49
Male	75

1.3 Involvement: Do you spend most of your professional time	
Designing?	64
Managing?	31
Teaching design to management students?	6
Teaching management to design students?	6
Teaching design to design students?	46
Teaching management to management students	0

1.4 Please indicate the industry you are involved in:	
Design	63
Retail	21
Engineering	2
Manufacturing	3
Information Technology	7
Pharmaceutical products	0
Education	51
Any other (please specify)	

1.5 What is your highest professional qualification?	
Three year diploma	32
Three year Bachelor degree	11
Four year Diploma	27
Four year Bachelor / Honours degree	26
Masters degree	47
Doctorate	11
Any other (please indicate)	

1.6 Please write down the country in which you spend most of your professional effort
See last page

Listed below are various issues that could be important for managers to know. Please indicate how important you rate each one of the following for managers to know.

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
2 Contribution of design				
How important is it for the manager to know about:	1	2	3	4
2.1 The role a design application can play in business solutions? (Design application refers to the application of the result of the design process, e.g. a new or improved product, an advertisement or a shop/office interior.) Important	0 0%	2 1%	46 30%	105 69%
2.2 Case histories on the impact of design on business? Important	0 0%	6 4%	63 41%	86 55%
2.3 How design can provide a competitive advantage				
2.3.1 On the strategic level (overall strategy of a company)? Important	0 0%	13 9%	60 39%	80 52%
2.3.2 On the functional level (individual departments)? Important	0 0%	11 7%	78 51%	65 42%
2.3.3 On the project level (specific projects)? Important	0 0%	8 5%	59 40%	81 55%
2.4 The difference between the various design disciplines (e.g. product, graphic or interior design)? Neutral	31 20%	36 24%	50 33%	35 23%
2.5 Which design discipline is best suited to solve a problem? Neutral	44 30%	38 25%	30 20%	37 25%

	1 = totally unimportant	2 = unimportant	3 = important	4 = totally important
3 Integration of design				
How important is it for the manager to know that:	1	2	3	4
3.1 Design is an integrated team effort between company employees and designers? Important	0 0%	9 6%	42 27%	103 67%
3.2 Design should be included as early in the development process as possible? Important	0 0%	7 5%	30 19%	117 76%
3.3 Design information should be integrated with the following work flow process of the company: (Design information refers to the information contained in the design application.)				
3.3.1 Marketing? Important	0 0%	4 3%	72 47%	78 50%
3.3.2 Finances? Important	2 1%	27 18%	89 58%	36 23%
3.3.3 Human resources? Important	3 2%	31 21%	85 57%	31 21%

3.3.4 Manufacturing?	3	10	70	67
Important	2%	7%	47%	45%
3.3.5 Service delivery?	2	13	82	57
Important	1%	8%	53%	37%

1 = totally unimportant 2 = unimportant 3 = important 4 = totally important

4 Process of design	1	2	3	4
How important is it for the manager to know about:				
4.1 Design concepts, such as aesthetics or ergonomics?	54	36	41	23
Unimportant	35%	23%	27%	15%
4.2 The psychology of creativity?	63	37	34	18
Unimportant	42%	24%	22%	12%
4.3 The writing of a creative brief?	7	11	62	74
Important	5%	7%	40%	48%
4.4 Various possibilities how the brief can be executed?	52	39	34	27
Unimportant	34%	26%	22%	18%
4.5 The individual steps in the design process, such as				
4.5.1 Recognising the need for design?	44	41	32	37
Neutral	29%	27%	21%	24%
4.5.2 Analysing and formulating the design problem?	47	38	39	30
Neutral	30%	25%	25%	20%
4.5.3 Setting design objectives?	50	35	29	36
Neutral	33%	23%	19%	24%
4.5.4 Gathering relevant information?	56	36	35	29
Unimportant	36%	23%	23%	18%
4.5.5 Conceptualising applications?	59	40	33	20
Unimportant	39%	26%	22%	13%
4.5.6 Analysing design applications?	51	47	37	18
Unimportant	33%	31%	24%	12%
4.5.7 Selecting an appropriate design?	44	41	34	35
Neutral	29%	27%	22%	23%

4.5.8 Presenting the chosen design?	16 11%	38 25%	69 45%	29 19%
Important				
4.5.9 Implementing the design?	8 5%	15 10%	66 43%	65 42%
Important				
4.5.10 Assessing the design's effectiveness (short term)?	2 1%	19 12%	59 38%	74 48%
Important				
4.5.11 Determining the design's significance (to long term goals)?	0 0%	9 6%	56 37%	88 57%
Important				
4.6 Design as a multi-disciplinary approach that can incorporate expertise from other disciplines such as marketing, production or engineering?	1 1%	8 5%	43 28%	99 66%
Important				

1 = totally unimportant 2 = unimportant 3 = important 4 = totally important

5 Presentation of design	1	2	3	4
How important is it for the manager to understand the:				
5.1 Proposed alternative reality the designer is presenting? (Alternative reality refers to the proposed solution of the problem.)	0 0%	6 4%	68 44%	79 42%
important				
5.2 Popularised drawings e.g. perspective, 3D or exploded drawings?	1 1%	16 10%	83 54%	54 35%
Important				
5.3 Working drawings?	4 3%	36 23%	79 51%	35 23%
Important				
5.4 Written report(s) accompanying the design?	0 0%	22 15%	81 53%	49 32%
Important				
5.5 Detailed information on design drawings, e.g. technical symbols?	48 31%	46 30%	42 27%	18 12%
Unimportant				

1 = totally unimportant 2 = unimportant 3 = important 4 = totally important

6 Implementation of design	1	2	3	4
How important is it for the manager to know that:				
6.1 The manager must be involved on an ongoing basis in the implementation of the design application? Important	1 1%	9 6%	68 44%	75 49%
6.2 The design application is to be implemented as an integral part of the overall business strategy? Important	0 0%	8 5%	46 30%	99 65%
6.3 The implementation of a design application could involve many experts from other fields? Important	0 0%	6 4%	68 44%	79 52%
6.4 The implementation of the design application could be a long-term process? Important	0 0%	8 5%	49 33%	94 62%

1 = totally unimportant 2 = unimportant 3 = important 4 = totally important

7 Risk analysis of design	1	2	3	4
How important is it for the manager to know that:				
7.1 Integrating a design application is a calculated risk? Important	0 0%	7 5%	50 33%	97 62%
7.2 The designer cannot guarantee an increase in sales? Important	1 1%	10 7%	49 33%	90 59%
7.3 The designer carries part of the risk, e.g. with regards to future contracts? Important	1 1%	14 9%	52 34%	86 56%
7.4 Proper research can lower the risk? Important	0 0%	8 5%	35 23%	111 72%

Thank you very much for your co-operation. The results of the survey should be available by the end of the year. Please indicate whether you would like to receive a copy of the results.

Please send a copy of the results to:

Annexure D

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3					4.1	4.2	4.3	4.4		
									2.3.1	2.3.2	2.3.3	3.1	3.2	3.3.1	3.3.2	3.3.3	3.3.4	3.3.5						
26	4	m	3	7	6	Denmark	4	3	4	4	4	4	4	4	3	3	4	4	4	4	3	3	3	3
27	3	m	2	5	5	Finland	3	2	4	1	2	3	3	2	2	2	3	4	4	4	3	2	2	3
28	3	m	2	1	4	Australia	4	3	3	2	3	4	4	4	3	3	4	4	4	4	3	4	4	3
29	5		4	1	5	Portugal	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
30	2	m	5	7	3	SA	4	3	3	3	3	4	4	4	3	3	3	3	3	3	2	2	4	2
31	5		5	1	6	USA	3	2	4	3	4	4	4	3	2	2	2	2	3	3	3	4	4	3
32	3		5	1	6	USA	4	4	4	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
33	5	m	5	7	3	USA	4	3	4	4	4	4	4	4	3	4	3	3	3	3	3	2	4	3
34	2	m	5	7	3	SA	3	4	3	1	1	3	3	3	3	3	3	3	3	3	1	1	1	2
35	5	m	5	1	4	Portugal	4	3	3	3	4	3	3	3	3	2	4	2	4	4	4	3	3	4
36	3	m	2	1	4	Australia	4	3	3	2	3	4	4	4	3	3	4	4	4	4	3	4	4	3
37	4	m	2	5	5	Australia	4	3	3	2	2	3	3	4	4	4	3	3	3	3	3	2	3	3
38	5		1	1	6	USA	4	2	4	3	3	4	4	4	4	4	4	4	4	4	3	4	3	3
39	5	m	1	1	5	England	3	3	3	4	4	4	4	3	3	3	3	3	3	3	4	4	4	3
40	3	m	2	Energy:	6	anary Islan	4	3	3	4	2	3	3	4	3	2	4	4	4	4	4	3	3	3
41	2		4	5	4	Australia	4	3	3	3	4	4	4	3	3	3	3	3	3	3	4	4	4	4
42	3	m	1	1	2	Germany	4	3	4	2	2	4	4	4	4	4	4	4	4	4	4	3	3	3
44	2	m	1	1	5	Turkey	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
45	3	f	2	arketii	5	SA	4	3	4	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3
46	2		1	1	1	SA	4	4	3	3	4	4	4	3	3	4	2	4	4	4	4	4	4	4
47	4		5	1	5	SA	4	4	4	2	3	3	3	4	3	4	4	4	4	4	4	4	4	4
48	3	m	4	7	2	SA	4	4	4	3	3	3	3	4	3	4	4	4	4	4	2	2	3	1
49	5	m	1	1	5	USA	4	3	4	3	2	3	3	3	2	3	3	3	3	3	4	4	4	4
50	3	m	4	7	2	SA	3	4	4	3	3	3	3	3	3	3	3	3	3	3	2	2	3	1
51	4	m	1	1	3	SA	3	3	4	2	2	2	3	3	2	2	3	3	3	3	1	1	1	1
52	2	f	2	2	5	SA	4	3	4	2	2	3	3	3	3	3	3	3	3	3	3	2	2	2
53	4	m	1	ws me	4	Australia	4	3	3	3	4	3	4	3	4	3	4	4	4	4	4	2	4	4
54	2	f	1	1	1	USA	4	4	3	1	1	4	3	3	3	3	3	3	3	3	2	1	3	1
55	4		1	1	1	SA	4	4	2	1	1	3	3	3	3	3	3	3	3	3	1	1	3	1
56	5	m	5	7	5	Sweden	3	3	4	2	1	4	4	3	3	3	3	3	3	3	1	1	1	1
57	4		2	2	2	Spain	3	3	4	4	2	3	4	3	3	3	3	3	3	3	2	1	3	1
58	3		1	1	3	SA	4	4	3	1	1	4	4	3	3	3	3	3	3	3	1	1	3	1
59	2		3	7	5	Denmark	4	4	3	3	1	4	4	3	3	3	3	3	3	3	1	1	3	1
60	3		2	2	4	SA	3	3	4	2	2	4	4	3	3	3	3	3	3	3	2	2	4	2

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3					4.1	4.2	4.3	4.4	
									2.3.1	2.3.2	2.3.3	3.1	3.2	3.3.1	3.3.2	3.3.3	3.3.4	3.3.5					
61	3		1	7	2	Sweden	3	3	4	3	3	4	4	3	3	3	3	3	1	1	4	4	2
62	4		5	7	3	SA	3	4	4	4	4	4	3	2	2	2	2	2	2	2	2	2	2
63	3	m	2	2	4	USA	4	4	3	1	1	3	3	4	4	4	4	4	1	1	4	4	1
64	3	f	5	7	1	SA	3	4	4	2	2	4	4	3	3	3	3	3	1	1	4	4	3
65	2	f	1	1	2	Netherlands:	3	3	3	2	1	4	4	4	4	4	4	4	1	1	4	4	1
66	2	m	2	2	5	UK	4	4	4	3	2	4	4	4	2	3	4	4	3	3	3	3	4
67	2	f	1	1	5	UK	4	3	3	3	3	2	3	3	3	2	3	3	3	3	3	3	3
68	4	m	5	1	3	SA	3	3	3	4	4	4	4	3	3	3	3	3	1	1	3	3	1
69	4	m	1	1	5	USA	4	3	3	3	2	2	2	4	3	1	1	2	3	2	1	1	1
70	3	m	5	7	5	Botswana	4	4	4	4	4	4	4	4	4	3	4	3	4	4	4	4	4
71	3	m	5	7	5	Thailand	4	4	4	3	4	4	4	3	3	3	4	3	3	3	3	3	3
72	2	m	1	1	3	Philippines	4	3	4	4	4	3	4	4	2	3	4	2	2	4	3	4	4
73	5	m	5	7	5	SA	4	4	3	4	4	4	4	4	4	4	4	4	3	3	3	3	3
74	5	m	5	7	5	Sa	4	4	3	4	4	4	4	4	4	4	4	4	3	3	3	3	3
75	2	m	5	1	4	Australia	4	4	4	4	4	4	4	4	4	4	4	4	4	3	3	4	4
76	3	m	5	7	6	Taiwan	3	3	4	3	3	4	4	4	4	4	4	3	4	3	4	4	4
77	6	m	5	7	6	USA	4	3	3	3	3	4	4	4	3	2	4	4	3	3	3	3	3
78	5	m	5	7	5	USA	4	3	3	2	3	3	4	3	2	3	3	4	3	2	2	2	3
79	5	m	5	7	5	Brazil	3	3	4	3	3	3	4	4	3	2	4	4	3	3	3	3	4
80	4	m	2	1	5	Germany	4	4	4	4	3	4	4	3	2	4	4	4	3	3	3	2	2
81	3	m	1	5	5	Canada	4	4	3	3	3	4	4	4	3	4	4	3	3	3	3	2	2
82	4	m	2	1	5	SA	4	4	2	3	1	3	3	4	3	3	3	3	1	1	3	3	1
83	4	m	1	1	1	Sweden	4	4	4	2	1	4	4	3	3	3	3	3	1	1	3	3	1
84	4	m	5	7	5	Spain	3	3	4	4	2	4	4	3	3	3	3	3	1	1	3	3	1
85	5	m	2	2	2	Denmark	3	3	4	1	1	3	4	3	3	3	3	3	2	1	3	3	1
86	4	m	1	1	3	SA	4	4	3	3	3	4	4	3	3	3	3	3	1	1	3	3	1
87	3	m	3	7	5	Denmark	4	4	3	3	1	4	4	3	3	3	3	3	2	1	3	3	2
88	2	m	2	2	4	SA	3	3	4	2	2	4	4	3	3	3	3	3	2	2	4	4	2
89	3	m	1	7	2	Sweden	3	3	4	3	3	4	4	3	3	3	3	3	1	1	4	4	2
90	3	m	5	7	3	SA	3	4	4	4	4	4	4	3	3	3	3	3	2	2	4	4	2
91	4	m	1	1	3	SA	3	4	4	4	4	4	4	2	2	2	2	2	2	2	2	2	2
92	5	f	1	1	3	SA	3	4	3	3	1	4	4	3	3	3	3	3	1	1	3	3	2
93	2	f	1	1	2	Netherlands:	3	3	3	2	1	4	4	4	4	4	4	4	1	1	4	4	1
94	2	m	2	2	5	UK	4	4	4	3	2	4	4	4	4	4	4	4	1	1	3	3	4
95	5	m	5	7	5	SA	4	4	3	3	2	4	4	4	2	3	4	4	3	3	3	3	3
96	3	f	1	1	1	UK	4	4	2	2	1	2	2	4	1	1	1	1	1	1	3	3	1

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3			2.4	2.5	3.1	3.2	3.3					4.1	4.2	4.3	4.4
									2.3.1	2.3.2	2.3.3					3.3.1	3.3.2	3.3.3	3.3.4	3.3.5				
97	2	f	1	1	1	Spain	4	4	3	3	3	3	2	4	4	3	3	3	2	3	3	2	3	2
98	5	m	1	2	4	USA	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
99	2	f	2	2	4	USA	4	4	3	4	4	1	3	4	4	4	4	4	1	4	4	1	4	2
100	3	f	5	7	5	Netherlands: England	4	4	3	3	4	2	1	4	4	2	2	4	1	4	4	1	3	1
101	2	f	1	1	1	England	4	4	3	3	4	1	1	4	4	4	4	4	1	4	4	1	4	1
102	4	m	5	7	5	UK	4	4	4	4	4	1	1	4	4	4	4	4	1	4	4	1	4	2
103	3	f	1	2	1	USA	4	4	3	3	4	1	1	4	4	4	4	4	1	4	4	1	4	1
104	5	f	1	1	1	UK	4	4	3	3	3	1	1	4	4	4	3	3	1	4	4	1	4	1
105	3	m	5	7	5	Sweden	3	3	3	3	3	2	2	4	4	4	3	3	1	4	4	1	4	1
106	2	f	1	2	2	Portugal	3	4	4	4	4	4	4	3	3	4	4	4	1	4	4	1	4	1
107	4	m	1	7	3	SA	4	4	4	4	4	4	4	4	4	3	3	3	1	4	4	1	4	1
108	3	f	5	7	5	England	4	4	4	4	4	4	2	4	4	3	3	3	2	4	4	2	4	2
109	2	f	1	1	1	UK	3	4	3	3	3	1	1	4	4	3	3	3	1	4	4	1	4	1
110	4	f	5	7	5	Australia	3	4	4	3	3	1	1	4	4	4	4	4	1	4	4	1	4	1
112	2	f	1	1	1	UK	4	4	3	3	3	3	1	4	4	3	3	3	1	4	4	1	4	1
113	5	m	1	3	5	SA	4	3	4	4	4	4	1	4	3	3	3	2	2	2	2	2	2	2
114	2	m	1	1	1	USA	4	3	2	2	2	1	1	3	4	2	2	2	1	4	1	1	4	1
115	4	f	2	2	2	Spain	4	4	3	3	3	2	1	4	4	3	3	3	2	4	4	2	4	2
116	3	f	1	1	1	USA	3	3	4	4	4	4	1	3	4	3	3	3	1	4	4	1	4	1
117	3		5	7	3	Netherlands:	4	4	4	4	4	1	1	4	3	3	3	3	1	4	3	1	4	1
118	4	m	2	1	6	Germany	3	4	4	4	4	3	3	3	4	3	3	4	2	2	2	3	3	3
119	4		5	5	4	Sweden	4	4	3	3	3	2	1	4	4	4	4	4	1	4	4	1	4	1
120	5	m	2	5	5	USA	3	2	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	3
121	3	m	1	2	3	Portugal	4	4	3	3	3	2	1	4	3	3	3	3	1	1	1	1	1	1
122	4	m	2	7	6	Germany	3	3	4	3	3	3	4	3	3	3	3	3	3	3	2	3	3	3
123	4	m	1	1	3	SA	4	2	3	4	4	4	4	4	4	4	2	2	4	3	4	3	4	4
124	3	m	1	1	4	UK	4	4	4	3	4	4	4	4	4	4	4	4	3	3	3	4	4	3
125	5	f	2	1	3	Brazil	4	3	4	4	4	2	2	4	4	4	4	4	3	2	2	2	2	3
126	2	m	1	1	3	Brazil	4	3	4	4	4	4	4	4	4	3	3	4	3	3	3	3	3	3
127	4	f	5	7	5	UK	3	3	4	4	4	3	3	4	4	3	3	3	1	1	1	1	3	2
128	3	m	3	7	4	Netherlands:	4	4	4	4	4	2	2	4	4	4	4	4	1	1	1	1	4	1
129	2	f	1	1	3	England	2	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2	3	2
130	6	m	2	2	1	Mexico	4	4	4	3	3	3	2	4	4	4	4	4	1	1	1	1	4	1
131	4	m	1	1	3	SA	3	3	3	3	3	3	2	3	3	4	4	4	2	3	3	2	3	2

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3					4.1	4.2	4.3	4.4	
									2.3.1	2.3.2	2.3.3			3.3.1	3.3.2	3.3.3	3.3.4	3.3.5					
132	4	f	1	1	1	UK	4	3	3	3	1	4	4	4	4	4	4	4	2	2	2	4	1
133	3	m	3	7	4	Netherlands:	4	4	4	4	2	4	4	4	4	4	4	4	1	1	1	4	1
134	5	m	2	4	4	Australia	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	4	1
135	4	f	1	1	4	SA	3	3	3	3	2	3	4	4	3	3	3	3	2	2	2	4	1
136	2	f	1	2	3	USA	3	4	4	4	1	3	4	3	2	2	2	2	1	1	1	4	2
137	6	m	2	2	1	Mexico	4	4	4	3	3	4	4	4	4	4	4	4	1	1	1	4	1
138	3	f	1	5	3	UK	4	3	3	3	1	4	4	3	3	3	3	3	1	1	1	1	2
139	4	m	2	4	4	Australia	4	4	4	4	4	4	4	4	4	4	4	4	2	2	2	4	1
140	4	f	1	1	4	SA	3	3	3	3	2	3	4	4	3	3	3	3	2	2	2	4	1
141	4	f	5	7	5	UK	3	3	4	4	2	4	4	3	3	3	3	3	1	1	1	3	2
142	3	f	1	1	1	SA	3	3	2	2	1	3	3	3	2	2	3	3	1	1	1	3	1
143	4	m	5	7	5	USA	4	3	4	4	2	4	4	4	4	4	4	4	2	2	2	2	1
144	4	m	1	1	3	SA	3	3	3	3	3	3	3	4	3	3	3	3	2	2	2	3	2
145	3	m	1	1	1	SA	4	4	4	4	2	4	4	4	3	3	3	3	2	2	2	4	2
146	3	m	1	1	1	SA	4	4	4	4	2	4	4	4	3	3	3	3	2	2	2	4	2
147	2	f	1	1	3	England	2	3	2	2	2	2	2	3	2	2	2	2	2	2	2	3	2
148	2	f	1	2	3	USA	3	4	3	4	1	3	4	4	3	3	3	3	1	1	1	4	2
149	3	f	1	1	1	SA	3	3	2	2	1	3	3	3	2	2	3	3	1	1	1	3	1
150	2	f	1	1	1	New Zealand	4	3	4	3	1	4	4	4	3	3	3	3	1	1	1	4	1
151	4	f	1	1	1	Portugal	4	4	3	3	3	4	4	4	4	4	4	4	2	1	1	3	1
152	5	m	5	7	5	SA	4	4	2	3	3	2	2	3	2	2	2	2	3	3	3	3	3
153	3	f	1	1	1	UK	4	4	2	2	1	2	2	3	1	1	1	1	1	1	1	3	1
154	2	f	1	1	1	Spain	4	4	3	3	3	4	4	4	3	3	3	3	2	2	2	3	2
155	5	m	1	2	4	USA	4	4	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
156	2	f	2	2	4	USA	4	4	3	4	1	4	4	4	3	3	4	4	1	1	1	4	2
157	3	f	5	7	5	Netherlands:	4	4	3	4	2	4	4	4	2	2	4	4	1	1	1	3	1
158	2	f	1	1	1	England	4	4	3	4	1	4	4	4	3	3	4	4	1	1	1	4	1
159	4	m	5	7	5	UK	4	4	4	4	1	4	4	4	3	3	4	4	1	1	1	4	2
160	3	f	1	2	1	USA	4	4	3	4	1	4	4	4	3	3	4	4	1	1	1	4	1

	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3				4.1	4.2	4.3	4.4	
									2.3.1	2.3.2	2.3.3			3.3.1	3.3.2	3.3.3	3.3.4	3.3.5				
18	3	m	3	1	5	Portugal	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	2
22	2		2	1	1	UK	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4
43	3		1	3	5	USA	4	4	4	4	4	4	4	4	4	2	4	4	4	4	4	4
77	4	m		7	5	USA	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
78	6	m	2	5	5	lew Zealand	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
111	ank from																					

1's 44 47 50 56 59 51 44 16 8 2 0 1 0 1 48 1 0 0 0 0 0 1 1 0
 2's 41 38 35 36 40 47 41 38 15 19 2 9 8 6 16 36 22 46 9 8 6 8 7 10 14 8
 3's 32 39 29 35 33 37 34 69 66 59 56 43 68 83 79 81 42 68 46 68 49 50 49 52 35
 4's 37 30 36 27 20 18 35 29 65 74 88 99 79 54 35 49 18 75 99 79 94 97 90 86 111
 5's
 6's
 7's

TOT 154 154 150 154 152 153 154 152 154 154 154 153 151 153 154 154 152 154 153 153 153 151 154 150 153 154
 AVE 2.4 2.34 2.34 2.21 2.09 2.14 2.39 2.73 3.22 3.33 3.52 3.59 3.48 3.23 2.94 3.18 2.19 3.42 3.59 3.48 3.57 3.58 3.52 3.46 3.67
 STDEV 1.03 1.03 1.16 1.11 1.06 1.03 0.97 0.62 0.61 0.60 0.58 0.44 0.57 0.68 0.78 0.61 0.88 0.53 0.52 0.50 0.52 0.50 0.60 0.64 0.50
 CORR

	4.5	4.6	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	7.1	7.2	7.3	7.4
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	1	2	1	1	2	3	1	4	3	3	4	4	4	4	4
3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	3	4	3	3	4	4	3	3	3	3	3	4
5	4	4	4	4	4	4	4	3	4	4	4	4	3	3	4
6	4	4	4	3	4	3	4	4	4	4	4	4	4	4	4
7	3	3	3	3	3	3	3	3	3	3	4	4	3	3	4
8	3	2	2	2	2	2	3	3	4	4	4	4	4	4	4
9	3	4	2	4	4	3	2	3	3	3	3	3	3	3	3
10	4	4	4	4	4	4	4	4	4	4	3	4	3	3	4
11	3	4	3	1	1	1	3	3	4	4	4	4	3	3	4
12	4	2	3	2	2	2	4	4	4	4	4	4	3	3	4
13	4	4	4	3	3	3	3	3	4	3	4	4	3	3	3
14	2	2	2	2	2	2	1	3	3	3	3	3	3	3	4
15	1	1	1	2	3	4	2	3	4	3	4	4	4	4	4
16	4	2	4	2	3	3	2	3	4	4	4	4	3	3	4
17	2	1	1	1	2	3	4	4	3	4	4	4	4	4	4
19	2	2	2	2	2	2	2	2	4	3	3	3	4	3	4
20	4	4	4	4	4	4	3	3	4	4	4	4	4	3	4
21	4	3	2	3	3	3	3	2	3	3	3	3	3	3	3
23	4	4	4	4	3	4	3	4	4	4	4	3	3	2	4
24	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4
25	2	2	1	1	4	4	3	4	4	3	4	4	4	4	4

	4.5										4.6	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	7.1	7.2	7.3	7.4
	4.5.1	4.5.2	4.5.3	4.5.4	4.5.5	4.5.6	4.5.7	4.5.8	4.5.9	4.5.10	4.5.11													
18	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
22	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
43	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
77	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
78	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

111

Annexure E

Statistical Analysis

1 Introduction

This annexure displays the result of the statistical analysis that led to the conclusions in the main body of the thesis.

2 Results of the questionnaire

2.1 Background information

In total 160 completed questionnaires were received. Of these five questionnaires were disqualified. In four questionnaires the number of fours marked was 40 or more out of 43 questions, which means that more than 93% marked the maximum score. On questionnaire number 111 none of the answers were filled in. Given the fact that the population is very homogenous and that the standard deviation is very small, this number is deemed sufficient to make conclusions about designers that is fairly representative of the whole (Waliman, 2005: 279).

2.1.1 Responses to Question 1.1

Table 1 Responses to Question 1.1: Age group			
Age	n	%	<i>Comments:</i> A bell-shaped distribution with the highest number (30.1%) between 30 – 39 and 57.5% between 30 – 49.
Under 20	0	0%	
20 – 29	34	22.2%	
30 – 39	46	30.1%	
40 – 49	42	27.4%	
50 – 59	28	18.3%	
60 and above	3	2.0%	
Total	153	100.0%	

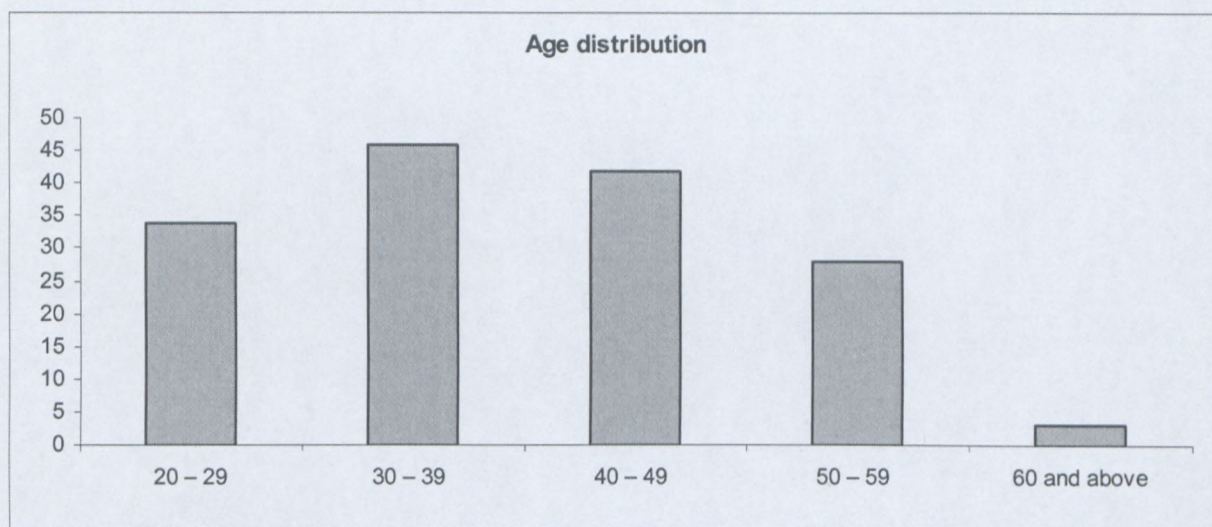


Figure 1 Age distribution

2.1.2 Responses to Question 1.2

Table 2 Responses to Question 1.2: Gender

gender	n	%	<i>Comments: Males outnumbered Females by about 3 to 2.</i>
Female	75	60.5%	
Male	49	39.5%	
Total	124	100.0%	

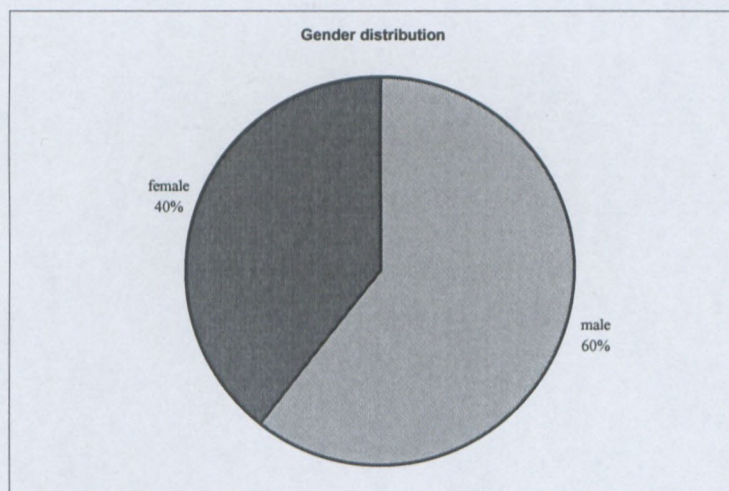


Figure 2 Gender distribution

2.1.3 Responses to Question 1.3

Table 3 Responses to Question 1.3: Professional time

Professional time	#	n	%	Comments: When added together, 78% (about three-quarters) of the respondents were involved in design, by either designing or teaching design, and 24.1% (about one-quarter) were involved in management by either managing or teaching management.
Designing	1	64	41.8%	
Managing	2	31	20.2%	
Teaching design to management students	3	6	3.9%	
Teaching management to design students	4	6	3.9%	
Teaching design to design students	5	46	30.1%	
Teaching management to management students	6	0	0%	
Total		153	99.9%	

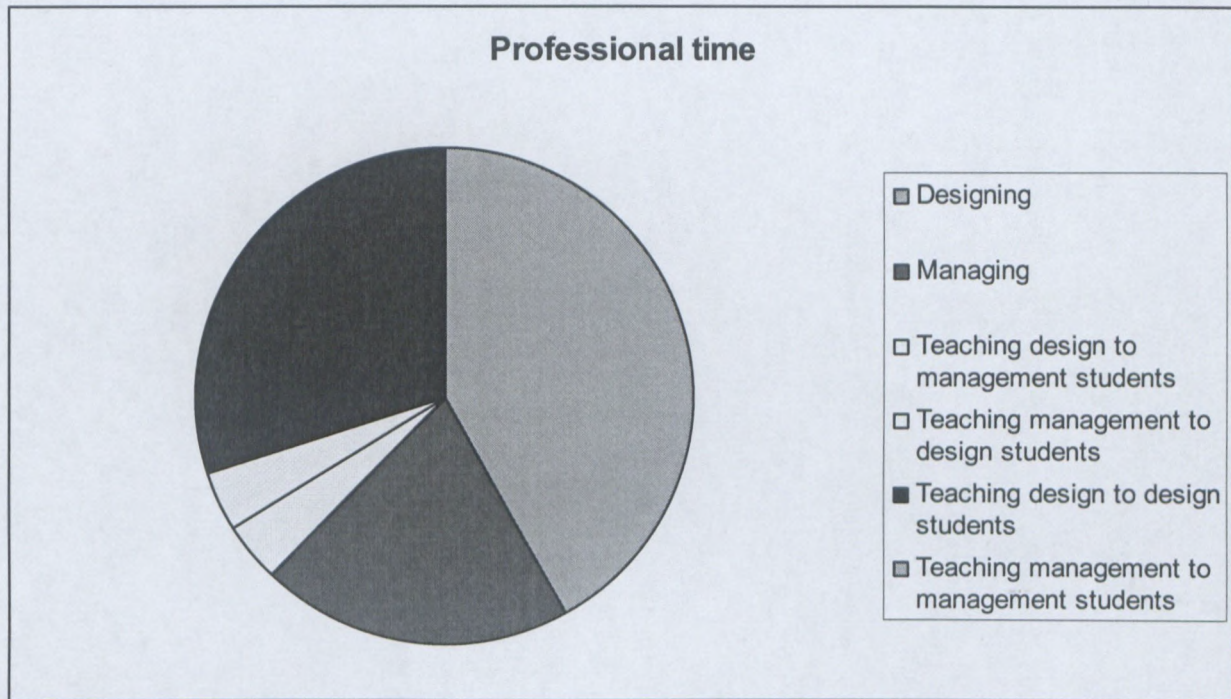


Figure 3 Professional time

2.1.4 Responses to Question 1.4

Industry involvement	#	n	%	Comments: The most respondents (40.9%) were involved in design with the second most (33.1%) involved in education. A further analysis indicates that of the 51 respondents who indicated that they were involved in education, 38 (75.5%) indicated in Question 1.3 that they were involved in teaching design to design students and six (11.8%) indicated that they taught design to management students. When these 44 (38 + 6) respondents are added to the 63 who indicated that they were involved in design (Question 1.3 #1), it means that a total of 107 (69.5%) of the respondents are either involved in design or teaching in design.
Design	1	63	40.9%	
Retail	2	21	13.6%	
Engineering	3	2	1.3%	
Manufacturing	4	3	1.9%	
Information Technology	5	7	4.6%	
Pharmaceutical products	6	0	0%	
Education	7	51	33.1%	
Other (One each from promotion of design, management, energy, marketing, news media, aerospace and printing.)	8	7	4.6%	
Total		154	100.0%	

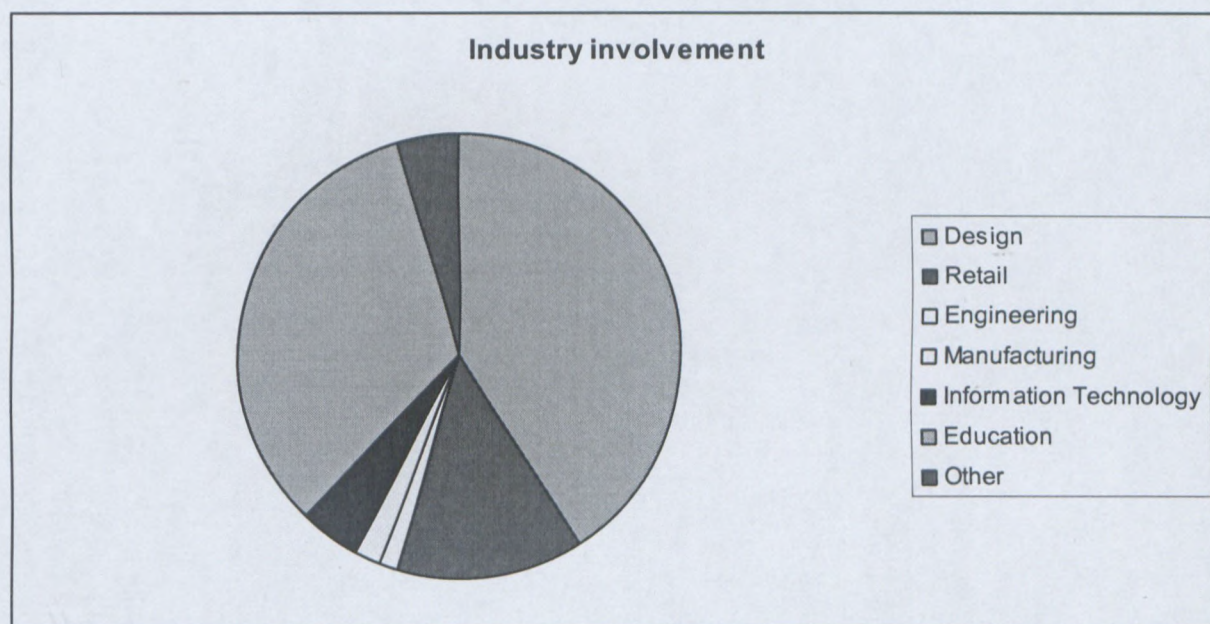


Figure 4 Industry involvement

2.1.5 Responses to Question 1.5

Table 5 Responses to Question 1.5: Professional qualification

Qualification	#	n	%	<i>Comments:</i> The highest professional qualifications of 47 (30.5%) of the respondents were a Master's degree. A further detailed analysis of the 47 respondents with a master's degree and the seven with a doctorate revealed that 33 (56.9%) of the 58 indicated that they were involved in teaching (Question 1.3), of which 28 (48.3%) were involved in teaching design to design students. Of the seven respondents with a doctorate, one was involved in teaching design to management students, while the other six were all involved in teaching design to design students. Of the 47 respondents with a Master's degree, 26 (55.3%) were involved in teaching design to design students.
Three year diploma	1	32	20.8%	
Three year Bachelor degree	2	11	7.1%	
Four year Diploma	3	27	17.5%	
Four year Bachelor's / Honours degree	4	26	16.9%	
Master's degree	5	47	30.5%	
Doctorate	6	11	7.2%	
Total		154	100.0%	

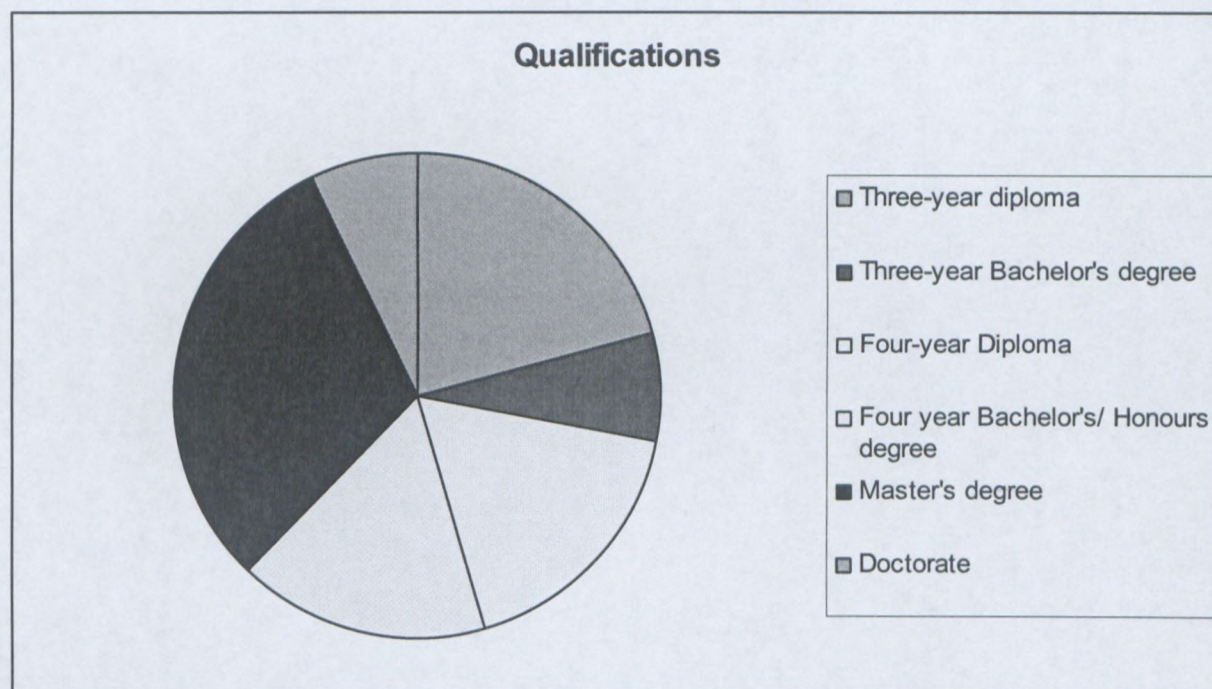


Figure 5 Qualifications

2.1.6 Responses to Question 1.6

Country	n	%	Country	n	%
Australia	9	5.8%	New Zealand	1	0.65%
Botswana	1	0.65%	Philippines	1	0.65%
Brazil	3	1.9%	Portugal	5	3.3%
Canada	2	1.3%	South Africa	52	33.8%
Canary Islands	1	0.65%	Spain	6	3.9%
Colombia	1	0.65%	Sweden	6	3.9%
Denmark	3	1.9%	Taiwan	2	1.3%
Finland	1	0.65%	Turkey	1	0.65%
Germany	4	2.6%	United Kingdom	21	13.6%
Mexico	2	1.3%	Uruguay	1	0.65%
The Netherlands	7	4.6%	United States of America	24	15.6%
Total				154	100.0%

The most respondents originated from South Africa (52 or 33.8%), followed by the United States of America (24 or 15.6%), and then the United Kingdom (21 or 13.6%). Respondents from the other countries were fewer than 6% per country.

2.2 Contribution of design

Questions 2 to 7 asked how important it was for a manager to know about the various aspects of the contribution that design could make to a business. The responses were analysed as follows:

Table number						Comments:
#	(a)	(b)	(c)	(d)	total	
n	(e)	(f)	(g)	(h)	(i)	
%	(j)	(k)	(l)	(m)	(n)	
c	(o)		(p)			
Ave	(q)					
St dev	(r)					

corresponds with the number of the question on the questionnaire.

(a) Number 1 on the Likert scale indicating *totally unimportant*.

(b) Number 2 on the Likert scale indicating *unimportant*.

(c) Number 3 on the Likert scale indicating *important*.

(d) Number 4 on the Likert scale indicating *totally important*.

n refers to the number of respondents.

(e) – (h) refers to the actual number of responses who indicated 1, 2, 3 or 4 respectively.

(i) refers to the total number of responses for this question.

% refers to the proportion of responses.

(j) – (m) refers to the proportion of responses for each category expressed as a percentage.

(n) refers to the total of the percentages, which is 100%, unless a problem with rounding occurs.

c refers to the combination of the unimportant and important responses.

(o) refers to the proportion of combined responses indicating either a 1 or 2, which provide the total number of responses for *unimportant*.

(p) refers to the proportion of combined responses indicating either a 3 or 4, which provide the total number of responses for *important*.

Ave (q) refers to the numerical average (or mean) for the total number of responses, a measure of central tendency. The midpoint i.e. the average between the numbers 1, 2, 3, and 4, is 2.5.

St dev (r) refers to the standard deviation for the total number of responses, a measure of dispersion.

2.2.1 Responses to Question 2.1

Table 7 Responses to Question 2.1: The importance of the role a design application can play in business solutions						
#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents. The response is therefore accepted as very important.
n	0	2	46	105	153	
%	0%	1.3%	30.1%	68.6%	100%	
c	2 or 1.3%		151 or 98.7%			
Ave	3.67					
St dev	0.43					

2.2.2 Responses to Question 2.2

Table 8 Responses to Question 2.2: The importance of case histories on the impact of design on business						
#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents. The response is therefore accepted as important.
n	0	6	63	84	153	
%	0%	3.9%	41.2%	54.9%	100%	
c	6 or 3.9%		147 or 96.1%			
Ave	3.51					
St dev	0.62					

2.2.3 Responses to Question 2.3.1

Table 9 Responses to Question 2.3.1: The importance of design providing a competitive advantage on the strategic level						
#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents. The response is therefore accepted as important.
n	0	13	60	80	153	
%	0%	8.5%	39.2%	52.3%	100%	
c	13 or 8.5%		140 or 91.5%			
Ave	3.44					
St dev	0.60					

2.2.4 Responses to Question 2.3.2

Table 10 Responses to Question 2.3.2: The importance of design providing a competitive advantage on the functional level						
#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents. The response is therefore accepted as important. It is interesting to note that the majority of the respondents chose #3. This difference is, however, not statistically significant. (See significance test below.)
n	0	11	78	65	154	
%	0%	7.1%	50.7%	42.2%	100%	
c	11 or 7.1%		143 or 92.9%			
Ave	3.35					
St dev	0.60					

2.2.5 Responses to Question 2.3.3

Table 11 Responses to Question 2.3.3 The importance of design providing a competitive advantage on the project level						
#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents. The response is therefore accepted as important.
n	0	8	59	81	148	
%	0%	5.4%	39.9%	54.7%	100%	
c	8 or 5.4%		140 or 94.6%			
Ave	3.49					
St dev	0.52					

Significance test

A test of significance can be done to determine whether the result in Question 2.3.2 is statistically different from the expected result for 2.3.1, 2.3.2 and 2.3.3 by using the X^2 -test (Rose & Sullivan, 1993: 154 – 163):

Table 12 χ^2 -test for 2.3.1, 2.3.2 and 2.3.3

#	2	3	4	Total
2.3.1	13 E = 10.760 (O - E)/E = 0.466	60 E = 66.244 (O - E)/E = 0.589	80 E = 75.996 (O - E)/E = 0.211	153
2.3.2	11 E = 10.831 (O - E)/E = 0.003	78 E = 66.677 (O - E)/E = 1.923	65 E = 76.492 (O - E)/E = 1.727	154
2.3.3	8 E = 10.409 (O - E)/E = 0.558	59 E = 64.079 (O - E)/E = 0.403	81 E = 73.512 (O - E)/E = 0.763	148
total	32	197	226	455

$$\chi^2 = 6.643$$

Degrees of freedom: $\nu = 4$

Critical value for χ^2 : $P = 10\%$: 7.78

The responses for Question 5 have therefore no statistically significant difference between the observed and the expected frequencies.

2.2.6 Responses to Question 2.4

Table 13 Responses to Question 2.4: The importance of the difference between the various design disciplines

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents indicated that the difference was important. It was, however, not statistically significant (see below for a significance test).
n	31	36	50	35	152	
%	20.4%	23.7%	32.9%	23.0%	100%	
c	67 or 44.1%		85 or 55.9%			
Ave	2.59					
St dev	0.90					

Significance test

A test of significance can be done to determine if it is reasonable to conclude that the responses 55.9% ($p = 0.559$) could have come from a population where the responses would be equal, thus 50%

($\pi = 0.5$). For large samples we can usually rely on the normal approximation to the binomial distribution and assume that 95% of repeated sample proportions would be within the limits ± 1.96 (Rose & Sullivan, 1993: 154 – 163).

$$\begin{aligned}
 z &= \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}} \\
 &= \frac{0.559 - 0.5 - (1/304)}{\sqrt{(0.559)(0.441)/152}} \\
 &= 1.383.
 \end{aligned}$$

The result is less than 1.96 and therefore not statistically significant. With regards to the result of Question 2.4, it can thus be concluded that the difference between the respondents indicating *important*, compared with those respondents who indicated *unimportant*, was not significant.

2.2.7 Responses to Question 2.5

Table 14 Responses to Question 2. 5: The importance of knowing which design discipline is best suited to solve a problem

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents indicated that the difference was unimportant. It is, however, not statistically significant (see below for a significance test).
n	44	38	30	37	149	
%	29.5%	25.5%	20.1%	24.8%	99.9%	
c	82 or 55.0%		67 or 45.0%			
Ave	2.4					
St dev	0.98					

Significance test

$$\begin{aligned}
 z &= \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}} \\
 &= \frac{0.55 - 0.5 - (1/298)}{\sqrt{(0.55)(0.45)/149}} \\
 &= 1.144.
 \end{aligned}$$

The result is less than 1.96 and therefore not statistically significant. With regards to the result of Question 2.5, it can thus be concluded that the difference between the respondents indicating *important*, compared with those respondents who indicated *unimportant*, was not significant.

2.2.8 Summary of the responses to Question 2

The responses to Question 2, on the contribution of design, can now be summarised. See Table 5.15 and Figure 5.6.

Q	topic	ave	rank*	St D	M	result
2.1	Role of design application	3.67	1	0.43	4	Very Important
2.2	Case histories	3.51	2	0.62	4	Important
2.3.1	A competitive advantage					
2.3.1	On the strategic level	3.44	4	0.60	4	Important
2.3.2	On the functional level	3.35	5	0.60	3	Important
2.3.3	On the project level	3.49	3	0.52	4	Important
2.4	Difference between design disciplines	2.59		0.90	3	Neutral
2.5	Which discipline is best suited	2.40		0.98	1	Neutral

* The results indicated as important, are ranked in relative order of importance based on the average.

St D = Standard Deviation

M = Mode (most frequent value).

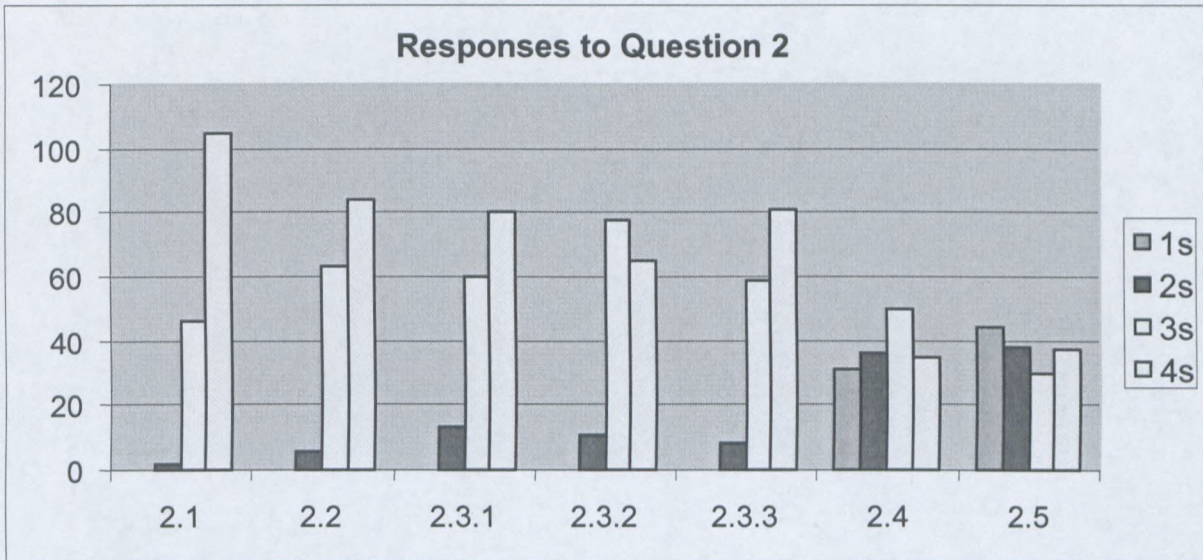


Figure 5.6 Responses to Question 2

The importance of the role of the design application is not only strongly supported, but a low standard deviation indicates a fair amount of consensus. The importance of case histories received the second highest average and is also strongly supported, but a higher standard deviation indicates a greater degree of difference of opinions. When only the answers to Questions 2.3 are considered, it is significant that the role of design on the project level received the strongest support and also the most coherence. The differences between the design disciplines and which discipline is the best suited, did not receive enough support to be accepted as important. What is significant, though, is that the opinions on these two issues differ quite considerably.

2.3 Integration of design

2.3.1 Responses to Question 3.1

Table 16 Responses to Question 3.1: The importance of design as an integrated team effort between company employees and designers

#	1	2	3	4	total	<i>Comments:</i> Respondents felt strongly that design was an integrated team effort.
n	0	9	42	103	154	
%	0%	5.8%	27.3%	66.9%	100%	
c	9 or 5.8%		145 or 94.2%			
Ave	3.61					
St dev	0.53					

2.3.2 Responses to Question 3.2

Table 17 Responses to Question 3.2: Importance of including design as early in the development process as possible						
#	1	2	3	4	total	<i>Comments:</i> Respondents felt strongly that design should be included early in the development process.
n	0	7	30	117	154	
%	0%	4.6%	19.5%	75.9%	100%	
c	7 or 4.6%		147 or 95.4%			
Ave	3.71					
St dev	0.43					

2.3.3 Responses to Question 3.3.1

Table 18 Responses to Question 3.3.1: Design information should be integrated with the marketing processes of the company						
#	1	2	3	4	total	<i>Comments:</i> Almost all the respondents felt that design information should be integrated with the marketing information. Not everybody agreed on the level of importance, though. The respondents who indicated <i>important</i> were almost equally divided between <i>important</i> and <i>totally important</i> .
n	0	4	72	78	154	
%	0%	2.6%	46.8%	50.6%	100%	
c	4 or 2.6%		150 or 97.4%			
Ave	3.48					
St dev	0.54					

2.3.4 Responses to Question 3.3.2

Table 19 Responses to Question 3.3.2: Design information should be integrated with the financial processes of the company						
#	1	2	3	4	total	<i>Comments:</i> Strongly supported by respondents, but not as strongly as the previous question. See below for a X^2 -test to establish whether the differences between the responses of 3.3.1 to 3.3.5 are significant.
n	2	27	89	36	154	
%	1.3%	17.5%	57.8%	23.4%	100%	
c	29 or 18.8%		125 or 81.2%			
Ave	3.03					
St dev	0.66					

2.3.5 Responses to Question 3.3.3

Table 5.20 Responses to Question 3.3.3: Design information should be integrated with the human resources processes of the company						
#	1	2	3	4	total	<i>Comments:</i> Just over three-quarters of the respondents felt that it was important to integrate design with human resources processes. See below for a X^2 -test to establish whether the differences between the responses of 3.3.1 to 3.3.5 are significant.
n	3	31	85	31	150	
%	2.0%	20.7%	56.7%	20.7%	100%	
c	34 or 22.7%		116 or 77.4%			
Ave	2.96					
St dev	0.69					

2.3.6 Responses to Question 3.3.4

Table 21 Responses to Question 3.3.4: Design information should be integrated with the manufacturing processes of the company						
#	1	2	3	4	total	<i>Comments:</i> Strongly supported by the respondents. See below for a X^2 -test to establish whether the differences between the responses of 3.3.1 to 3.3.5 are significant.
n	3	10	70	67	150	
%	2.0%	6.7%	46.7%	44.7%	100.1%	
c	13 or 8.7%		137 or 91.3%			
Ave	3.34					
St dev	0.58					

2.3.7 Responses to Question 3.3.5

Table 22 Responses to Question 3.3.5: Design information should be integrated with the service delivery processes of the company						
#	1	2	3	4	total	<i>Comments:</i> Strongly supported by the respondents. See below for a X^2 -test to establish whether the differences between the responses of 3.3.1 to 3.3.5 are significant.
n	2	13	82	57	154	
%	1.3%	8.4%	53.3%	37.0%	100%	
c	15 or 9.7%		139 or 90.3%			
Ave	3.26					
St dev	0.58					

When analysed with Microsoft Excel's Pivot Tables, 24 (15.6%) respondents indicated *totally important* to each one of the five questions, while 106 (68.8%) respondents indicated *totally important* or *important* to each one of the five questions. This indicates that many respondents felt strongly that it was important for managers to know how to integrate design with the information of the various processes of a company.

Significance test

#	1	2	3	4	Tot
3.3.1	0 E = 1.617 (O - E)2/E = 1.617	9 E = 14.147 (O - E)2/E = 1.873	42 E = 62.449 (O - E)2/E = 6.696	103 E = 75.787 (O - E)2/E = 9.771	154
3.3.2	0 E = 1.617 (O - E)2/E = 1.617	7 E = 14.147 (O - E)2/E = 3.611	30 E = 62.449 (O - E)2/E = 16.86	117 E = 75.787 (O - E)2/E = 22.411	154
3.3.3	3 E = 1.575 (O - E)2/E = 1.290	31 E = 13.780 (O - E)2/E = 21.52	85 E = 60.872 (O - E)2/E = 9.607	31 E = 73.819 (O - E)2/E = 24.837	150
3.3.4	3 E = 1.575 (O - E)2/E = 1.290	10 E = 13.780 (O - E)2/E = 1.037	70 E = 60.872 (O - E)2/E = 1.383	67 E = 73.819 (O - E)2/E = 0.630	150
3.3.5	2 E = 1.617 (O - E)2/E = 0.091	13 E = 14.147 (O - E)2/E = 0.093	82 E = 62.449 (O - E)2/E = 6.121	57 E = 75.787 (O - E)2/E = 4.657	154
Total	8	70	309	375	762

Questions 3.3.1 – 3.3.5:

$$X^2 = 137.012$$

Degrees of freedom: $\nu = 12$

Critical value for X^2 : $P = 0.1\%$: 32.91

Question 3.3 has therefore a statistically significant difference between the observed and the expected frequencies, with $P < 0.001$.

The same exercise was repeated with only questions 3.3.1, 3.3.4 and 3.3.5 as the combined *important* and *totally important* responses in these questions were more than 90%. The result was:

$$X^2 = 31.833$$

Degrees of freedom: $\nu = 6$

Critical value for X^2 : $P = 0.1\%$: 22.46

Questions 3.3.1, 3.3.4 and 3.3.5 have therefore a statistically significant difference between the observed and the expected frequencies, with $P < 0.001$.

The same exercise was repeated a third time with only questions 3.3.4 and 3.3.5. The result was:

$$X^2 = 2.293$$

Degrees of freedom: $\nu = 3$

Critical value for X^2 : $P = 10\%$: 6.25

Question 3.3.4 and 3.3.5 have therefore not a statistically significant difference between the observed and the expected frequencies.

The following **conclusion** can therefore be reached: Although all the topics were indicated as important, the most important was that design information should be integrated with the marketing processes. Of lesser importance, but still significant, was that design information should be integrated with the manufacturing and service delivery processes. The respondents did not distinguish between the last two, namely integration with financial processes and integration with human resource processes. They can thus be regarded as joint third.

2.3.8 Summary of the responses to Question 3

The results of Question 3, on the integration of design and management, can now be summarised. See Figure 7 and Table 24.

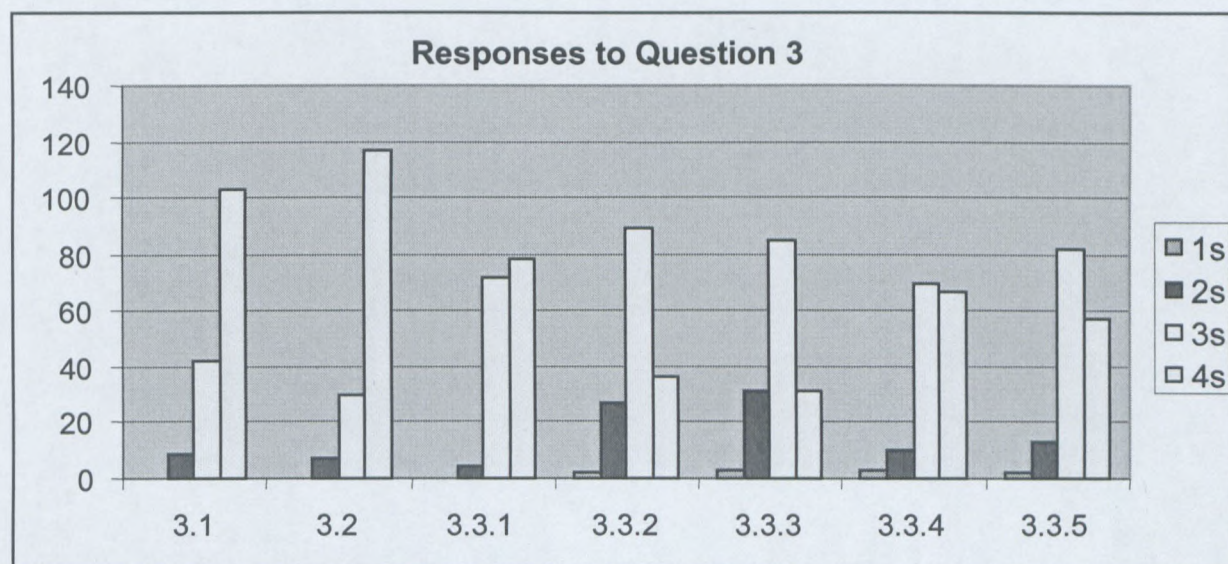


Figure 7 Responses to Question 3

Q	topic	ave	rank	st d	M	result
3.1	Design as integrated team effort	3.61	2	0.53	4	Important
3.2	Design to be included as early as possible	3.71	1	0.43	4	Important
3.3	Design information to be integrated with					
3.3.1	Market information	3.48	3	0.54	4	Important
3.3.2	Financial information	3.03	6	0.66	3	Important
3.3.3	Human resources information	2.96	7	0.69	3	Important
3.3.4	Manufacturing information	3.34	4	0.58	3	Important
3.3.5	Service delivery information	3.26	5	0.58	3	Important

The integration of design received much support from the respondents. All seven issues were indicated as important. It is significant that the importance of an early integration received not only the most support, but also had the highest consistency of opinion. The importance for managers to know how to integrate design information with the company's human resources information received the least support from the respondents. The opinions on this issue were the most divided.

2.4 Process of design

2.4.1 Responses to Question 4.1

Table 25 Responses to Question 4.1: The importance to know about design concepts, such as aesthetics or ergonomics						
#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about design concepts.
n	54	36	41	23	154	
%	35.1%	23.4%	26.6%	14.9%	100%	
c	90 or 58.5%		64 or 41.5%			
Ave	2.2					
St dev	0.99					

Significance test

$$\begin{aligned}
 z &= \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}} \\
 &= \frac{0.585 - 0.5 - (1/308)}{\sqrt{(0.585)(0.415)/154}} \\
 &= 2.06.
 \end{aligned}$$

As z is bigger than 1.96, the result is statistically significant.

2.4.2 Responses to Question 4.2

Table 26 Responses to Question 4.2: The importance for managers to know about the psychology of creativity

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about the psychology of creativity.
n	63	37	34	18	152	
%	41.5%	24.3%	22.4%	11.8%	100%	
c	100 or 65.8%		52 or 34.2%			
Ave	2.05					
St dev	1.10					

2.4.3 Responses to Question 4.3

Table 27 Responses to Question 4.3: The importance for managers to know about the writing of a creative brief

#	1	2	3	4	total	<i>Comments:</i> There was strong support among the respondents that managers should know how to write a creative brief.
n	7	11	62	74	154	
%	4.6%	7.1%	40.3%	48.0%	100%	
c	18 or 11.7%		136 or 88.3%			
Ave	3.32					
St dev	0.80					

2.4.4 Responses to Question 4.4

Table 28 Responses to Question 4.4: The importance for managers to know about the various possibilities of how a brief can be executed

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about the various possibilities of how a brief can be executed.
n	52	39	34	27	152	
%	34.2%	25.7%	22.4%	17.7%	100%	
c	91 or 59.9%		61 or 40.1%			
Ave	2.24					
St dev	1.08					

Significance test

$$z = \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}}$$

$$= \frac{0.599 - 0.5 - (1/304)}{\sqrt{(0.599)(0.401)/152}}$$

$$= 2.41.$$

As z is bigger than 1.96, the result is statistically significant.

2.4.5 Responses to Question 4.5.1

Table 29 Responses to Question 4.5.1: The importance for managers to know about recognising the need for design

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about recognising the need for design. This result is, however, not statistically significant.
n	44	41	32	37	154	
%	28.6%	26.6%	20.8%	24.0%	100%	
c	85 or 55.2%		69 or 44.8%			
Ave	2.4					
St dev	1.03					

Significance test

$$z = \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}}$$

$$= \frac{0.552 - 0.5 - (1/308)}{\sqrt{(0.552)(0.448)/154}}$$

$$= 1.22.$$

As z is smaller than 1.96, the result is not statistically significant.

2.4.6 Responses to Question 4.5.2

Table 30 Responses to Question 4.5.2: The importance for managers to know about analysing and formulating the design problem						
#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about analysing and formulating the design problem. This result is, however, not statistically significant.
n	47	38	39	30	154	
%	30.5%	24.7%	25.3%	19.5%	100%	
c	85 or 55.2%		69 or 44.8%			
Ave	2.34					
St dev	1.03					

Significance test

$z = 1.22$ (Same calculation as above.)

As z is smaller than 1.96 the result is not statistically significant.

2.4.7 Responses to Question 4.5.3

Table 31 Responses to Question 4.5.3: The importance for managers to know about setting design objectives						
#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about setting design objectives. This result is, however, not statistically significant.
n	50	35	29	36	150	
%	33.3%	23.3%	19.3%	24.0%	99.9%	
c	85 or 56.6%		65 or 43.3%			
Ave	2.34					
St dev	1.16					

Significance test

$$z = \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}}$$

$$= \frac{0.566 - 0.5 - (1/300)}{\sqrt{(0.566)(0.433)/150}}$$

$$= 1.55.$$

As z is smaller than 1.96 the result is not statistically significant.

2.4.8 Responses to Question 4.5.4

Table 32 Responses to Question 4.5.4: The importance for managers to know about gathering relevant information

#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about gathering relevant information. This result is statistically significant.
n	56	36	35	27	154	
%	36.4%	23.4%	22.7%	17.5%	100%	
c	92 or 59.8%		62 or 40.2%			
Ave	2.21					
St dev	1.11					

Significance test

$$z = \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}}$$

$$= \frac{0.598 - 0.5 - (1/308)}{\sqrt{(0.598)(0.402)/154}}$$

$$= 2.40.$$

As z is greater than 1.96 the result is statistically significant.

2.4.9 Responses to Question 4.5.5

Table 33 Responses to Question 4.5.5: The importance for managers to know about conceptualising applications						
#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was not important for managers to know about conceptualising applications.
n	59	40	33	20	152	
%	38.8%	26.3%	21.7%	13.2%	100%	
c	99 or 65.1%		53 or 34.9%			
Ave	2.09					
St dev	1.06					

2.4.10 Responses to Question 4.5.6

Table 5.34 Responses to Question 4.5.6: The importance for managers to know about analysing design applications						
#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was not important for managers to know about analysing applications.
n	51	47	37	18	153	
%	33.3%	30.7%	24.2%	11.8%	100%	
c	98 or 64.0%		55 or 36.0%			
Ave	2.14					
St dev	1.03					

2.4.11 Responses to Question 4.5.7

Table 35 Responses to Question 4.5.7: The importance for managers to know about selecting an appropriate design						
#	1	2	3	4	total	<i>Comments:</i> The majority of respondents felt that it was not important for managers to know about selecting an appropriate design. This result is, however, not statistically significant.
n	44	41	34	35	154	
%	28.6%	26.6%	22.1%	22.7%	100%	
c	85 or 55.2%		69 or 44.8%			
Ave	2.39					
St dev	0.97					

Significance test

$$z = \frac{p - \pi - (1/2n)}{\sqrt{\pi(1 - \pi)/n}}$$

$$= \frac{0.552 - 0.5 - (1/308)}{\sqrt{(0.552)(0.448)/154}}$$

$$= 1.22.$$

As z is smaller than 1.96 the result is not statistically significant.

2.4.12 Responses to Question 4.5.8

Table 36 Responses to Question 4.5.8: The importance for managers to know about presenting the chosen design						
#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was important for managers to know about presenting the chosen design.
n	16	38	69	29	152	
%	10.5%	25.0%	45.4%	19.1%	100%	
c	54 or 35.5%		98 or 64.5%			
Ave	2.73					
St dev	0.62					

4.13 Responses to Question 4.5.9

Table 37 Responses to Question 4.5.9: The importance for managers to know about implementing the chosen design						
#	1	2	3	4	Total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about implementing the chosen design.
n	8	15	66	65	154	
%	5.2%	9.7%	42.9%	42.2%	100%	
c	23 or 14.9%		132 or 85.1%			
Ave	3.22					
St dev	0.61					

2.4.14 Responses to Question 4.5.10

Table 38 Responses to Question 4.5.10: The importance for managers to know about assessing the design's effectiveness (short term)						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about assessing the design's effectiveness (short term).
n	2	19	59	74	154	
%	1.3%	12.3%	38.3%	48.1%	100%	
c	21 or 13.6%		133 or 86.4%			
Ave	3.33					
St dev	0.60					

2.4.15 Responses to Question 4.5.11

Table 39 Responses to Question 4.5.11: The importance for managers to know about determining the design's significance (to long term goals)						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about determining the design's significance (to long term goals).
n	0	9	56	88	153	
%	0%	5.9%	36.6%	57.5%	100%	
c	9 or 5.9%		144 or 94.1%			
Ave	3.52					
St dev	0.58					

2.4.16 Responses to Question 4.6

Table 40 Responses to Question 4.6: The importance for managers to know about design as a multi-disciplinary approach						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that design is a multi-disciplinary approach.
n	1	8	43	99	151	
%	0.6%	5.3%	28.5%	65.6%	100%	
c	9 or 5.9%		142 or 94.1%			
Ave	3.59					
St dev	0.44					

2.4.17 Summary of the responses to question 4

Question 4 dealt with how important it is for managers to know about the individual steps in the design process. Mixed results were returned. The results are summarised in Table 41 and Figure 8. An average of below 2.5 is an indication that the majority of respondents felt that the issue was unimportant.

Q	Topic	ave	rank	st d	M	results
4	The importance of					
4.1	Design concepts	2.20		0.99	1	Unimportant
4.2	Psychology of creativity	2.05		1.10	1	Unimportant
4.3	Writing of a creative brief	3.32	4	0.80	4	Important
4.4	Execution of a brief	2.24		1.08	1	Unimportant
4.5	Steps in the design process					
4.5.1	Recognising the need	2.40		1.03	1	Neutral
4.5.2	Analysing the problem	2.34		1.03	1	Neutral
4.5.3	Setting objectives	2.34		1.16	1	Neutral
4.5.4	Gathering information	2.21		1.11	1	Unimportant
4.5.5	Conceptualising	2.09		1.06	1	Unimportant
4.5.6	Analysing design applications	2.14		1.03	1	Unimportant
4.5.7	Selecting	2.38		0.97	1	Neutral
4.5.8	Presenting	2.73	6	0.62	3	Important
4.5.9	Implementing	3.22	5	0.61	3	Important
4.5.10	Short term effectiveness	3.33	3	0.60	4	Important
4.5.11	Long term significance	3.52	2	0.58	4	Important
4.6	Multi-disciplinary approach	3.59	1	0.44	4	Important

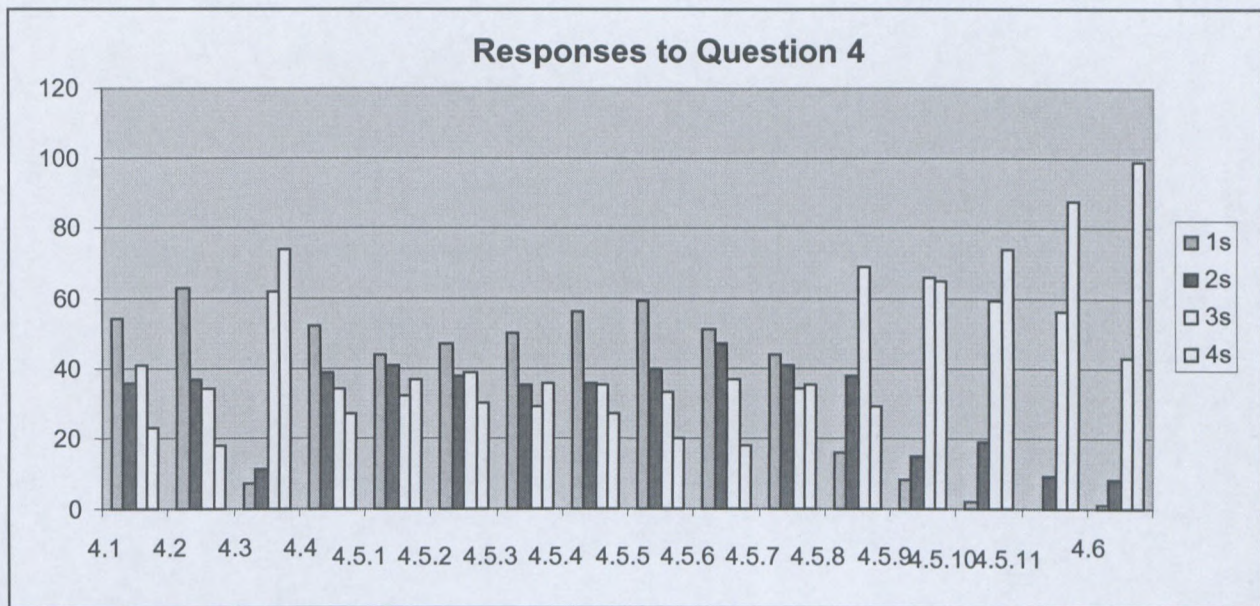


Figure 8 Responses to Question 4

The importance of design as multi-disciplinary approach received the most support with the highest coherence of opinion. It is significant that the issues early on in the design process did not receive much support, with the writing of a creative brief being a significant exception. The importance of writing a creative brief received the fourth most support. It is once again clear that the opinions in the issues that were not supported differed the most. The biggest difference of opinion among the supported issues was the writing of a creative brief (st dev = 0.8), while the most coherent opinions among the not-supported issues was the importance of selecting a design discipline (st dev = 0.97). From this turning point the coherence of the supported issues increased, while the coherence of the non-supported items decreased.

Out of the sixteen issues in the design process, only six were indicated as important and they are in order of preference as follows:

1. Understanding that design is a multi-disciplinary approach
2. Understanding the long term significance of design
3. Understanding the short term effectiveness of design
4. Know how to write a creative brief
5. Understand how to implement a given design
6. Understand how to present a design

2.5 Presentation of design

2.5.1 Responses to Question 5.1

Table 42 Responses to Question 5.1: The importance for managers to know about the alternative reality the designer is presenting

#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about the alternative reality the designer is presenting.
n	0	6	68	79	153	
%	0%	3.9%	44.4%	51.6%	99.9%	
c	6 or 3.9%		147 or 96.1%			
Ave	3.48					
St dev	0.57					

2.5.2 Responses to Question 5.2

Table 43 Responses to Question 5.2: The importance for managers to know about popularised drawings

#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about popularised drawings.
n	1	16	83	54	154	
%	0.7%	10.4%	53.9%	35.0%	100%	
c	17 or 11.1%		137 or 88.9%			
Ave	3.23					
St dev	0.68					

2.5.3 Responses to Question 5.3

Table 44 Responses to Question 5.3: The importance for managers to know about working drawings

#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was important for managers to know about working drawings.
n	4	36	79	35	154	
%	2.6%	23.4%	51.3%	22.7%	100%	
c	40 or 26.0%		114 or 74.0%			
Ave	2.94					
St dev	0.78					

2.5.4 Responses to Question 5.4

Table 45 Responses to Question 5.4: The importance for managers to know about written report(s) accompanying the design						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know about written report(s) accompanying the design.
n	0	22	81	49	152	
%	0%	14.5%	53.3%	32.3%	100%	
c	22 or 14.5%		130 or 85.6%			
Ave	3.18					
St dev	0.61					

2.5.5 Responses to Question 5.5

Table 46 Responses to Question 5.5: The importance for managers to know about detailed information on design drawings						
#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was unimportant for managers to know about detailed information on design drawings.
n	48	46	42	18	154	
%	31.2%	29.9%	27.3%	11.7%	100.1%	
c	94 or 61.0%		60 or 39.0%			
Ave	2.19					
St dev	0.88					

Significance test for responses to Question 5

#	1	2	3	4	Tot
5.1	0 E = 10.572 (O - E)2/E = 10.572	0 E = 25.134 (O - E)2/E = 14.567	68 E = 70.416 (O - E)2/E = 0.083	79 E = 46.877 (O - E)2/E = 22.012	153
5.2	1 E = 10.641 (O - E)2/E = 8.735	16 E = 25.299 (O - E)2/E = 3.418	83 E = 70.876 (O - E)2/E = 2.074	54 E = 47.184 (O - E)2/E = 0.985	154
5.3	4 E = 10.641 (O - E)2/E = 4.145	36 E = 25.299 (O - E)2/E = 4.527	79 E = 70.876 (O - E)2/E = 0.931	54 E = 47.184 (O - E)2/E = 3.146	154
5.4	0 E = 10.503 (O - E)2/E = 10.503	22 E = 24.970 (O - E)2/E = 0.353	81 E = 69.956 (O - E)2/E = 1.744	49 E = 46.571 (O - E)2/E = 0.127	152
5.5	48 E = 10.641 (O - E)2/E = 131.153	46 E = 25.299 (O - E)2/E = 16.94	42 E = 70.876 (O - E)2/E = 11.765	18 E = 47.184 (O - E)2/E = 18.051	153
	53	126	353	235	610

Questions 5.1 – 5.5:

$$\chi^2 = 265.829$$

Degrees of freedom: $\nu = 12$

Critical value for χ^2 : $P = 0.1\%$: 32.91

Question 5 has therefore a statistically significant difference between the observed and the expected frequencies, with $P < 0.001$.

2.5.6 Summary of the responses to Question 5

When the responses to Section 5, on the presentation of the design, are listed, an interesting pattern emerges, which is demonstrated in Table 48. There is a trend that the more technical the presentation, the less important the respondents felt they are for managers to know about. The correlation coefficient (r) between the two sets of data is -0.919 . Considering that correlations are expressed as a factor between -1.0 (strong negative), 0.0 (weak) and 1.0 (strong), it is clear that this is a very strong

negative correlation, meaning that the more technical the presentation, the less important respondents felt they are for managers to know about. The responses to Question five are summarised in Figure 9 and Table 48.

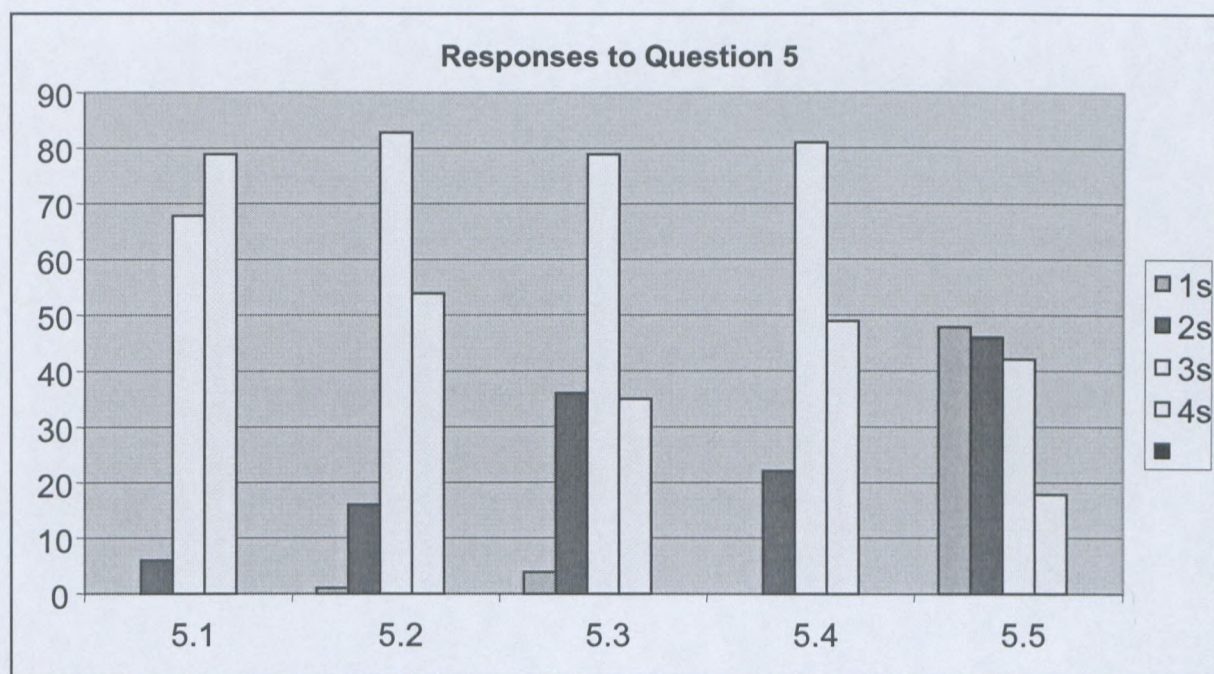


Figure 9 Responses to Question 5

Q	topic	ave	rank	st dev	M	result
5.1	Alternative reality	3.48	1	0.57	4	Important
5.2	Popular drawings	3.23	2	0.68	3	Important
5.3	Working drawings	2.94	4	0.78	3	Important
5.4	Written reports	3.18	3	0.62	3	Important
5.5	Detailed information	2.19	5	0.88	1	Unimportant

The importance of managers understanding the alternative reality received the most support and had the highest coherence of opinion. The importance for managers to understand working drawings, although deemed important, received the least amount of support, with the highest inconsistency of opinion.

2.6 Implementation of design

2.6.1 Responses to Question 6.1

Table 49 Responses to Question 6.1: The manager must be involved on an ongoing basis in the implementation of the design application						
#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was important for managers to be involved in an ongoing basis in the implementation of the design application.
n	1	9	68	75	153	
%	0.7%	5.9%	44.4%	49.0%	100%	
c	10 or 6.6%		143 or 94.4%			
Ave	3.42					
St dev	0.53					

2.6.2 Responses to Question 6.2

Table 50 Responses to Question 6.2: The design application is to be implemented as an integral part of the overall business strategy						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that the design application is to be implemented as an integral part of the overall business strategy.
n	0	8	46	99	153	
%	0%	5.2%	30.1%	64.7%	100%	
c	8 or 5.2%		145 or 94.81%			
Ave	3.59					
St dev	0.52					

2.6.3 Responses to Question 6.3

Table 51 Responses to Question 6.3: The implementation of a design application could involve expertise from other fields						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that the implementation of a design application could involve expertise from other fields.
n	0	6	68	79	153	
%	0%	3.9%	44.4%	51.6%	99.9%	
c	6 or 3.9%		147 or 96.1%			
Ave	3.48					
St dev	0.50					

2.6.4 Responses to Question 6.4

Table 52 Responses to Question 6.4: The implementation of the design application could be a long-term process

#	1	2	3	4	total	<i>Comments:</i> A majority of respondents felt that it was important for managers to know that the implementation of the design application could be a long-term process.
n	0	8	49	94	151	
%	0%	5.3%	32.5%	62.2%	100%	
c	8 or 5.3%		143 or 94.7%			
Ave	3.57					
St dev	0.52					

Significance test

Table 53 χ^2 -test for 6.1 to 6.4

#	1	2	3	4	Tot
6.1	1 E = 0.251 (O - E) ² /E = 2.238	9 E = 7.775 (O - E) ² /E = 0.193	68 E = 57.939 (O - E) ² /E = 1.747	75 E = 87.034 (O - E) ² /E = 1.664	153
6.2	0 E = 0.251 (O - E) ² /E = 0.251	8 E = 7.775 (O - E) ² /E = 0.006	46 E = 57.939 (O - E) ² /E = 2.460	99 E = 87.034 (O - E) ² /E = 1.645	153
6.3	0 E = 0.251 (O - E) ² /E = 0.251	6 E = 7.775 (O - E) ² /E = 0.405	68 E = 57.939 (O - E) ² /E = 1.747	79 E = 87.034 (O - E) ² /E = 0.742	153
6.4	0 E = 0.248 (O - E) ² /E = 0.248	8 E = 7.674 (O - E) ² /E = 0.014	49 E = 57.182 (O - E) ² /E = 1.171	94 E = 85.897 (O - E) ² /E = 0.764	151
	1	31	231	347	610

Questions 6.1 - 6.4:

$$\chi^2 = 15.546$$

Degrees of freedom: $\nu = 9$ Critical value for χ^2 : P = 10%: 14.68Critical value for χ^2 : P = 0.5%: 16.92

Question 6 has therefore a statistically significant difference between the observed and the expected frequencies, although not particularly strong, with $0.1 > P < 0.05$.

2.6.5 Summary of the responses to Question 6

The results of Question 6, on the implementation of the design application, can now be summarised. See Figure 10 and Table 54.

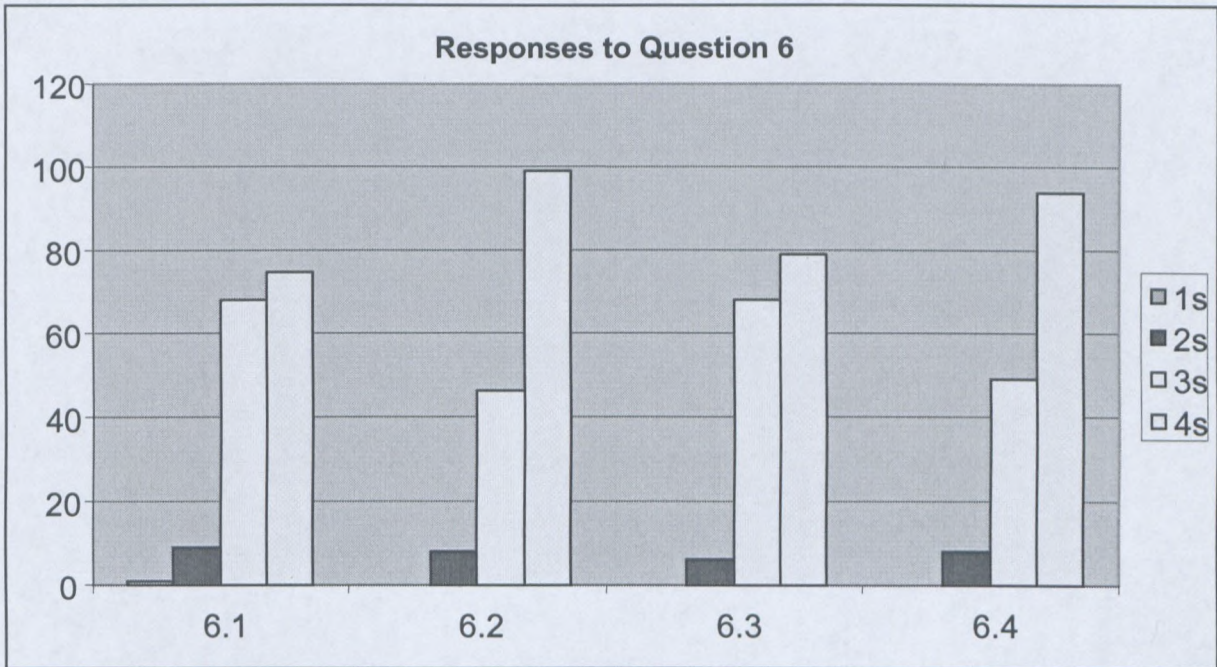


Figure 10 Responses to Question 6

Q	Topic	ave	rank	st d	M	result
6.1	Manager involved	3.42	4	0.53	4	Important
6.2	Part of overall business strategy	3.59	1	0.52	4	Important
6.3	Could involve other expertise	3.48	3	0.50	4	Important
6.4	Could be a long-term process	3.57	2	0.52	4	Important

The respondents felt the strongest about the importance for managers to know that the design application is to be implemented as an integral part of the overall business strategy. The importance of the manager's being involved on an ongoing basis received the least amount of support. It is, however, important to bear in mind that the differences are only significant on the 10% confidence level and not on the 5% confidence level. The dispersion of the opinions seems not to vary much and falls between a standard deviation of 0.50 to 0.53. It can therefore be concluded that all four matters are deemed important, but that the order of importance is not very significant.

2.7 Risk analysis of design

2.7.1 Responses to Question 7.1

Table 55 Responses to Question 7.1: Integrating a design application is a calculated risk						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that integrating a design application is a calculated risk.
n	0	7	50	97	154	
%	0%	4.5%	32.5%	62.0%	100%	
c	7 or 4.5%		147 or 94.5%			
Ave	3.58					
St dev	0.50					

2.7.2 Responses to Question 7.2

Table 56 Responses to Question 7.2: The designer cannot guarantee an increase in sales						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that the designer cannot guarantee an increase in sales.
n	1	10	49	90	150	
%	0.7%	6.7%	32.7%	60.0%	100.1%	
c	11 or 7.3%		139 or 92.7%			
Ave	3.52					
St dev	0.60					

2.7.3 Responses to Question 7.3

Table 57 Responses to Question 7.3: The designer becomes a partner in the risk						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that the designer becomes a partner in the risk.
n	1	14	52	86	153	
%	0.7%	9.1%	34.0%	56.2%	100%	
c	15 or 9.8%		138 or 90.2%			
Ave	3.46					
St dev	0.64					

2.7.4 Responses to Question 7.4

Table 58 Responses to Question 7.4: Proper research can lower the risk						
#	1	2	3	4	total	<i>Comments:</i> A strong majority of respondents felt that it was important for managers to know that proper research can lower the risk.
n	0	8	35	111	154	
%	0%	5.2%	22.7%	72.1%	100%	
c	8 or 5.2%		146 or 94.8%			
Ave	3.67					
St dev	0.50					

Significance test

Table 59 χ^2 -test for 7.1 to 7.4					
#	1	2	3	4	Tot
7.1	0 E = 0.504 (O - E)2/E = 0.504	7 E = 9.830 (O - E)2/E = 0.815	50 E = 46.881 (O - E)2/E = 0.208	97 E = 96.786 (O - E)2/E = 0.0005	154
7.2	1 E = 0.492 (O - E)2/E = 0.528	10 E = 9.574 (O - E)2/E = 0.019	49 E = 45.663 (O - E)2/E = 0.244	90 E = 94.272 (O - E)2/E = 0.194	150
7.3	1 E = 0.501 (O - E)2/E = 0.498	14 E = 9.766 (O - E)2/E = 1.836	52 E = 46.576 (O - E)2/E = 0.632	86 E = 96.157 (O - E)2/E = 1.073	153
7.4	0 E = 0.504 (O - E)2/E = 0.504	8 E = 9.830 (O - E)2/E = 0.341	35 E = 46.881 (O - E)2/E = 3.011	111 E = 96.786 (O - E)2/E = 2.088	154
	2	39	186	384	611

Questions 7.1 – 7.4:

$$\chi^2 = 12.492$$

Degrees of freedom: $\nu = 9$

Critical value for χ^2 : P = 10%: 14.68

Question 7 has therefore not a statistically significant difference between the observed and the expected frequencies, with $P < 0.1$.

2.7.5 Summary of the responses to Question 7

The responses to Question 7 can now be summarised. See Figure 11 and Table 60.

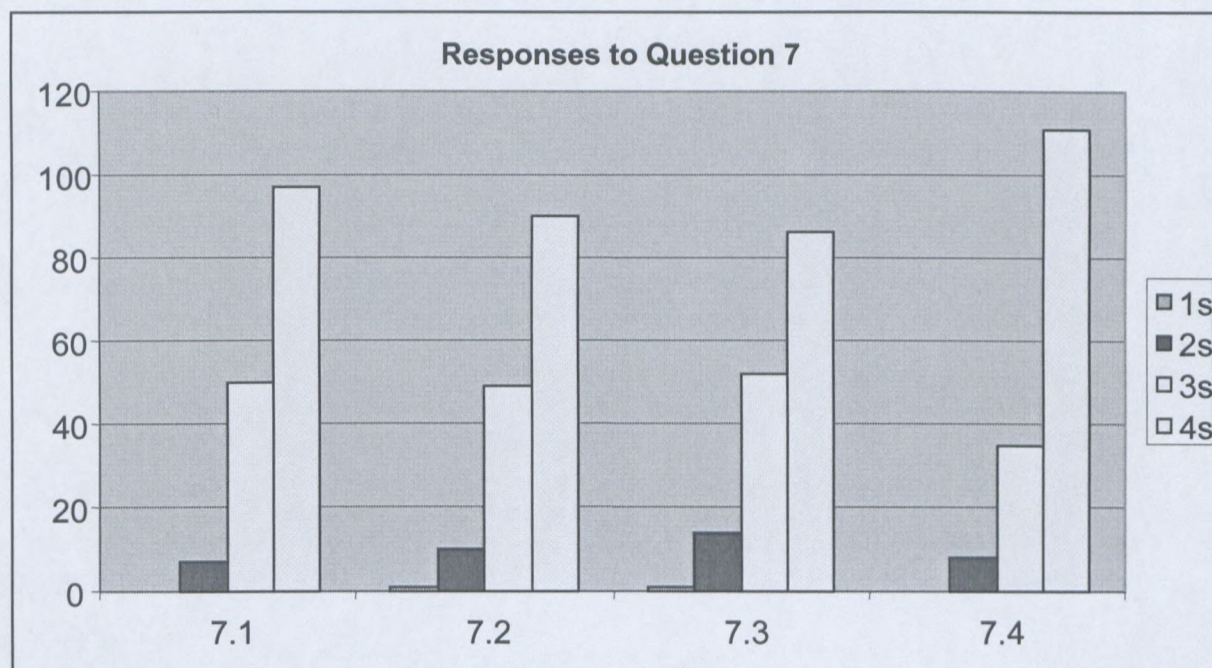


Figure 11 Responses to Question 7

Table 60 Summary of the results of Section 7

Q	Topic	ave	rank	st d	M	result
7.1	Integrating design is a calculated risk	3.58	1	0.50	4	Important
7.2	Designer cannot guarantee an increase in sales	3.52	2	0.60	4	Important
7.3	Designer becomes a partner in the risk	3.46	4	0.64	4	Important
7.4	Research can lower the risk	3.47	3	0.50	4	Important

The respondents felt that all four issues were important. With the mean and standard deviation so close to one another, the only valid deduction is that each issue is in the main equally important for the respondents.

2.8 Relationship between average and standard deviation

A very interesting relationship was observed between the average (mean) and the standard deviation. The correlation between the two was calculated at -0.9479 . Considering that correlations are expressed as a factor between -1.0 (strong negative), 0.0 (weak) and 1.0 (strong), it is clear that this is a very strong negative correlation. This means that the lower the average (indicating that the issue is unimportant), the higher the dispersion of opinions. The reverse is also true that the higher the average (indicating that the issue is important), the lower is the dispersion of opinions. When respondents indicated an issue as unimportant the disagreement was very high and when respondents indicated an issue as important the agreement was very high.

This phenomenon might be ascribed to the fact that many respondents opted to mark a 3 and 4 (indicating important or totally important) on the questionnaire. When some respondents indicated certain issues as unimportant (a 1 or 2 on the questionnaire), it created a high measure of dispersion when combined with those respondents who marked many 3s and 4s. Four returned questionnaires were disregarded, because there were 40 or more (more than 93%) 4s marked. An impression was formed that respondents saw the questionnaire as a wish list and did not really apply their minds. This impression was confirmed in informal discussions as well as a discussion on the PHD-Design discussion list. This is, however, just an impression and needs to be further researched.

2.9 Summary of the responses to the questionnaire

In this section the responses to the various questions were listed and analysed. The responses were divided into three categories:

- (a) Important: Issues indicated by the respondents that they were important for managers to know. They were selected based on an overwhelming majority or sometimes a small majority combined with a significance test which proved that the results were statistically significant.
- (b) Neutral: Issues for which the responses were a small majority indicating either important or unimportant. The majorities in all these instances were so small that they could not pass a significance test.
- (c) Issues indicated by the respondents as unimportant for managers to know. These issues either received a clear majority or passed a significance test.

In the light of the research question what managers need to know in order to manage the design research, only the responses in category (a) can be accepted. These results were discussed in a focus group, the topic of the next section.

Annexure F

Content Analysis

1 Introduction

This annexure displays the result of the Content analysis that led to the conclusions in the main body of the thesis.

2 Universities

2.1 University A

(a) Marketing course

First year

- Thinking about business
- Human Resource Management
- Microeconomics
- Macroeconomics
- Foundations for Information Systems
- Mathematics
- Statistics

Second year

- Financial Accounting
- Business Accounting
- Marketing
- Business Finance
- Business Law
- Economics
- Business Statistics
- Research and survey statistics

Third year

- Marketing
- Marketing Research
- Operations Management
- Professional Communication
- Advanced Micro and Macroeconomics
- Quantitative Methods in Economics
- Advanced Labour and Development Economics
- Public sector Economics

International Trade and Finance

Fourth year

Business Strategy

Marketing Honours

Marketing Project

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.2 University B

(a) Degree in Marketing

The core subjects are Marketing and Industrial Communication. Some of the outcomes, related to the completion of each unit, are:

Entrepreneurship:

Have a proper understanding of entrepreneurship and the critical success factors for new venture creation.

Understand the role of the entrepreneur and the importance of the entrepreneurial team in successful new venture creation.

Identify the resources needed and prepare a financial plan for a new venture.

Develop a business plan for their own opportunities.

Economics for Managers:

Understand how the economy works.

Explain how interest rates are determined, why there is an increase or decrease.

Explain how exchange rates are determined, why and when they can change.

Understand how the market forces of demand and supply interact to determine price and output.

Marketing

Having a proper understanding of the overall marketing management process and marketing environment.

Develop a marketing grid and positioning chart for a business.

Analyse the product and service portfolios of a business.

Have a proper understanding of the overall marketing plan.

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.3 University C

(a) Entrepreneurship

Entrepreneurship 3a

The objective of this module is to familiarise students with the behavioural aspects of entrepreneurship and key issues involved in establishing a small enterprise. The module also explains the role of various governmental and non-governmental support systems working for entrepreneurship development, classification of small business and status of entrepreneurship development.

Entrepreneurship 3b

The objective of this module is to teach students how to identify business opportunities and work towards starting their own business ventures. It also deals with start-up strategy formulation and business plan preparation. In this course the students will have to prepare their individual plans.

(b) Marketing

Marketing 3a

To develop an understanding of the theory and practice in consumer behaviour, advertising, retailing and contemporary issues in marketing South Africa. Global, database, relationship, and service marketing and commerce are studied.

Marketing 3b

To develop an understanding of the theory and practice of marketing strategy, marketing research and service marketing. Selected contemporary issues – such as creativity for marketing, ethics and e-commerce – are also included.

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity was studied as part of a subject, the emphasis was not strong enough to be

reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2..4 University D

(a) Business Management

The study of Business Management describes the role of the entrepreneur and manager in the business world. The studies include the principles of general management, marketing, operations management, financial management, purchasing management, human resources management, entrepreneurship, and strategic management. According to information received creativity forms a small part of the BCom degree.

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity was studied as part of a subject, the emphasis is not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.5 University E

(a) Marketing Management

Purpose: This course provides an understanding and analysis of the marketing environment; target markets; marketing research; and basics of strategic marketing variables.

Outcomes: The student will be able to:

- a) Explain the role of marketing in a business organisation.
- b) Demonstrate the importance of marketing research and an adequate marketing information system in the business sector.
- c) Use the strategic marketing variables in a business situation.
- d) Prepare a marketing plan.
- e) Distinguish between national and international marketing activities and techniques.

Topics: Marketing environment; selection and analysis of target markets; the importance of marketing research and marketing information systems; strategic marketing variables; product concepts; developing and managing products; pricing decisions and pricing policies; marketing distribution channels; wholesaling and retailing; distribution concepts; promotion concepts; the people concept in marketing management; and international marketing.

(b) Entrepreneurship and Business Opportunities

Purpose: This course provides an understanding of the concept of entrepreneurship and business opportunities, and includes the important small business management functions of planning, organising, leading and controlling.

Outcomes: The student will be able to:

- a) Distinguish between entrepreneurship, creativity and innovation.
- b) Conduct a feasibility study and draw up a business plan.
- c) Recognise business opportunities and conduct market research to determine the viability of a product.
- d) Compile a pro-forma income and expenditure statement, cash flow statement and balance sheet.
- e) Apply management principles in a small business context.

Topics: Introduction to the concept of entrepreneurship and business opportunities; differentiating between creativity and innovation; the management of a small business; general management issues and problems; the financial, marketing, purchasing, staffing, public relations, and administration functions in a small business.

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity and innovation was studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.6 University F*(a) Marketing Management***First year:**

General Management subjects

Second year:

Marketing Management

An overview of marketing

Analysing the market environment

Consumer decision-making

Information of marketing decision-making and marketing research

Segmenting and target markets

Positioning the firm and its products

Using relationship marketing to pursue customer satisfaction

Product decisions

Developing and managing products

Marketing channels and the role of intermediaries

The promotional strategy and marketing communication

Implementing promotional mix strategies

Pricing concepts and setting the right price

Putting it all together: The strategic marketing plan.

Marketing Communications Management

Overview of integrated marketing communications

Marketing communications process

Environmental regulatory issues in marketing communications

Ethical issues in marketing communications

The communications process and fundamentals of buying behaviour

Persuasion in marketing communications

New product adoption and marketing communications

Brand names, logos, packages and point-of-purchase materials

Overview of advertising management

Creative advertising strategy

Message appeals and endorsers in advertising

Analysis of advertising media

Media strategy

Assessing advertising effectiveness

Overview of sale promotion management

Direct marketing and database marketing

Public relations and sponsorship marketing

Personal selling fundamentals.

Third year:

Internet marketing strategy

Web business models

The nature of the online customer

Customer support and online quality

Contextualisation

Traffic and brand building

Privacy in an online environment

Internet marketing plans

(b) International marketing management and strategy

The strategic marketing management process

The emerging importance of international marketing

The international marketing environment

Cultural environment
 Economic environment
 Financial environment
 International political and legal environments
 International marketing entry strategies
 Exporting
 Franchising
 Licensing
 Direct investment
 Strategic alliances
 International marketing strategies
 Adaptation vs standardisation
 Pricing strategies
 Channels and distribution strategies
 Promotional strategies
 Logistics
 Marketing, organising, implementing, and control

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity and innovation was studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received, although mention was made about new product development.

2.7 University G

(a) Marketing Management (year 1 – 3)

Fundamentals of marketing
 Sales decisions
 Marketing of services
 Consumer behaviour
 Marketing research
 Distribution decisions
 Product decisions
 Price decisions
 Marketing communication
 Contemporary marketing issues
 Strategic marketing
 Other modules from Economics, Business Management, Accounting and Statistics must also be

included.

(b) Honours in Marketing

Research Methodology

Marketing of Services

Strategic Marketing

Research script

Direct Marketing

International Marketing

Business Marketing

The Management of e-Commerce and e-Business

Retail Marketing

Corporate Communication Management

International Communication

Development Communication

Branding and Visual Identity

Sport Marketing

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.8 University H

(a) Marketing Management

First level

Introduction to the Economic and Management Environment

Business Management

Economics

Accounting concepts, principles and procedures

Accounting reporting

Commercial law

English Communication for Business

Second level

General management

Marketing management
 Public relations
 Customer behaviour
 Labour relations management
 Microeconomics
 Human resource management
 Financial management
 Productions and operations management
 Purchasing management
 Introduction to entrepreneurship and small business management
 Risk management
 Real estate

Third level

Strategic management
 Relationship marketing
 Marketing research
 Product management
 Promotion management

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.9 University I

(a) Marketing Management

In today's world, marketing is probably one of the most important tasks in any organisation. On a daily basis individuals and businesses are engaged in various marketing activities such as product decisions, price determination, distribution of products/services as well as the introduction/creating awareness thereof.

(b) Entrepreneurship and Innovation

It could assist students to obtain an orientation of possibly establishing their own business in future and not strive to achieve the so-called work security in the form of a fixed appointment. Therefore it

allows the students to create own job opportunities but also to make creative contributions to other businesses. The subjects are:

Introduction to entrepreneurship

Small Business Management

Creativity and Innovation Management

Strategic and Corporate entrepreneurship (Intrapreneurship)

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity was studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.10 University J

(a) Entrepreneurship

Starting a Business (theory)

Starting a Business (practice)

Operating a Business

Harvesting the Enterprise

SME Consulting and Communication

Business Law for SMEs

Strategic Linkages for SMEs

SME Management

Global Markets and Exports

Information Management for SMEs

(b) Management

First year

Introduction to Business

General Management

Second year

Marketing Management

Financial and Analytical Techniques

Business Financing

Operations and Materials Management

Third year

Financial Management
 Retail and Services Marketing
 Industrial Relations
 Consulting and Communications
 Marketing and Communication
 Operations Management
 Management: Capita Selecta
 Strategic Management

(c) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.11 University K

(a) Marketing

Principles of Marketing II

An introduction to marketing management in the contemporary environment.

Market segmentation and target market analysis.

A survey of the integrative role played by marketing in organisation strategic planning.

Contemporary product/service, promotion, human resource, distribution and pricing problems and opportunities.

Analysing, planning, implementing and controlling the market function.

The importance of behavioural and structural market analysis.

Problem formulation and the research agency brief.

Understanding the marketing research environment.

A survey of sampling issues, research design and statistical analysis with an emphasis on analysing marketing data supplied by outside firms.

Promotional strategy II

A theoretical and practical approach to analysis, planning, controlling and implementing the marketing and communications programme.

The uses and misuses of advertising, public relations, sales management and sales promotion. Consumer behaviour theory forms the sound basis for discussions on information processing, creative strategy development and media management issues.

Issues such as organisational structure support, the focus on recruiting, organising, training and managing the sales force.

Marketing III

An extensive review and synthesis of behavioural science applications in marketing strategy development.

Consumer decision process, information processing, environmental influences and individual differences.

Organisational decision-making

Industrial goods and services, purchasing and materials management fundamentals and logistics.

The marketing mix.

Setting objectives, selecting and implementing strategies.

A critical examination of the integrative role of marketing in configuration, co-ordination and linkage decisions.

Market analysis, strategy and policy formulation techniques in the emerging globalised marketing environment.

Behavioural, structural, organisational resource and distinctive competency analysis techniques.

Extensive use of the case study method.

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity was studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.12 University L

(a) Management course

The management course establishes guidelines and principles to promote the efficient and effective performance of managers within business enterprises. In addition to management principles and management functions, this involves a study of the firm's major functional areas. Some of the fields of study are:

The environment of South African Business

A consideration of the political, economic, technological and social trends.

Principles of management

A study of the principles which are fundamental to efficient and effective management performance.

Marketing

A study of the principles and techniques which assist management in the satisfaction of consumer needs and wants through exchange processes.

Financial Management

A study of short-term and long-term investment and financing decisions.

Production Management

A study of the principles and techniques guiding management in the efficient conversion of raw materials into finished products.

Management of Human Resources

A study of individual behaviour, work group behaviour and industrial relations.

Strategic Management

A study of the relationship between the firm and its environment in the pursuit of its long-term and short-term goals.

While all the areas of management listed above are covered in some depth, the focus of this university was on marketing. Principles of Marketing are covered in depth in Management I and Management II, while topics such as Consumer Behaviour, Marketing Research, International Marketing, Service Marketing and Marketing Communications are covered in depth in Management III and Management IV.

(b) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2.13 University M*(a) Business Management 1A***Introduction to Marketing Management**

This module will provide learners with a global overview of Marketing Management as a functional management area and prepare them for the challenges of the South African business environment in a multicultural context. The purpose of this module was to provide the learner with intellectual competencies, practical skills and an understanding of marketing management with reference to the marketing environment, consumer behaviour, market segmentation, target market decision, market positioning and the marketing mix.

Personal selling

This module focuses on the role and function of personal selling. The module deals with the tasks of the sales person to satisfy consumer needs, to establish long-term relationships and to contribute to the profit objective of the organisation.

(b) Marketing 1B

Marketing research

The purpose of this module was to cover the range of decisions implicit in planning and executing marketing research. The model develops the intellectual competencies and practical skills of learners regarding the marketing research process.

(c) Marketing Management 2A

Consumer behaviour

This module focuses on the influence of consumer behaviour on the development and implementation of marketing strategies.

(d) Marketing Management 2B

Marketing planning and strategy

This module focuses on the development, evaluation and implementation of marketing strategies in business organisations.

(e) Conclusion

There was no reference made in the title of the subjects to the study of creativity or innovation. Although creativity could be studied as part of a subject, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline was not mentioned in any of the information received.

2 Universities of Technology / Technikons

Universities of Technology, or Technikons as they were known previously, offer a National Diploma, which means that the subjects are standardised for all participating Technikons. The subjects may be offered at different times (see Table 5.62), but they are all basically the same. A specific Technikon may not change more than 30% of the prescribed content.

(a) Marketing

The National Diploma Marketing, which is offered at all the Technikons, consists of the following subjects, with an indication of the year the subjects are offered:

Table E.64 Subjects offered in the ND Marketing course related to the year of study

Technikon	A	B	C	D	E	F	G	H	I	J
National Diploma subjects										
Marketing	1-3	1-3	1-3	*	1-3	1-3	1-3	1-3	1-3	1-3
Personal Selling	1	1	1	*	2	1	1	1	2	1
Accounting for Marketers	1	1	2	*	1	1	1	1	1	1
Mercantile Law	1	2	3	*	1	3	2	2	3	1
Communication in English	1	1	3	*	1	1	1	1	1	1
Communication in Afrikaans		1	3				1	1	1	
Consumer Behaviour	2	2	1	*	2	2	2	2	1	2
Quantitative Techniques	2	2	2	*	2	2	2	2	2	1
Economics	2	1	1	*	1	1	1	2	2	2
End user computing	2	1	1	*	2	2	2	1	1	2
Sales Management	3	3	2	*	3	3	3	3	3	3
Marketing Research	3	3	3	*	3	3	3	3	3	3
Advertising and Sales Promotion	3	2	2	*	3	2	3	3	2	2

B Tech subjects										
Advanced Marketing Finance	4	4	4			4	4	4	4	
Marketing	4	4	4			4	4	4	4	
Applied Marketing	4		4			4		4	4	
Economics	4	4	4				4		4	
Applied Promotion	4	4				4		4	4	
Marketing Research		4					4			
Quantitative Techniques							4		4	
* Exact year not specified										

(b) ND Small Business Management

Year one

Small Business Management I
Marketing I
Credit Control I
Communication I
Personal selling I

Year two

Small Business Management II
Marketing II
Administration Management II
Production Management II
Labour Relations and Law II

Year three

End user computing
Small Business Management III
Marketing III
Experiential Training

This course encourages creativity and innovation from an entrepreneurial point of view as the course covers various angles of the development of a business right from idea generation.

(c) B Tech Marketing

Advanced Marketing
Marketing
Applied Marketing
Economics
Applied Promotion

(d) Conclusion

There was no reference made in the title of the subjects about the study of creativity or innovation. Although innovation was studied as part of a subject in Small Business Management, the emphasis was not strong enough to be reflected in an official name of a subject. The design discipline, which was offered at most Technikons, was not mentioned in any of the information.

Annexure G

Testing the Framework

1 Introduction

This annexure displays the result of the testing of the framework that led to the conclusions in the main body of the thesis. During the academic year 2008, the approach of the model was followed by the fourth year students in Industrial Design. The design projects were submitted in partial fulfilment of the requirements for the degree Baccalaureus Technologiae in Industrial Design.

In all the projects design students were required to obtain additional knowledge. In most instances, this was explicit, through publications, as well as tacit through personal experience of the problem of suggested solutions.

Name	Titel	Short description	Knowledge used	Knowledge produced
W F Booyens	Creating an ergonomic workspace for cytotechnologists specific to their microscope tasks	The aim of the design project was to create an ergonomic workspace for cytotechnologists. Cytotechnologists are microscope workers who analyse or screen cell specimens presented to them in the form of slides which can be viewed under a microscope, As a result they are exposed to continuous static muscular work.	Cytology, the medical and scientific study of cells (Its most common application is the identification and diagnosis of cancers of various organs.) The functioning of a cytology laboratory, including the techniques, methods and the daily interaction of the cytotechnologists with the compound microscope within the context of their workstations. The technical nature and features of the compound microscope.	A comprehensive, more user friendly workstation, allowing cytotechnologists to work for longer hours at higher concentration levels.
C Grant	The Companion	Short description The goal was to make transportation of	Knowledge used Supporting equipment of the electric guitar,	Knowledge produced An all encompassing guitar case,

	<p>Guitar Case: Redesigning the electric guitar case to improve transportation of the equipment.</p>	<p>the electric guitar and all of its necessary equipment easier in order to increase the mobility of the electric guitarist. This could be achieved by combining the electric guitar case, the amplifier and the speaker into a single product.</p>	<p>i.e. amplifier, speaker/driver, lead, power cord and adapter; Setting up of the equipment; Sound production, speakers and amplifiers; Material technologies.</p>	<p>which housed all the elements needed to play the electric guitar.</p>
<p>A G Fakier</p>	<p>Designing an inexpensive sports car for the South African context</p>	<p>The objective was to produce an inexpensive sports car for the South African market that is able to challenge some of the bigger sports car manufacturers such as Lotus, Porsche and Audi. Parts will be sourced from local distributors and will be mainly Volkswagen and Ford parts. The car will be designed to house the 2008 VW polo GTi engine, which is a 1.8 liter 20 valve turbocharged engine.</p>	<p>Sport car features, such as safety and performance; Manufacturing of a sports car; Sport car manufacturers in South Africa; Consumer behaviour of the target market, i.e. sport car enthusiasts; Traffic laws and road traffic regulations.</p>	<p>Combining locally available elements and producing an economically viable sports car for the South African market,</p>

Name	Titel	Short description	Knowledge used	Knowledge produced
A Kankondi	Cleantouch. Enhancing personal hygiene for the visually impaired using public / unfamiliar facilities.	Visually impaired individuals can not assess the condition of ablation facilities with regards for example cleanliness, and as a result they are exposed to unhygienic conditions. The aim is to develop a working concept that can enhance the level of hygiene for visually impaired individuals using public ablation facilities.	Features and layout of ablation facilities; National Building Regulations, Buildings Standards Act (1977); South African Bureau of Standards (SABS) 0010 Code of Practice for the Application of the National Building Regulations (1990); Definitions of disability with reference to the medical and social models; Medical aspects and other effects and implications of visual impairment or disability; White paper on integrated National Disability Strategy 91997).	Producing a user friendly roll of paper gloves in a dispenser, that passes over a sanitising liquid. The gloves are easy to use to clean selected areas in ablation facilities.

Name	Title	Short description	Knowledge used	Knowledge produced
WF Booyens and H F Chilton	Creation of a product that re-establishes the links between the cultivation of food and its ultimate use by people living in urban settings.	The goal was to involve urbanites in a hands-on experience of cultivating their own edible plants while producing fresh healthy food and reduce waste.	Hydroponics systems; Growth mediums that can act as a soil replacement, e.g. perlite, rockwool, expanded clay; Cultivation of food and crop yielding plants; Genetically modified crops; Nutrients, and water retention; Relationship between humans and the cultivation of their own food; Therapeutic qualities of gardening; Trends towards globalisation, urbanisation, industrialisation and the agricultural industry.	A small-scale hydroponics system was developed to successfully grow edible plants within the constraints of the urban environment.
I Felmore	Septech. The monitoring and maintenance of a septic tank system	A large section of the South African population makes use of septic tanks. Over time, the layers get thicker, resulting in a blocked system. The aim of this project was to design a device that will operate from the septic tank to inform the owner of the status and levels of the septic tank.	Septic tank disposal systems, including the major problems of the current system; Current monitoring and measuring systems; Hygiene and safety; Bacteriological reactions; Ultrasonic sensors.	A monitoring device that measures the level in a septic tank and activated an alarm when attention is needed. It also reduces spilling of dangerous substances in the environment.

Name	Titel	Short description	Knowledge used	Knowledge produced
A Delen	Sound insulated drumming booth	Urbanisation led to densely populated areas with an increase potential of noise pollution. As a result musicians, who play loud instruments such as brass or drums, cannot play in the convenience and privacy of their homes without disturbing the neighbourhood.	<p>Physics of sound;</p> <p>Soundproofing methods and materials such as plaster board, hardboard MDF, mineral fibre board, Polyurethane foam, Mass Loaded Vinyl, Visco elastic polymers, or rubber;</p> <p>Methods of buildings and structures that contain sound well.</p>	An inexpensive compact sound proof cubicle.
W Oppermann	Snowsport Head Protection	The aim was to design a product that would more effectively prevent head injury in snows ports, primarily skiing and snowboarding.	<p>Consumer behaviour of the target market, such as the motivation and general behaviour of people participating in snow sports;</p> <p>Skiing as a sport;</p> <p>Ski related head injuries;</p> <p>Snowboard related head injuries;</p> <p>Level of protection required; Advances in material science and technology;</p> <p>Injury prevention measures;</p> <p>Science of impact absorption.</p>	Headgear that is more comfortable to wear, more ergonomic and will reduce injuries on impact.

Name	Titel	Short description	Knowledge used	Knowledge produced
W N Adendorff	Hybrid Bodyboard	The aim of the project was to improve bodyboards in order to increase performance and its durability in most conditions.	<p>Consumer behaviour, such as classification of bodyboarders in terms of sport personality;</p> <p>Types of environments the board are used in;</p> <p>Characteristics of bodyboards, i.a. deterioration, performance properties; Advances in materials.</p>	An improved bodyboard that increases performance with better durability.
W Momberg	Mobile animal stretcher unit	The aim is to design a foldable lightweight stretcher, specifically used to transport an animal to ease everyday operation by SPCA staff and other veterinary clinic staff. Such a stretcher, which is needed by all animal welfare, does not exist at the moment.	<p>Animal injuries and illnesses;</p> <p>Animal behaviour;</p> <p>Manufacturing with aluminium;</p> <p>Research on substituting products (make shift stretchers) being used;</p> <p>Strengths and weaknesses of stretchers;</p> <p>Different areas in which an animal stretcher is to be used.</p>	A foldable lightweight animal stretcher.

Name	Titel	Short description	Knowledge used	Knowledge produced
T Raad	Improving the sustainability of home oral hygiene products as well as the environmental impact of their packaging waste.	The aim of the project was to design a more sustainable oral hygiene product, not only to reduce wastage of toothbrushes, toothpaste and dental floss, which have a limited life span, but also to improve the overall oral hygiene routine.	Oral hygiene; Consumer behaviour during oral hygiene; Life cycle of toothbrushes, toothpaste and dental floss, their functions, how and with what materials they are made; Packaging of toothbrushes, toothpaste and dental floss.	An all in one toothbrush, housing its own toothpaste and dental floss. The parts can be replaced rather than the whole instrument.
G Hugo	Bakseat.	The aim of the project was to design a seating system for passengers in the load area of a bakkie (pick up truck) that effectively improves the safety of the passengers and caters for the practical needs of the users.	Design and engineering for the safety of automobile passengers; Most common causes of injury to passengers in the load area of a bakkie; Road safety; South African National Road Traffic Act; Consumer behaviour of practical needs of passengers in the load area of a bakkie.	An ergonomically designed and safe seat, that is easy to remove when the space is required.

Name	Titel	Short description	Knowledge used	Knowledge produced
A Voigt	Water problems in rural and informal South African communities.	The aim of the project was to make water collection points more user friendly and to create an area that is hygienic and minimises water wastage.	Water distribution; Water wastage ; Ways to combat water wastage; Hygiene and sanitation.	A water distribution that does not leak and keeps the surrounding area dry.
V Bougas	Improving the vaginal speculum so that its operation is efficient and user friendly.	The current products are uncomfortable for both gynaecologists and their patients.	Elements of Gynaecology, including preventative health care for women; Consumer behaviour of gynaecologists and patients; Product knowledge of existing specula; Material properties of potential new specula; Laboratory testing techniques.	A proposed speculum that eliminates the use of extra tools, such as light sources and lubrication, as well as improving the mechanism. The use of the speculum will be less time consuming and more efficient for the gynaecologist, whilst it still ensures a more comfortable examination for the patient.
T Richet	Furniture for single room dwellers	The aim of the project was to discover how a family of furniture might be designed to optimise space, and to support to the lifestyle of people in single room living conditions.	Consumer behaviour of a single room dweller, including lifestyle, utilisation of space and personal environment; Domestic ergonomics, including storage solutions; Lighting, including differences between artificial and natural lighting, psychological effects of lighting, etc.	Ergonomically friendly multi-purpose furniture that fits in with modern living.

Name	Titel	Short description	Knowledge used	Knowledge produced
N Harmse and D Snetler	Designing suitable equipment for public playgrounds in Cape Town, fostering safe play in child development	The aim of the project was to encourage children to use outdoor playing environments created by public playgrounds and to reduce the risk of injuries	<p>Elements of Anthropology;</p> <p>Play theories;</p> <p>Elements of play;</p> <p>Ergonomic study;</p> <p>Occupational therapy (in the context of functions of play);</p> <p>A study of existing and contemporary public playgrounds and equipment;</p> <p>Safety concerns surrounding the use of public playgrounds;</p> <p>Consumer behaviour of target market, for example children and parent's needs;</p> <p>UN Convention on the Rights of the Child.</p>	New trendy and safe outdoor playing facilities.
J Odell	To redesign the bucket/tub bath using universal design principles to make bathing/personal hygiene more accessible to the whole of South Africa	Although bathing is an important part of personal hygiene, less than 50% of SA population have access to piped water in their homes. The aim of the project was to develop a cost effective solution to the problem of bathing in SA	<p>Transportation of water;</p> <p>Heating water for bathing;</p> <p>Personal hygiene, including the bathing process;</p> <p>Disposal of dirty water;</p> <p>Ergonomics.</p>	A new bath that making bathing easier and keeps water warm for a longer time period.

Name	Title	Short description	Knowledge used	Knowledge produced
W Momberg	Access by Design: Infra-Red Wall light switch unit	Current light switches are not accessible to people with disabilities. The aim is to design a touch switch that provides barrier free access to a room.	Technology of a touch switch; Infra red and radio frequency and its applications; Electricity current, stream breakers; Research and analysis of available light switches; Different disabilities and its impairments, e.g. spinal cord injury, damage to the cerebrum or brain stem.	A new switch whereby individuals in a wheel chair would be able to switch the light on by breaking an infra red beam that reaches the floor on a 90 degree angle.

CAPE PENINSULA
UNIVERSITY OF TECHNOLOGY

