

AN INVESTIGATION INTO EUROPEAN DESIGN MANAGEMENT CAPABILITY ASSESSMENT

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This dissertation is being submitted in fulfilment for the requirements for the degree of Doctor of Philosophy for Cardiff Metropolitan University

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DECLARATION

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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ABSTRACT

This thesis investigates factors which promote design management success and considers how design management capabilities in businesses and organisations can be assessed. The investigation is based on exploration and identification of important factors for the successful use of design management. A review of the literature confirms the assimilation between the design process and NPD process success factor research, resulting in the development of the concept design management. A comprehensive list of the nine most frequently referenced NPD process success factors is derived from 64 research studies.

A contextual review confirms the validity of the Design Management Staircase Model, the only known model to evaluate design management capabilities. The validity of the nine factors for promoting design management success is analysed based on a dataset gathered through the Design Management Europe (DME) Award. This validity is confirmed through an analysis of qualitative data gathered with DME Award entrants. The third part of the analysis builds the basis for a comparison between the Design Management Staircase Model and the NPD process success factors. This investigation provides insight into the design management capabilities of companies, identifying which factors are of greatest importance for design management capability assessment. Further, the analysis demonstrates that a complete process more important than any single factor.

The PhD contributes to new knowledge regarding the importance of design management to business resourcing, a meta-analysis that reveals the nine most important factors for design management, the importance of a process driven

approach to factor implementation, and a set of recommendations for the development of an improved design management capability assessment model.

The underlying message of the results in this PhD thesis is that successful design management capabilities are highly dependent on the right expertise and building a complete process which consists of nine success factors.

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It is possible that something in this thesis is not perfect or others may be missing. They are my failures. But the good parts are there because all these people put their efforts into this thesis, and they are the ones to be applauded.

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CHAPTER ONE

1. INTRODUCTION

1.1 CONTEXTUAL BACKGROUND

Since 2007, The National Centre for Product Design + Development Research (PDR) at Cardiff Metropolitan University has been one of the partner organisations of the Design Management Europe (DME) Award. Since November 2012, PDR has been the leading partner of the DME Award, holding two of currently seven DME Award board positions (Gavin Cawood – President, Sebastian Hesselmann – Technical Officer). The key objective of the partners is the organisation of the annual DME Award competition. The DME Award is the only European business award dedicated to the management of design. As part of the registration process for the DME Award, participants are required to fill out a research questionnaire. This questionnaire contains 30 questions providing detailed insight into the design approach of the participants. Over eight editions of the DME Award, 486 questionnaires of primarily European businesses of all sizes and sectors were gathered, representing the largest and most comprehensive database of its kind. Since 2009, PDR has been fulfilling the role of the research partner within the DME Award partners, evaluating the gathered data and undertaking further research into the field of design management. In order to support this role, PDR was awarded funding for one PhD position to investigate the effectiveness of European design management implementation informed by the

data gathered through the DME Award. This thesis is one of the outcomes of this investigation.

1.2 BACKGROUND

Design is good for business. This understanding has become more and more the focus and the reality in academic research, but also foremost in industry. The discipline of design has been undergoing a transformation from a discipline concerned with aesthetics to an imperative for innovation, differentiation and economic success.

Successful executives should treat design as more than a finishing discipline that simply improves products' aesthetics. Instead, design should influence every aspect of customers' experiences (Vella, 2008).

Numerous initiatives and research projects have been trying to demonstrate the impact of design on performance, particularly economic, and promote the awareness of the benefits of design, as illustrated in the Design Council's 'fact-finder' report (2007):

Shares in design-led businesses have outperformed the FTSE 100 by more than 200% over the past decade.

For every £100 a design alert business spends on design, turnover increases by £225.

Businesses that add value through design see a greater impact on business performance than the rest (Design Council, 2007, p. 4).

Industry now recognises the importance of design and utilises and integrates it in various different areas. It is recognised as an important tool for technological and non-technological, socially responsible and environmentally sustainable, innovation, or it is simply utilised as a differentiator in the market place.

Design has also increasingly been recognised on a national and European policy level. By 2014 design had become an integral part of national innovation policies in 15 out of 28 European Union member states (Whicher, 2014). Design promotion activities exist in all European member states. For the first time in 2009 the European Commission had a public consultation on design as a driver of user-centred innovation. Following this, in the same year the Competitiveness Council recognised design as a source to gain a competitive advantage. In 2010, the European Commission included design in EU policy for the first time in the 'Innovation Union'. Since then, the European Commission has funded various design initiatives and projects (Whicher, 2014). Both the increasing recognition and inclusion of design in national and EU policies illustrate the increased recognition of the importance of design for the European economy. However, despite the growing interest and recognition in the economy and politics, research and knowledge on how to manage design – or design management – is still relatively limited and diverse in focus (e.g. Chiva and Alegre, 2009, Erichsen and Christensen, 2013, Vazquez and Bruce, 2002). Despite a growing number of outstanding case studies for the successful utilisation and integration of design, a particular lack of knowledge exists in assessing the impact of design management on business performance. Furthermore, it remains unclear what design and business capabilities have to be developed and utilised to allow the successful application of the concept of design management. Hence in 2009, the

European Commission identified two major barriers for the better use of design. The biggest barrier was identified as the lack of awareness of the potential of design in various areas, closely followed by a 'lack of knowledge and tools to evaluate the rate of return on design investment' (European Commission, 2009). Following this identified lack of knowledge and tools to evaluate the rate of return on design investment, Kootstra developed the Design Management Staircase Model as part of the DME Award (Kootstra, 2009). The DME Award was initiated as part of the two-year Award for design management Innovating and Reinforcing Enterprises (ADMIRE) project in the European PRO-INNO programme of the Directorate-General for Enterprise and Industry of the European Commission.

Despite both the growing acceptance of design, and the lack of knowledge and tools to assess design performance, at the time of writing the Design Management Staircase Model remains the only model aimed at explicitly assessing design management capabilities of businesses and organisations.

1.3 AIM

In light of this, it is the aim of the PhD research to improve the current knowledge in the field of design management capability assessment in businesses and organisations. This is achieved through an exploration and identification of important factors for successful use of design management. Based on a review of the Design Management Staircase Model it is explored how the identified success factors for design management can inform and improve current design management capability assessment.

1.4 STRUCTURE

Figure 1.1 provides an overview of the chapter structure

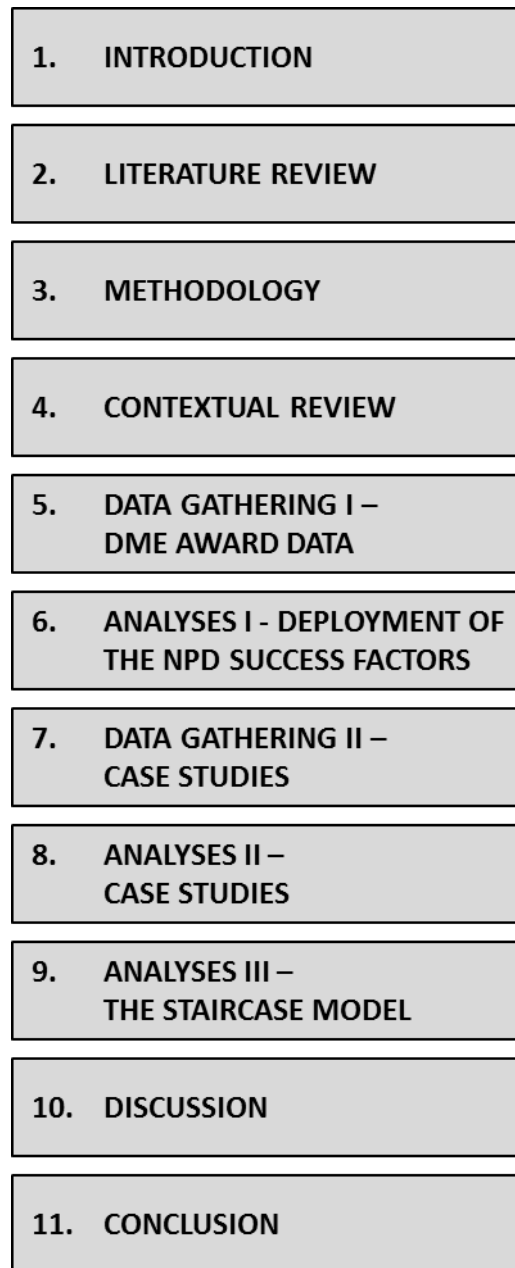


Figure 1.1: Thesis chapter structure

- **CHAPTER 1: INTRODUCTION** – provides an overview of the research undertaken in the thesis. It also specifies the research problem, the motivation and intended contribution to knowledge.
- **CHAPTER 2: LITERATURE REVIEW** – sets the theoretical framework and scope of the study. A literature review on the evolution of design

management and a systematic literature review on the evolution of new product development process research are performed. Furthermore, a comprehensive list of most frequently referenced NPD process success factors is derived from the literature. It is argued that the NPD process success factors can be equally used for the concept of design management as a success predictor.

- **CHAPTER 3: METHODOLOGY** – sets out the methodology development of the study. This includes establishing the general research aim, the subordinated research objectives, research approach and design. Furthermore, the methodological background for the literature and contextual review, the case study development and the case study analyses are developed.
- **CHAPTER 4: CONTEXTUAL REVIEW** – continues to set the theoretical framework and scope for the study. The purpose of the chapter is to introduce the origins and functions of the Design Management Staircase Model. The following review of the functionality of the model includes a critical investigation of the Design Management Staircase Model structure and its underlying questionnaire. Results show that the Design Management Staircase Model is largely built upon three major sources: The Design Atlas, The Design Process Audit and the Danish Design Ladder. The assessments of the findings lead to the elaboration of the research question for this study.
- **CHAPTER 5: DATA GATHERING I – DME AWARD DATA** – introduces the data gathered via the Design Management Europe (DME) Award.
- **CHAPTER 6: ANALYSES I – DEPLOYMENT OF THE NPD SUCCESS FACTORS** – sets out to explore the deployment of the nine NPD process success factors based on the DME Award dataset. Corresponding questions from the DME Award questionnaire to the nine NPD process success factors are identified, and a ranking system to calculate the effective utilisation

of the NPD process success factors is established. Subsequently, the effective utilisation of the nine NPD process success factors is analysed.

- **CHAPTER 7: DATA GATHERING II – CASE STUDIES** – introduces the second data-gathering phase – semi-structured interviews with previous DME Award entrants. It describes the content development for the semi-structured interview guide, the participant recruitment process, and introduces each participant.
- **CHAPTER 8: ANALYSES II – CASE STUDIES** – forms the second analysis chapter, the analysis of the semi-structured interviews and questionnaires. The chapter provides the coding structure for the pilot interview and case studies. Furthermore, it presents the results of the individual case studies and a cross-case analysis.
- **CHAPTER 9: ANALYSES III – THE STAIRCASE MODEL** – addresses the analyses of the Design Management Staircase Model. This chapter aims to provide insight into the design management capabilities of the dataset based on the Design Management Staircase Model and analysis of the functionality of the model itself.
- **CHAPTER 10: DISCUSSION** – discusses the key research findings of the different chapters, paving the way for the conclusion.
- **CHAPTER 11: CONCLUSION** – presents the conclusions drawn from the research undertaken in this thesis by answering the presented research questions and highlighting new contributions to knowledge. It will reflect on the weaknesses and limitations of the research and set out recommendations for future research to expand on the results.

CHAPTER TWO

2. LITERATURE REVIEW

This chapter reviews the literature to set the theoretical framework and scope of the study. A literature review on the evolution of design management is conducted. Subsequently, a systematic literature review on the evolution of new product development process research from 1974 to 2009 is performed. Furthermore, a comprehensive list of most frequently referenced NPD process success factors is derived from the literature. It is argued that the NPD process success factors can be equally used as success predictors for design management.

2.1 INTRODUCTION

The particular focus of the research is the impact of design management on business performance, and what design management capabilities have to be developed to ensure a successful application of the concept of design management. Two particular research fields emerged: Design management and new product development process research.

In his book 'Design Management' Farr (1966) described for the first time how increasing demands and tasks from the design discipline led to the occurrence of what he described as 'design management', and laid the foundation for the

development of a new discipline. Over 40 years later, McBride (2007) described design management as a fully established discipline in the academic and business world alike. Several authors show that good industrial design and design effectiveness can contribute to business financial performance (e.g. Gemser and Leenders, 2001, Hertenstein et al., 2005). Furthermore, Gemser and Leenders (2001) suggest that the impact of design on business performance depends on the skills and talent of the employed designers. It has been postulated that design management is a central aspect of the impact of design on business performance. Chiva and Alegre (2009) confirmed that design management influences business performance and plays a mediating role between investment into design and design performance. Nevertheless, research in the field of design management is still limited in its scope and often lacking a particular focus (e.g. Chiva and Alegre, 2009, Erichsen and Christensen, 2013, Vazquez and Bruce, 2002). Despite Chiva and Alegre's study, a particular lack of academic research exists in assessing the impact of design management on business performance. Furthermore, it remains unclear what design and business capabilities have to be developed and utilised for the successful application of the concept of design management. The only existing model to assess businesses' design management capabilities – the Design Management Staircase Model – was developed by Kootstra (2009) as part of the DME Award. The model aims to enable European businesses to assess and improve their design management capabilities in order to increase their effective use of design and improve their competitive edge and business success. In spite of this, the rationale for the Design Management Staircase Model has never received any academic interrogation, leaving the model open to criticism regarding its validity and usability.

An initial literature review into new product development (NPD) process research indicated that the design process is one part of the NPD process, and that the concept design management had its origins in the NPD process. This evolution arose out of two influential findings. Firstly, research emerged which demonstrated that the structure and management of the NPD processes, and the factors included within it, influenced business success. Secondly, the importance of good design as a contributor to success is widely acknowledged. The NPD process and design management follow the same pathway of factors. However, the discriminating factor between the two is that design management is the intangible, cohesive element for all factors and activities. Thus it can be argued that the key to successful design management, and which capabilities need to be developed, lies in the structure and scope of the NPD process. Various research studies have analysed the success factors underlying the NPD process (e.g. Balbontin et al., 1999, Cooper, 1979a, Cooper, 1980, Cooper and Kleinschmidt, 1987c, Cooper and Kleinschmidt, 1993b). The application of these NPD process success factors have been proven to contribute to successful product outcomes.

However, in the existing literature there is a lack of similar research studies on design management success factors. A number of studies and tools aim to assess the design process, such as the Design Atlas and the Design Process Audit (Moultrie and Fraser, 2004, Preddy and Conte, 2000). However, these studies fall short in capturing design management capabilities but are rather aimed at the design process. For example the Design Atlas fails to explain why the factors considered in the model are considered as important assessment criteria, as there is no evidence of empirical research to substantiate the tool (Preddy and Conte, 2000).

Further design or design management models exist and can be roughly categorised into the following:

1. Design management models assessing the function of design within organisations

This category includes Design or design management models such as the Danish Design Ladder. The Design Ladder classifies the function of design in organisations into four different levels. The higher an organisation is placed on the ladder, the more strategically design is utilised in the organisation (Ramlau and Melander, 2004). However, the Design Ladder does not provide any insight as to how organisations can improve their design integration to achieve the next level. Furthermore, the model focuses specifically on 'design levels' rather than on 'design management levels' thus ignoring important management implications.

2. Models highlighting the value and benefits of design or design management

In addition, a range of attempts have been made to highlight the value and benefits of design when implementing good design practice (e.g. Hayes, 1990, Mozota, 2006). Mozota (2006) found that design creates value through increasing customer value, improving internal business processes, and providing strategic value for the organisation. Hayes (1990) found that design has a particular impact as a facilitator, as a differentiator, as an integrator, and as a communicator.

However, both areas of design or design management models do not provide adequate methods to assess design management capabilities of organisations and businesses. Consequentially, it might be argued that without substantial research on design management success factors there is little basis for the development of

reliable design management assessment models and tools. However, design management is closely related to the NPD process; therefore the question might be asked if the NPD process success factors can equally be used as success predictors for design management. If so, this also provides the opportunity to explore how such factors are recognised within the Design Management Staircase Model.

Hence, this literature review concentrates on the following aspects:

- The evolution of the concept of design management
- The evolution of NPD process success factor research
- Establishing a comprehensive list of NPD process success factors from the literature to inform an analytical framework for assessing design management models.

The literature review on the evolution of the concept of design management and the NPD process success factor research will confirm the assimilation between the design process and NPD success factor research, resulting in the development of the concept design management. Consequently, it is hypothesised that NPD process success factors equally influence the success of project outcomes when using design management. A comprehensive list of the most frequently referenced NPD process success factors is derived from 64 research studies. This list opens the pathway into further research on design management success factors.

2.2 DESIGN MANAGEMENT

The new product development process has a complementary sub process known as the design process. In contrast to the NPD process, which describes the entire process, from idea conception to marketable product, the design process describes

the creative activities conducted in order to progress a company's business goals (Moultrie et al., 2006). Over the last nine decades, the design process has gone through significant changes from its point as a mere idea of integrating design into the development process to what is now considered the design management discipline.

Farr (1966) noticed a change in the industry caused by increasingly complex demands on the design function. Different design subjects had evolved with specialised designers for each field, demanding more specialised knowledge as the demands of industry grew. According to Farr (1966), these developments made it necessary to coordinate the work of designers. Thus Farr conceptualised the discipline of design management and the role of a Design Manager. Farr defines design management as:

'...the function of defining a design problem, finding the most suitable designer, and making it possible for him to solve it on time and within the agreed budget.' (Farr, 1966, p. 3)

Despite the growing demand for specialised design functions, this role was still limited in scope. A Design Manager was seen only as necessary whenever new designs were developed. Therefore, this position was typically filled by an external design coordination expert who managed the different design functions within a company. Within the boundaries of design function, a Design Manager was responsible for acquiring all necessary information for the design project, compiling a design team, setting budgets and timeframes and driving the design project to the prototype stage (Farr, 1966). In order to ensure an unproblematic and smooth project delivery, Farr (1966) recommended that the Design Manager directly reports to the

managing director of the company. Furthermore, for a Design Manager it was seen as necessary to possess a very particular skillset and significant knowledge in various fields. This role was mainly concerned with problem-solving, planning and coordinating tasks. This required in-depth knowledge about the industry, the design discipline and consumer research, and a technical understanding of processes and materials (Farr, 1966).

One year later, Archer (1967) argued that a wider approach has to be taken in order to take full advantage of new designs. In particular, the strategy for design needed to be developed and considered. This included the place of the product in the market, pricing of the product but also questions of the development, for example tooling costs or the extent of testing the product. He claimed that these are predominantly questions concerning the management and marketing department of every business and not the design department. Nevertheless, he declared that the answers to the questions both affect the design but were also affected by the design function. Hence, he highlighted the need to include basic design education as part of a general management education (Archer, 1967). In difference to Farr (1966), Archer (1967) did not see the need for a dedicated Design Manager to manage the design function as he claimed that this role should be fulfilled by the general management. But at the same time he recognised that the management of design needs to be integrated into general business management as the design function impacts management decisions and vice versa. Similarly, Gorb and Dumas (1987) stated that design is predominantly concerned with the external appearances of products, for example style and colour, but also needs to take into consideration technical, marketing, engineering and production resources and restraints. Therefore, Gorb and Dumas (1987) defined

design not as a function but as a process that is fully integrated into the organisational and management structures:

‘... a course of action for the development of an artefact or a system of artefacts; including the series of organisational activities required to achieve that development.’ (Gorb and Dumas, 1987, p.54)

Nevertheless, they also identified that large parts of the design process were not recognised as such, leading to gaps in the design management process (Gorb and Dumas, 1987).

Oakley (1984) conducted a study on the place of design within organisations. He identified specific management and leadership skills that characterised successful design managers and that a Design Manager has a crucial role for success. The primary responsibility of the Design Manager was described as maintaining a good working relationship within the design team and with all other departments of the business and building the right teams with the appropriate resources. Thereby, Oakley (1984) described the role of the Design Manager similar to Farr (1966) almost 20 years earlier. However, in difference to Farr, the Design Manager was not an external specialist who directs the design function when needed. In fact, Oakley (1984) extended the responsibilities of a Design Manager to developing a product strategy and possessing managerial knowledge to ensure a design integration into the business structures. And while Archer (1967) still claimed that the management needs to acquire basic design knowledge, Oakley (1984) postulated that the Design Manager acquires management skills to ensure a full integration of design as an

interdisciplinary process into the organisational structures as described by Gorb and Dumas (1987).

Nearly half a century after the introduction by Farr (1966), design management has evolved to an independent and recognised business and academic discipline (McBride, 2007). In 1976 the London Business School included design into their MBA programme and has continued to teach design as an integral part of the programme. Also, industry has been showing a growing interest in the contributions of design to product and business success, propelled by governmental design support programmes, in particular in Great Britain (Gorb and Dumas, 1987). However, this professional and academic field is still emerging and evolving and studies about the contributions of design to commercial success have remained largely anecdotal (Gorb and Dumas, 1987, McBride, 2007, Vazquez and Bruce, 2002). For instance, Turner (2000) claimed through experiences at Heathrow Airport Holdings (formerly BAA) that the integration between business and design is still difficult to achieve and often incomplete. In order to work to its full potential, design has to be part of the 'DNA' of the business. It needs to be instilled from top management to all other employees – all need to be aware and supportive. Similarly, Stamm (2004) describes the collaboration between managers and designers and the acceptance of design as challenging and a major barrier for design in business life.

Design and the understanding and application of design has significantly changed over the last century, as illustrated by Perks et al. (2005). It was only in the period from the 1920s to the 1950s that design emerged as a separate discipline, propelled by an increased demand for consumer goods and visually appealing products. According to Perks et al. (2005), it was not until the following decade that design

became a profession with specialised design disciplines as portrayed by Farr. During the 1980s, design was predominantly perceived as a styling activity and was commonly affiliated to particular designer brands (Perks et al., 2005). In the 1990s, design was considered as one of the factors within new product development. It was only integrated within the stages of the NPD process that were associated with design. Design was the final step that made the product 'presentable' to the market (Perks et al., 2005). In the early 2000s, design was increasingly considered as a leading factor within the NPD process. A highly competitive industry results in the need for creativity and innovation in order to maintain and develop competitive advantages against businesses in the same niche. Design propels innovation and is the supportive muse throughout product development. In addition, designers help direct tasks across a vast breadth of functional activities. Giving designers a more fundamental role can enhance the entire product development process, creating a more synergistic versus individualistic environment (Perks et al., 2005). This was a remarkable transformation in the role of design within the NPD process as it not only leads product development, but is also a critical sub-process within it. The importance of design in the product development process was highlighted by Hertenstein et al. (2005). As a result, it was discovered that the use of design is strongly associated with better financial performance in various ways, e.g. higher return on sales, higher return on assets, higher growth rates for sales, net income and operating cash flow (Hertenstein et al., 2005). These findings clearly demonstrate that design is a powerful sub-process in product development and lead to the conclusion that its positive effects are magnified once integrated within the development process. However, once a part of the process, it becomes necessary to

implement management skills such as motivation and persuasion, relationship management and negotiation, and the ability to market a product effectively (Perks et al., 2005).

Due to the importance of effective management of the design process, the concept of 'design management' arose. Design management encompasses steps that involve the creation and augmentation of managerial and strategic decisions:

'Design Management is the effective deployment by line managers of the design resources available to a company in order to help the company achieve its objectives.' (in Mozota, 2003, p. 70)

This discipline oversees and directs a company's creativity and manages the company itself in accordance with their design principles. Through the discovery and conveyance of the mode in which design can add to the value of business strategy, it fulfils the need to manage staff and other financial resources (Mozota, 2003). Most importantly, the coordination with other managerial functions highly influences the effectiveness of the design management process. Through the assimilation of design management within NPD, product development and the generation of positive customer interaction are simplified. Therefore, it can be argued that it is essential that design management is a component of a company's working strategy (Montana et al., 2007). In summary, design management is the 'management portion' of the new product development process that functions under the consideration of design principles. Hence, McBride (2007) describes design management as:

'...design-minded leadership. It is the bridge between design and business.' (McBride, 2007, p.22)

2.3 THE NEW PRODUCT DEVELOPMENT PROCESS

The main challenge for every business worldwide is to maintain their competitiveness. In a steadily changing internal and external environment with technological changes and the evolution of customer needs, companies are forced to satisfy the new conditions in the market place (Balbontin et al., 1999). It is widely accepted that continuous innovation is necessary in order to maintain a competitive edge and to respond to constant changes (Brentani, 2000). According to Baregheh et al. (2009), innovation is defined as:

'...the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.' (Baregheh et al., 2009, p. 1334)

Therefore, innovation is primarily concerned with the development process of new products and services. Thus Baregheh et al. (2009) argue that developing and marketing new products is the most effective way to respond to the constant changes with which all businesses are faced. With the overall goal of contributing to the business objectives, the development and marketing of new products can ensure the drive of businesses by maintaining their customers' satisfaction and therefore sustaining the business profitability, growth and success. In short, the development of new products is essential to the survival of every business. But, new product development is also afflicted with high risks (Brentani, 2000). Crawford and Benedetto (2003) state that about 40% of new products fail in the market place,

which highlights a need for understanding how to reduce costs for new product development and how to increase success rates.

New product development encompasses the development and design of novel goods and services. In addition, once the end product is achieved, this 'item' needs to be marketed to the public. In order to get from point A to point Z, there is a methodology that should be followed (Brentani, 2000). Ideally, these methods should incorporate solutions that are most applicable to the individual business. The NPD process in its most basic definition is:

'...the entire set of activities required to bring a new concept to a state of market readiness...including everything from the initial inspiring new product vision, to business case analysis activities, marketing efforts, technical engineering design activities, development of manufacturing plans, and the validation of the product design to conform to these plans, through the development of the distribution channels for marketing and introducing the product.' (Otto and Wood, 2001, p. 5)

As noted above, major research on the NPD process was undertaken in the 1980s to the early 1990s. During this period, specific NPD process factors were identified and tested to discriminate which particular factors were deemed critical for success. However, the first major research studies on the NPD process had already been carried out during the mid-1970s. In one of the earliest studies, Chakrabarti (1974) identified the major importance of a product champion. This product champion drives product development and possesses a particular skill set in order to fulfil this

role effectively. A product champion should have technical competency and a deep understanding of both the market and the company. They are also required to show a degree of aggression in order to drive new product development from the beginning to end. This finding gives the first hints that a certain level of management competence is necessary to drive successful new product development. However, in the same year, Szakasits (1974) undertook a major research study on the Hungarian electronics industry. Independent of Chakrabarti's findings, he identified a range of ten factors as being important for the success of a new product. The ten examined factors are either operational factors, such as a technical assessment, or knowledge related, such as employing experienced engineers in the development process. Similarly, Jervis (1975) discovered a set of market-oriented, resource, technical and organisational factors relating to project success. All his identified factors were also operational-type factors or knowledge related. Neither of these studies demonstrated any evidence that management competence to drive new product development is necessary, which tended to refute the findings of Chakrabarti (1974). In fact, both studies highlighted that it is most important to undertake a set of operational-type factors and to acquire sufficient knowledge to carry these factors out. Despite some evidence from previous studies (e.g. Chakrabarti, 1974) indicating that a product champion is of major importance to a successful outcome, Rubenstein et al. (1976) noted that many of the studied projects were unsuccessful, even though a product champion was leading the development process. He concluded that the product champion is one influential factor amongst a wide range of other factors. Interestingly, he also suggested examining the internal management structure and approach for further research. In the mid-1980s, a highly influential study by Cooper

and Kleinschmidt (1986) summarised the wide range of research studies on NPD process success factors published during this period. Cooper and Kleinschmidt (1986) conducted a survey of 123 different firms. These firms provided 252 product pairs: one failed product and one successful product. Thirteen different factors were tested for their influence on success in this comparative study. From these 13 factors, nine were found to have a significant influence on a successful project outcome. All of these factors were only related to the pure set of operational-type factors that a new product has to undergo during its development process, e.g. market research, in-house testing, and test market. Nevertheless, this study provided early evidence that both addressing these critical success factors and effective management of these factors are strongly related to success (Cooper and Kleinschmidt, 1986). A large number of studies during the 1980s came to similar conclusions to Cooper and Kleinschmidt regarding the type of factor or activity found to be influential to the NPD process (e.g. Baker et al., 1986, Bronnenberg and Engelen, 1988, Brentani and Dröge, 1988, Cooper, 1980, Cooper, 1984b, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1987b, Cooper and Kleinschmidt, 1987c, Cooper, 1988, Hopkins, 1981, John and Snelson, 1988, Lilien and Yoon, 1989, Maidique and Zirger, 1984). All of these studies have in common the fact that operational-type factors, knowledge factors, created outcomes and benefits, or a combination of all three factors are seen as influential NPD process success factors. For example, Cooper and Kleinschmidt (1987c) established a list of the top ten predictors for successful financial performance of a new product. The financial performance was measured in terms of profitability, payback, relative profits, sales and sales versus objectives. This list primarily concentrated on factors describing the gained benefits and outcomes of the

new product development. Thus it contains four different types of synergy effects which have to be gained in order to achieve successful financial performance of the product. This includes a strong synergy between the project needs and existing resources, technological, marketing and engineering synergy. Three further predictors are related to creating a product advantage for the new product, which includes having a product which is perceived as superior by the customer, is of higher quality than competitive products and offers unique benefits to the customer which are not offered by the competition. The three remaining factors are knowledge-related factors. They include customer needs, desires and preferences, the product definition and the choice of the target market. Also, it is of importance to define all three factors before the start of the actual product development (Cooper and Kleinschmidt, 1987c).

Similarly, Brentani and Dröge (1988) found five critical factors for product success. Again, these five factors primarily describe gained synergy effects during the new product development process, including overall corporate synergy effects, in technical and production areas as well as for marketing. The fourth factor is competitive advantage that increases the likelihood of product success. The final factor is the product performance criteria. This factor is related to setting the evaluation criteria for the expected product performance, which influences the perceived success of a product. The findings of both research studies show the aforementioned shift to emphasizing the potential benefits and outcomes of the new product as identified success factors in combination with knowledge factors. However, if the outcome is becoming the focus as a determinant of the new product development success, it raises the question of how this desired outcome can be

achieved. The Cooper and Kleinschmidt (1986), Cooper and Kleinschmidt (1987c) and Brentani and Dröge (1988) results show that it is necessary to undertake a set of operational factors in order to establish common guidelines for new product development. These operational factors are primarily concerned with the front end of the NPD process, and include gaining knowledge about competitors and customers. It must be established what unique competitive advantage and what synergy effects will be achieved. How well this is carried out, however, depends on how proficiently all factors are undertaken, and therefore depends on the skills and knowledge of all involved in new product development. This is underlined by Pinto and Slevin (1987). They found a range of ten different influential factors to new product success. Pinto and Slevin showed that a range of operational factors such as user testing, or technical assessment, must be undertaken, but also highlighted the need for a strategy, setting out the goals and objectives for the new product along with the deliverable benefits. Pinto and Slevin (1987) also found a factor relating to personnel issues as influential. This factor includes the recruitment and selection, and in particular the training, of the staff who are involved in new product development. It is pointed out that it is necessary to consider the people as an influential factor. It is their knowledge, skills, goals and personalities that largely determine the outcome of the development process. This is particularly noteworthy because it centralises the influence of the involved individuals, and it ties into the first considered study regarding the necessary skill set of a product champion (Chakrabarti, 1974). However, two years prior to Pinto and Slevin's study, Voss (1985) found that the skills and qualifications of the management involved in the development process are not influential to success, which is a necessary prerequisite for design management.

Simultaneously, it was concluded that despite this finding the skills and qualifications of management cannot be excluded, but rather are influential for highly complex development projects as opposed to the simple nature of the projects selected in Voss' study.

During the later period of NPD research, a study with interestingly contrasting results was published. Zirger and Maidique (1990) analysed 86 electronic product pairs in a comparative study for success factors. The most notable result of the comparison was the critical need for managerial excellence. Their work suggested that managerial excellence should especially be achieved in terms of good planning, involving all phases of the NPD process. This is secured by the formation of functional groups which interact and coordinate the different factors during the development process. In addition, the study emphasized the importance for a product champion role to be assigned to an appropriate individual. A product champion maintains responsibility throughout the whole process, setting and communicating clear goals to all involved. These goals have to be based on thorough market studies that have determined user needs for the product. Of critical importance is the senior management support for the right strategy. This strategy must be aligned to the firm's existing competencies and resources (Zirger and Maidique, 1990). Overall, these study results represented something of a paradigm shift, considering that only four years earlier the emphasis was placed on operational factors. Within this four-year period, the focus of research into NPD success factors moved from emphasising operational-type factors to stressing the synergistic relationship between desired business and product outcomes. However, this left the question about how these benefits and desired outcomes can be achieved. Simultaneously, new research findings regarding the

necessary skill set of the involved individuals confirm research findings from the early 1970s and pave the way towards the results of Zirger and Maidique (1990), asserting that managerial excellence is critical as a predictor for success in the new product development.

The initial shift towards recognising the outcomes and deliverable benefits of the new product development process is further evident in the following years. Edgett et al. (1992) conducted a major research study on UK-based businesses, comparing 86 British-owned companies with 116 Japanese-owned companies. The majority of the identified factors which contribute to new product success were again related to specific product advantages, e.g. superior quality and reliability and synergy effects. One year later, Cooper and Kleinschmidt (1993a) published their research findings based on a study with 103 projects of the chemical industry in Europe and North America. In contrast to earlier research studies, Cooper and Kleinschmidt created a conceptual model combining all product and non-product advantages into a new category, 'the strategy'. Likewise, all synergy effects were merged into a new category, the 'corporate environment'. It was found that following a strategy with the aim to create a direct differential product advantage is the most important factor to predict success. However, choosing a strategy that involves creating non-product advantages proved to be less effective in achieving a successful product. Similarly, synergies were found to be only moderately important for the success of the new product. However, it is noticeable that only four out of nine measured synergy effects stood out as discriminators between successful and unsuccessful products. Among these four synergy effects, the number one factor was building on existing management skills and resources (Cooper and Kleinschmidt, 1993a). A year later, the

evolution of the ideal factor set continued and can be seen through the analysis performed by Cooper (1994). Cooper analysed 103 new products from 21 different firms to deduce their key success factors. This study resulted in a framework of eleven different criteria for new product development to be profitable. These factors, in contrast to Zirger and Maidique (1990), incorporate and combine both operational- and managerial-type factors. For example, when up-front homework was conducted, products incurred a 43% higher success rate. This includes market research, business and financial analyses, preliminary market assessment and preliminary technical assessment. In combination, it is necessary that effective management of the market research and the preliminary market assessment is concurrently executed. In relation to this, the organization of the management needs to be structured as a cross-functional team that is led by a product champion and supported by top management. Furthermore, the quality of execution over trial production, production start-up, product development, in-house testing and preliminary technical assessment is the leading point for profitability (Cooper, 1994). The shift from operational importance to emerging managerial importance, and then to a combination of the both, makes it apparent that these two categories should work synergistically within a framework of overall quality management. In the following years, numerous studies support this newly emerged structure of the product development in different variations. These findings are further confirmed in later studies by Cooper and Kleinschmidt, e.g. Cooper and Kleinschmidt (1995a), Cooper and Kleinschmidt (1995b) and Cooper and Kleinschmidt (1995c). Similarly, Cooper and Kleinschmidt (1995c) identified five main principles to be carried out in order to achieve the highest possible success in the new product development. Homework

activities, including initial screening, preliminary technical and market assessment, and business and financial analysis are revealed as fundamental for the success of the new product development process. These homework activities, as well as further operational-type factors such as marketing, market studies, customer tests and trial sells, must be carried out in order to achieve higher success rates, higher profits and more speedily delivered projects. In combination with seeking a defined product advantage that is aligned with the product strategy, these are crucial stages in the product development. Most importantly, the management of this process must be structured in cross-functional teams that are accountable for the entire project from beginning to end, but also needs to be led by a product champion or project leader who drives the project through the different development phases, and ensures its high-quality execution.

In their large-scale study with 1400 companies, Song and Parry (1997a) came to comparable results regarding the interaction of operational- and management-type factors, albeit they revealed different factors as crucial for the successful product development. They highlighted the managerial need of cross-functional integration, and a high level of internal commitment across a number of functional areas of the development process. This management structure ensures not only a simplified process due to the high level of integration but also increases the chance of identifying and discontinuing new product ideas with little potential. At the same time, it is essential that a range of operational-type factors, e.g. business and market analysis, product testing and technical and manufacturing feasibility analysis, are carried out.

A further shift is noticeable in the study results of Balbontin et al. (1999). Forty-nine companies from the United Kingdom and 38 companies from the USA from key industrial sectors were questioned about their NPD practices, and about successful and unsuccessful projects alike. Congruent with the previously presented results, it was proven that operational-type factors such as prototype testing are crucial for product development success in both countries. However, the vast majority of the results concentrate on the soft skills of the development process, for example the management skills. A high level of interdepartmental teamwork with good communication between these departments and a participative leadership style is required, according to Balbontin et al. (1999). Furthermore, the top management must be supportive and involved in the development process. The development teams themselves should be given sufficient free time in order to increase their creativity. At the same time, it is, however, required that all team members possess general business understanding.

A breakthrough that helped direct business strategies towards a different approach to the use of management was the concept of the Stage Gate Model (Cooper and Kleinschmidt, 1993d). This model did not focus on specific factor types that need to be undertaken during the NPD process, but rather focused on ensuring that there is a check point after each factor is completed. It centres on the idea of 'go or kill' decisions at key points, and checks on the quality of execution, the business and economic perspective and the proposed action plan of the product. The Stage Gate Process model represents a filtering funnel that ensures only the best ideas and products go through onto the next step to prevent wasting or spreading out resources and time. This process includes a 'Gate Keeper' role that ideally consists of

a cross-functional group of senior managers. This role is particularly important during the preliminary stages, when pure ideas are considered and screened, already casting out the ones that are deemed non-viable (Cooper and Kleinschmidt, 1993d, Cooper et al., 2002, Cooper, 2009). This approach is critical to highlight because it took an innovative step to taking the focus away from the operational factors, and placing more gravity on managerial tasks, and in this case, screening. If screening is well executed, the factors that are eventually chosen by a company turn out to be the most successful. Managing the idea and process, and aligning this to the business resources, are now the key factors. Additionally, this is all overseen by senior management, who are in the position to make decisions based on an overview of available resources etc. This methodology ensures that the company can identify, and concentrate on, the most promising ideas without wasting any resources for other projects.

In 2003, Dr Marjorie Adams conducted a study on best practice projects for the Product Development and Management Association (PDMA). The study summarised the current state of the industry with regard to applied techniques, benchmarking against the best performing companies of the time. The outcomes of the study are discussed in Barczak et al. (2009) and show that a well-defined strategy discriminates 'winning' and 'losing' companies. Furthermore, these high-performing companies used a more formal process to gather ideas, had in-store multifunctional teams with a supporting team leader, and obtained enhanced support from senior management. It is clear that Barczak et al. (2009) emphasized managerial issues of strategy, multifunctional teams and top management support. It is these facets, the study suggested, that separate the thriving from the mediocre. Undergoing certain

operational factors no longer seemed to be a contemporary issue. After the completion of these studies, the differences remained in the 'how to' management. Similarly, Brentani and Kleinschmidt (2004) compared 320 companies and found that to achieve outstanding results the best performers incorporated senior management and utilized appropriate resources that were committed to the NPD process. Most importantly, these firms had a 'new product development' culture, which was thus far a novel implement. Simply put, these companies had a corporate culture that supported their NPD process, i.e. company values were instilled with the importance of the NPD process. The message that was conveyed to management was

'Focus on the softer elements that make up the behavioural environment in order to set the tone of an organization for successful...NPD.' (Brentani and Kleinschmidt, 2004, p. 324)

2.3.1 NPD PROCESS SUCCESS FACTOR LIST

It is now widely known that management of the development process is an issue of major importance. Table 2.1 was created based on 64 studies on new product development success factors. This table lists the most frequently referenced success factors listed in descending order of most referenced, including the study sources in which they were found. The distribution of the new product development process success factor references for Table 2.1 and Table 2.2 are illustrated in Figure 2.1 and Figure 2.2. Both show a clear concentration of publications for the time period from 1984 to 1997 with 41 publications out of a total of 64 [Figure 2.1] and 36 publications out of a total of 57 [Figure 2.2].

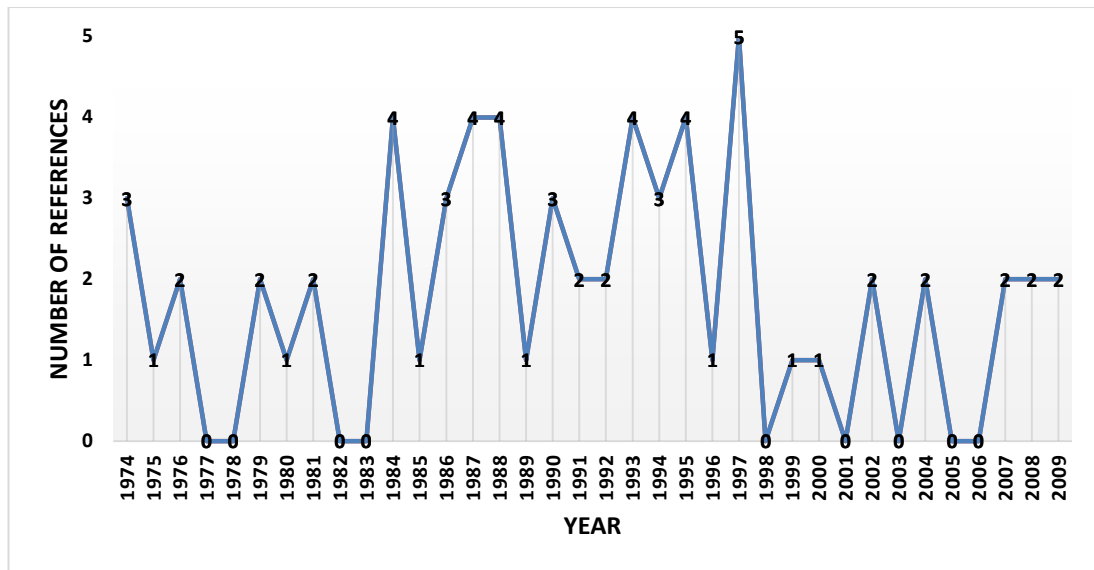


Figure 2.1: Distribution of new product development process success factors references (1974-2009)

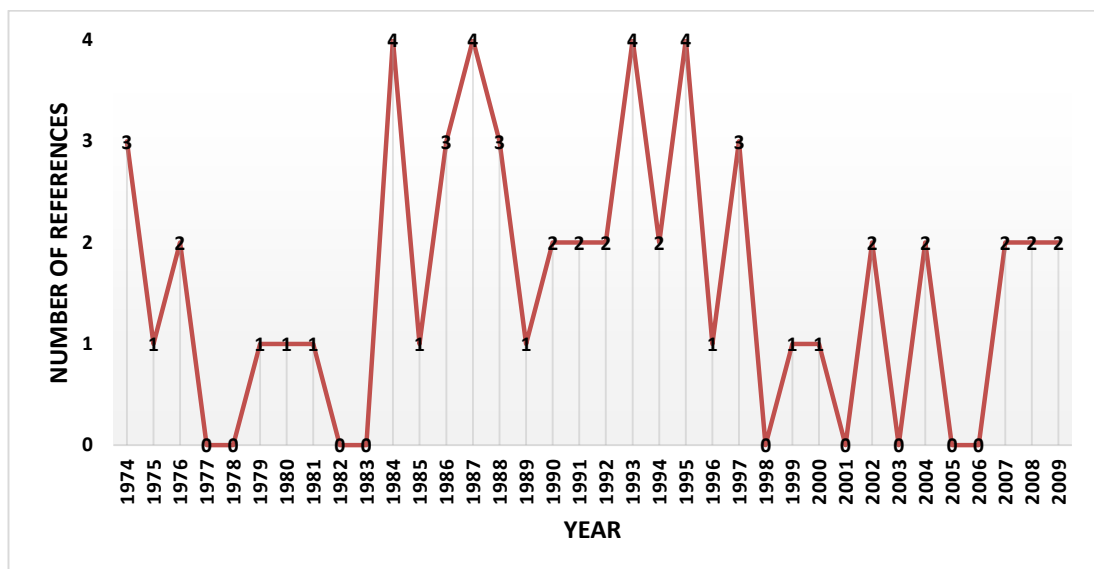


Figure 2.2: Distribution of adjusted new product development process success factors references (1974-2009)

Reference Count ¹	Factor	References	Definition ²
28	User involvement and testing	(Balbontin et al., 1999, Barczak et al., 2009, Bronnenberg and Engelen, 1988, Cooper, 1979b, Cooper, 1980, Cooper and Kleinschmidt, 1986, Cooper and Kleinschmidt, 1987b, Cooper and Kleinschmidt, 1987c, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper and Kleinschmidt, 1993b, Cooper, 1994, Cooper and Kleinschmidt, 1995c, Cooper et al., 2002, Cooper and Edgett, 2008, Edgett et al., 1992, Gemünden et al., 1992, Huang et al., 2002, Jervis, 1975, Johnne and Snelson, 1988, Lilien and Yoon, 1989, Mishra et al., 1996, Pinto and Slevin, 1987, Rochford and Rudelius, 1997, Rothwell et al., 1974, Rubenstein et al., 1976, Song and Parry, 1997a, Utterback et al., 1976)	'User involvement and testing' refers to the understanding that a new product has to respond to user needs. A frequent interaction with users is required in order to gain all necessary information regarding their needs, to understand what benefits are desired, what superior performance is, what quality means, and what the user value depends on. A verification that the product responds to the customers' needs and the customer acceptance is obtained through testing the product or prototype before the full-scale launch or development. Hereby, testing can refer to the technical inspection in a lab or under controlled conditions or field trials in collaboration with the end users.
26	Cross-functional project teams	(Balbontin et al., 1999, Barczak et al., 2009, Barczak, 1995, Cheng and Shiu, 2008, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 1995c, Cooper and Kleinschmidt, 2007, Cooper and Edgett, 2008, Ebadi and Utterback, 1984, Hopkins, 1981, Jervis, 1975, Johnne and Snelson, 1988, Lilien and Yoon, 1989, Pinto and Slevin, 1987, Pinto and Pinto, 1990, Rothwell et al., 1974, Song and Parry, 1997a, Song and Parry, 1997b, Szakasits, 1974, Verworn, 2009, Voss, 1985, Yap and Souder, 1994, Zirger and Maidique, 1990)	'Cross-functional project teams' refers to having a core project team with members from different functions within the company. This cross-functional team is committed to and accountable for the project from the beginning to the end, and all team members have an overall business understanding. Good internal communications within the cross-functional teams are essential to ensure the close interaction between the different team members and functions within the company. It is suggested to install adequate and formal communication channels such as feedback mechanisms and regular meetings to ensure high-quality interdepartmental coordination and cooperation.
25	Product advantage	(Balbontin et al., 1999, Brentani and Dröge, 1988, Bronnenberg and Engelen, 1988, Cheng and Shiu, 2008, Cooper, 1979a, Cooper, 1979b, Cooper, 1980, Cooper, 1981, Cooper, 1984b, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1987b, Cooper and Kleinschmidt, 1987c, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993c, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Edgett et al., 1992, Lilien and Yoon, 1989, Maidique and Zirger, 1984, Mishra et al., 1996, Parry and Song, 1994, Utterback et al., 1976, Zirger and Maidique, 1990)	'Product advantage' refers to the perception of the customer regarding the superiority of the product. This superiority can be achieved through product advantages or non-product advantages. A product advantage can be reached through, e.g., products with greater customisation, more relative advantages to the customers, reduction of customer costs, and superiority in quality, reliability and design. A non-product advantages service can be gained through superior technical support, product availability, company image and reputation, brand name and the perceived level of competence.

¹ Number of research studies the particular factor was referenced in.

² All factor definitions were derived from the referenced articles for each factor.

25	Synergy and familiarity	(Baker et al., 1986, Brentani and Dröge, 1988, Bronnenberg and Engelen, 1988, Cooper, 1979a, Cooper, 1979b, Cooper, 1981, Cooper, 1984b, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1987c, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995a, Edgett et al., 1992, Hopkins, 1981, Lilien and Yoon, 1989, Maidique and Zirger, 1984, Parry and Song, 1994, Rubenstein et al., 1976, Song and Parry, 1997a, Verworn, 2009, Yap and Souder, 1994, Zirger and Maidique, 1990, Zirger, 1997)	'Synergy and familiarity' refers in particular to the fit between the requirements for the new product development and existing company capabilities. This can include a fit regarding management resources and skills, in-house technology, in-house resources, customer service and existing sales force, marketing and manufacturing. Furthermore, synergy and familiarity refers to placing new products in familiar markets and the degree of congruence with corporation goals of the new products. Generally, it is advised to minimise newness in the NPD process to one dimension.
21	Top management	(Baker et al., 1986, Balbontin et al., 1999, Barczak et al., 2009, Brentani and Kleinschmidt, 2004, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 2007, Cooper and Edgett, 2008, Hopkins, 1981, John and Snelson, 1988, Kleinschmidt et al., 2007, Lilien and Yoon, 1989, Maidique and Zirger, 1984, Pinto and Slevin, 1987, Rubenstein et al., 1976, Utterback et al., 1976, Yap and Souder, 1994, Zirger and Maidique, 1990)	The factor 'top management' refers to the strong involvement of the top management in the NPD process, with a high level of support from the beginning to the end. By involving the top management, which is accountable for the project outcome, it is ensured that all necessary resources are committed to the project and that it receives the necessary support for a successful product launch.
20	Market research	(Barczak et al., 2009, Cooper, 1984a, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993b, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Edgett et al., 1992, Hopkins, 1981, Huang et al., 2002, Maidique and Zirger, 1984, Mishra et al., 1996, Rothwell et al., 1974, Rubenstein et al., 1976, Szakasits, 1974, Zirger and Maidique, 1990)	'Market research' refers to undertaking a detailed assessment of the market. The aim of market research is to obtain a qualitative and quantitative understanding of the market, the customer needs and wants, and the competitive situation.
17	Market launch	(Barczak et al., 2009, Cheng and Shiu, 2008, Cooper, 1979a, Cooper, 1979b, Cooper, 1980, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993b, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Dwyer and Mellor, 1991a, Hopkins, 1981, Keller, 2004, Kleinschmidt et al., 2007, Lilien and Yoon, 1989, Maidique and Zirger, 1984)	'Market launch' refers to the launch efforts on a full commercial basis for the new product. The detailed planning and the quality of the launch efforts are critical. The launch must be well resourced and sales force, advertising, promotion, customer service and product delivery and availability have to be coordinated. Also, the timing of the product launch is important as an early market introduction is beneficial.
16	Initial screening	(Barczak, 1995, Barczak et al., 2009, Cooper, 1979b, Cooper, 1980, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993b, Cooper and Kleinschmidt, 1993c, Cooper,	'Initial screening' refers to the formal activity of selecting ideas for new product development for further investigations. Only ideas with a strong commercial potential are retained. A small amount of funding is allocated to

		1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Dwyer and Mellor, 1991a, Huang et al., 2002, Johnne and Snelson, 1988, Mishra et al., 1996, Zirger and Maidique, 1990)	these ideas to explore their potential further.
16	Preliminary technical assessment	(Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Dwyer and Mellor, 1991b, Hopkins, 1981, Huang et al., 2002, Pinto and Slevin, 1987, Rochford and Rudelius, 1997, Song and Parry, 1997a, Szakasits, 1974, Verworn, 2009)	'Preliminary technical assessment' precedes the development phase of the new product idea. It is concerned with the technical feasibility of the proposed product to eliminate technical problems and uncertainties before development and manufacturing. Key questions of the assessment are: Can it be developed? What technical solutions are required? At what costs? Can it be manufactured?
15	Preliminary financial analysis	(Barczak et al., 2009, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993b, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Hopkins, 1981, Huang et al., 2002, Rochford and Rudelius, 1997, Song and Parry, 1997a, Szakasits, 1974)	'Preliminary financial analysis' refers to the activity of developing an economical plan and budget for the new product. Costs, a sales forecast, a potential return on investment and the payback period are assessed. This analysis is typically performed before the development stage, and thereafter repeatedly performed to adjust to changed circumstances.
15	New product strategy	(Barczak, 1995, Barczak et al., 2009, Cooper, 1984b, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper, 2000, Cooper and Kleinschmidt, 2007, Johnne and Snelson, 1988, Meyer and Roberts, 1986, Pinto and Slevin, 1987, Zirger and Maidique, 1990)	'New product strategy' refers to the development of an appropriate strategy for the new product. This strategy is defined early on in the development process and sets out the new product goals and objectives, the target market and the product concept. This strategy has to be aligned to the company strategy and defines how the new product contributes to achieving the company objectives. Furthermore, the new product strategy describes the new product and non-product advantages to be achieved.
15	Product definition	(Baker et al., 1986, Barczak et al., 2009, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1987b, Cooper and Kleinschmidt, 1987c, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Pinto and Slevin, 1987, Rubenstein et al., 1976, Szakasits, 1974, Verworn, 2009, Zirger and Maidique, 1990)	The 'product definition' refers to the development of a definition for the new product. This has to be done before the development stage and is strongly supported by previously undertaken research. It defines the product concept, the product benefits, the target market, and the requirements to develop and produce the new product. Therefore, specifying schedules, milestones, manpower, equipment requirements are established in collaboration with all involved parties, including potential sub-contractors.
15	Product champion	(Barczak, 1995, Barczak et al., 2009, Chakrabarti, 1974, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Hopkins, 1981, Keller, 2004, Rothwell et al., 1974, Rubenstein et al., 1976, Voss, 1985, Yap and	'Product champion' refers to the leader of the cross-functional NPD teams. This individual leads and drives the new product development from the beginning to the end of the project. He has sufficient authority and power to efficiently coordinate the different involved parties and to integrate them into a continuous process. He typically possesses technical competence and a

		Souder, 1994, Zirger and Maidique, 1990)	deep knowledge about the company and market.
15	Marketing and sales	(Balbontin et al., 1999, Cooper, 1979a, Cooper, 1979b, Cooper, 1984b, Cooper, 1994, Cooper and Kleinschmidt, 1995c, Edgett et al., 1992, Hise et al., 1990, Jervis, 1975, Keller, 2004, Maidique and Zirger, 1984, Song and Parry, 1997b, Song et al., 1997, Szakasits, 1974, Utterback et al., 1976, Voss, 1985)	'Marketing and sales' refers to the quality of the marketing and selling efforts. It is particularly important to ensure that all involved staff are adequately trained and that both tasks are sufficiently resourced.
14	Market attractiveness	(Bronnenberg and Engelen, 1988, Cooper, 1979a, Cooper, 1981, Cooper, 1984b, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1987c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Edgett et al., 1992, Lilien and Yoon, 1989, Parry and Song, 1994, Song and Parry, 1997a, Yap and Souder, 1994, Zirger and Maidique, 1990)	'Market attractiveness' refers to the choice of market for the new product. It is recommended to place the new product in large and familiar markets with high growth rates, a high need level, a positive economic climate, stable demand and little competition. Dynamic markets with frequent product launches should be avoided.
12	Preliminary market analysis	(Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Dwyer and Mellor, 1991b, Huang et al., 2002, Song and Parry, 1997a, Zirger and Maidique, 1990)	'Preliminary market analysis' refers to the activity of undertaking a first and quick assessment of the market to gain initial insights about the market size and potential, customer interest and needs, requirements and value, and the competitive situation. The scope of this analysis is limited and makes use of, e.g., focus groups, key customers and experts.
11	Resources	(Brentani and Kleinschmidt, 2004, Bronnenberg and Engelen, 1988, Cooper and Kleinschmidt, 1995a, Cooper, 2000, Cooper and Kleinschmidt, 2007, Cooper and Edgett, 2008, Kleinschmidt et al., 2007, Rubenstein et al., 1976, Song and Parry, 1997a, Voss, 1985, Yap and Souder, 1994)	'Resources' refers to the allocation of sufficient and high-quality resources to the NPD process. This is best achieved with a formal system to assess the source of product supply for the NPD process and to ensure that all necessary resources to achieve new product success are allocated. It is suggested to include formal go/kill decisions for the project to avoid a stretch of company resources over too many projects.
9	Innovation culture	(Balbontin et al., 1999, Brentani and Kleinschmidt, 2004, Cooper and Kleinschmidt, 1995a, Cooper et al., 2002, Cooper and Kleinschmidt, 2007, John and Snelson, 1988, Kleinschmidt et al., 2007, Rubenstein et al., 1976, Song and Parry, 1997a)	'Innovation culture' refers to the internal company culture fostering the new product development process. It describes the creation of an internal company culture that rewards innovativeness and increases employee motivation. For instance, this is achieved by giving employees enough free time to work on creative projects and allocate resources for these projects, creating product idea schemes to generate ideas for new products from employees and providing internal workshops or conferences.
9	Technical proficiency	(Cooper, 1979a, Cooper, 1984b, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1995b, Keller, 2004, Rubenstein et al., 1976, Song and Parry, 1997b, Voss, 1985, Zirger, 1997)	'Technical proficiency' refers to the quality of execution of the technical activities of the NPD process, the technical sophistication of the project and the technical experience of the team.
9	Market testing	(Cooper, 1979b, Cooper, 1980, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993b, Cooper and Kleinschmidt, 1993c, Cooper,	'Market testing' refers to a limited trial sell of the product before the market launch to test the product, the production and the market acceptance.

		1994, Cooper and Kleinschmidt, 1995c, Huang et al., 2002)	
8	Product development	(Barczak et al., 2009, Cooper, 1979b, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Dwyer and Mellor, 1991a, Dwyer and Mellor, 1991b, Huang et al., 2002)	'Product development' refers to the actual design and development of the new product. The design and development is based on the previously cumulated information.
8	High-quality NPD process	(Cooper and Kleinschmidt, 1993e, Cooper and Kleinschmidt, 1995a, Cooper, 2000, Cooper and Kleinschmidt, 2007, Hopkins, 1981, Jervis, 1975, Utterback et al., 1976, Verworn, 2009)	A 'high-quality NPD process' refers to the establishment of strict and formalised procedures for the NPD process to ensure an effective and efficient development. The focus is on the quality of the execution of the different stages of the NPD process, and ensuring that all necessary stages are carried out.
7	Idea generation	(Barczak, 1995, Barczak et al., 2009, Cooper and Kleinschmidt, 1995c, Huang et al., 2002, John and Snelson, 1988, Parry and Song, 1994, Verworn, 2009)	'Idea generation' forms the start of the NPD process. This marketing task is carried out as a planned and formal activity to identify opportunities for new product developments. Ideas can be derived from technology, the market or customers.
6	R&D	(Barczak et al., 2009, Cooper, 1984a, Cooper and Kleinschmidt, 2007, Gemünden et al., 1992, Hise et al., 1990, Maidique and Zirger, 1984)	'R&D' refers to the existence of a well planned and executed R&D process within the NPD process. This includes a high internal spending on R&D but also strong cooperation in the field to increase its importance and complement existing in-house capabilities.
6	Management skills	(Cooper and Kleinschmidt, 1993a, Cooper, 1994, Jervis, 1975, Rothwell et al., 1974, Voss, 1985, Zirger and Maidique, 1990)	'Management skills' refers to the quality and ability of the management staff to ensure a well planned and communicated product development. It is recommended to rely on existing in-house management expertise and resources.
5	Process review and monitoring	(Barczak et al., 2009, Cooper and Edgett, 2008, Hopkins, 1981, Pinto and Slevin, 1987, Zirger and Maidique, 1990)	'Process review and monitoring' refers to the regular and formal review of the new product development process. It is distinguished between process reviewing and monitoring, which takes place during the actual NPD process after each stage and a formal review which takes place post launch. The purpose of both is to evaluate the project against initial targets and plans.
4	Trial production	(Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Dwyer and Mellor, 1991a)	No definition available
4	External cooperation	(Cheng and Shiu, 2008, Rubenstein et al., 1976, Szakasits, 1974, Utterback et al., 1976)	'External cooperation' refers to the extent of use of any outside expertise.
2	Commercialisation	(Huang et al., 2002, Song and Parry, 1997a)	'Commercialisation' refers to the activity of marketing the new product.
2	Portfolio management	(Barczak et al., 2009, Cooper and Edgett, 2008)	'Portfolio management' refers to the ranking and prioritising of the distribution of resources to ensure a sufficient allocation to each project. This is achieved by frequently evaluating the project, including go/kill decisions to improve the productivity.
1	R&D teams	(Barczak, 1995)	'R&D teams' refers to the use of R&D teams as functional teams as opposed to cross-functional teams.
1	Federal regulations	(Rubenstein et al., 1976)	'Federal regulations' refers to the degree of clarity and certainty about

			federal regulatory policies and future plans.
1	Experienced engineers	(Szakasits, 1974)	'Experienced engineers' refers to the employment of engineering staff with considerable experience in product development, production, planning and construction.
1	Trouble-shooting	(Pinto and Slevin, 1987)	'Trouble-shooting' refers to the preparation for potential problems in the NPD process. Anticipating potential problems enables the NPD teams to react quickly and adequately whilst losing a minimum of time and resources.
1	High-quality production	(Rothwell et al., 1974)	'High-quality production' refers to the quality of the manufacturing efforts. High-quality procedures ensure the reliability of the production.
1	Avoid technologies that require change in user behaviour	(Yap and Souder, 1994)	'Avoid technologies that require change in user behaviour'
1	Proficiency of predevelopment activities	(Cooper and Kleinschmidt, 1987a)	This factor refers to the quality of execution of all predevelopment activities.
1	Proficiency of market-related activities	(Cooper and Kleinschmidt, 1987a)	This factor refers to the quality of execution of market related activities. This includes market assessment, marketing research and the market launch.
1	High profit margins	(Maidique and Zirger, 1984)	This factor describes the generation of high profit margins with the new product.
1	Recognised need for project	(Utterback et al., 1976)	This factor describes that the need for the new product must be recognised by the user and must be recognised before a solution for this particular need exists.
1	Project was considered urgent	(Utterback et al., 1976)	This factor describes the urgency of the NPD project.

Table 2.1: New product development process success factors derived from literature

To limit the scope for further investigations into the examined NPD process success factors, only the NPD process success factors with 12 or more references were considered, leaving 16 NPD process success factors in total. This equals almost 20% of the possible reference count, and ensures a concentration on the most referenced, and therefore potentially the most important, NPD process success factors for further analyses.

Further refinements to the list were undertaken. The NPD process success factors *product advantage* and *synergy and familiarity*, with the third and fourth most references from the considered literature, were excluded from the list. Both

represent two important factors influencing the success of a new product. However, according to the derived definitions [see Table 2.1 and Table 2.2] these are not factors which are undertaken in the NPD process, but rather represent the desired outcome. The presented research, however, aims to examine NPD process success factors or activities which have been proven to promote the actual development of a new product. For similar reasons, the factors *market launch* and *marketing and sales* were excluded from the list. Both *market launch* and *marketing and sales* are not part of the core development process, but are undertaken subsequently. The NPD process success factor *market attractiveness* is defined as choosing an attractive market with high growth rates, a high need level, a positive economic climate, stable demand and little competition. This factor is also not an NPD process activity *per se*, and was excluded from the list. In fact, it represents the outcome of the factor *preliminary market analysis*, which is defined as an assessment of the market to gain insight about the market size and potential, customer interest and needs, requirements and value, and the competitive situation. Furthermore, the factor *initial screening* was excluded from the list. *Initial screening* is defined as the activity of selecting new product ideas with a strong commercial potential. In order to determine the commercial potential of a new product, several other factors have to be undertaken. These are typically pre-development factors, such as *preliminary technical assessment*, *preliminary financial analysis* and *preliminary market analysis* to determine the technical feasibility, the economic viability and the market potential of the new product. Therefore, *initial screening* can be characterised as a subheading of already existing factors in the list, which makes it redundant as a separate factor. The factor *product definition* is a direct outcome of the *initial screening* and the pre-

development factors and was therefore also excluded from the list. The final list of examined NPD process success factors for further investigations is presented as:

Reference Count ³	Factor	References	Definition ⁴
28	User involvement and testing	(Balbontin et al., 1999, Barczak et al., 2009, Bronnenberg and Engelen, 1988, Cooper, 1979b, Cooper, 1980, Cooper and Kleinschmidt, 1986, Cooper and Kleinschmidt, 1987b, Cooper and Kleinschmidt, 1987c, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper and Kleinschmidt, 1993b, Cooper, 1994, Cooper and Kleinschmidt, 1995c, Cooper et al., 2002, Cooper and Edgett, 2008, Edgett et al., 1992, Gemünden et al., 1992, Huang et al., 2002, Jervis, 1975, Johnne and Snelson, 1988, Lilien and Yoon, 1989, Mishra et al., 1996, Pinto and Slevin, 1987, Rochford and Rudelius, 1997, Rothwell et al., 1974, Rubenstein et al., 1976, Song and Parry, 1997a, Utterback et al., 1976)	'User involvement and testing' refers to the understanding that a new product has to respond to user needs. A frequent interaction with users is required in order to gain all necessary information regarding their needs, to understand what benefits are desired, what superior performance is, what quality means and what the user value depends on. A verification that the product responds to the customers' needs and the customer acceptance is obtained through testing the product or prototype before the full-scale launch or development. Hereby, testing can refer to the technical inspection in a lab or under controlled conditions or field trials in collaboration with the end users.
26	Cross-functional project teams	(Balbontin et al., 1999, Barczak et al., 2009, Barczak, 1995, Cheng and Shiu, 2008, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 1995c, Cooper and Kleinschmidt, 2007, Cooper and Edgett, 2008, Ebadi and Utterback, 1984, Hopkins, 1981, Jervis, 1975, Johnne and Snelson, 1988, Lilien and Yoon, 1989, Pinto and Slevin, 1987, Pinto and Pinto, 1990, Rothwell et al., 1974, Song and Parry, 1997a, Song and Parry, 1997b, Szakasits, 1974, Verworn, 2009, Voss, 1985, Yap and Souder, 1994, Zirger and Maidique, 1990)	'Cross-functional project teams' refers to having a core project team with members from different functions within the company. This cross-functional team is committed to and accountable for the project from the beginning to the end, and all team members have an overall business understanding. Good internal communications within the cross-functional teams are essential to ensure the close interaction between the different team members and functions within the company. It is suggested to install adequate and formal communication channels such as feedback mechanisms and regular meetings to ensure high-quality interdepartmental coordination and cooperation.
21	Top management	(Baker et al., 1986, Balbontin et al., 1999, Barczak et al., 2009, Brentani and Kleinschmidt, 2004, Cooper and Kleinschmidt, 1987a, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 2007, Cooper and Edgett, 2008, Hopkins, 1981, Johnne and Snelson, 1988, Kleinschmidt et al., 2007, Lilien	The factor 'top management' refers to the strong involvement of the top management in the NPD process with a high level of support from the beginning to the end. By involving the top management, which is accountable for the project outcome, it is ensured that all necessary resources are committed to the project and that it receives the necessary support for a successful product launch.

³ Number of research studies the particular factor was referenced in.

⁴ All factor definitions were derived from the referenced articles for each factor.

		and Yoon, 1989, Maidique and Zirger, 1984, Pinto and Slevin, 1987, Rubenstein et al., 1976, Utterback et al., 1976, Yap and Souder, 1994, Zirger and Maidique, 1990)	
20	Market research	(Barczak et al., 2009, Cooper, 1984a, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993b, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Edgett et al., 1992, Hopkins, 1981, Huang et al., 2002, Maidique and Zirger, 1984, Mishra et al., 1996, Rothwell et al., 1974, Rubenstein et al., 1976, Szakasits, 1974, Zirger and Maidique, 1990)	'Market research' refers to undertaking a detailed assessment of the market. The aim of market research is to obtain a qualitative and quantitative understanding of the market, the customer needs and wants and the competitive situation.
16	Preliminary technical assessment	(Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Dwyer and Mellor, 1991b, Hopkins, 1981, Huang et al., 2002, Pinto and Slevin, 1987, Rochford and Rudelius, 1997, Song and Parry, 1997a, Szakasits, 1974, Verworn, 2009)	'Preliminary technical assessment' precedes the development phase of the new product idea. It is concerned with the technical feasibility of the proposed product to eliminate technical problems and uncertainties before development and manufacturing. Key questions of the assessment are: Can it be developed? What technical solutions are required? At what costs? Can it be manufactured?
15	Preliminary financial analysis	(Barczak et al., 2009, Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993b, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Hopkins, 1981, Huang et al., 2002, Rochford and Rudelius, 1997, Song and Parry, 1997a, Szakasits, 1974)	'Preliminary financial analysis' refers to the activity of developing an economical plan and budget for the new product. Costs, a sales forecast, a potential return on investment and the payback period are assessed. This analysis is typically performed before the development stage and thereafter repeatedly performed to adjust to changed circumstances.
15	New product strategy	(Barczak, 1995, Barczak et al., 2009, Cooper, 1984b, Cooper and Kleinschmidt, 1993a, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995a, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper, 2000, Cooper and Kleinschmidt, 2007, John and Snelson, 1988, Meyer and Roberts, 1986, Pinto and Slevin, 1987, Zirger and Maidique, 1990)	'New product strategy' refers to the development of an appropriate strategy for the new product. This strategy is defined early on in the development process and sets out the new product goals and objectives, the target market and the product concept. This strategy has to be aligned to the company strategy, and defines how the new product contributes to achieving the company objectives. Furthermore, the new product strategy describes the new product and non-product advantages to be achieved.
15	Product champion	(Barczak, 1995, Barczak et al., 2009, Chakrabarti, 1974, Cooper and Kleinschmidt, 1993e, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Hopkins, 1981, Keller, 2004, Rothwell et al., 1974, Rubenstein et al., 1976, Voss, 1985, Yap and	'Product champion' refers to the leader of the cross-functional NPD teams. This individual leads and drives the new product development from the beginning to the end of the project. He has sufficient authority and power to efficiently coordinate the different involved parties and to integrate them into a continuous process. He typically possesses

		Souder, 1994, Zirger and Maidique, 1990)	technical competence and a deep knowledge about the company and market.
12	Preliminary market analysis	(Cooper and Kleinschmidt, 1986, Cooper, 1988, Cooper and Kleinschmidt, 1993c, Cooper, 1994, Cooper and Kleinschmidt, 1995b, Cooper and Kleinschmidt, 1995c, Cooper and Edgett, 2008, Dwyer and Mellor, 1991a, Dwyer and Mellor, 1991b, Huang et al., 2002, Song and Parry, 1997a, Zirger and Maidique, 1990)	'Preliminary market analysis' refers to the activity of undertaking a first and quick assessment of the market to gain initial insights about the market size and potential, customer interest and needs, requirements and value, and the competitive situation. The scope of this analysis is limited and makes use of, e.g., focus groups, key customers and experts.

Table 2.2: Adjusted new product development process success factors derived from literature

2.4 SUMMARY/CONCLUSION

The literature review presents the evolution of the design management concept from its introduction in 1966 to its current state. It then discusses the evolution of research on NPD process success factors since 1976 based on a systematic review. Success factors in the NPD process have extensively been researched, and numerous peer-reviewed research articles have been published. The literature review on the evolution of design management and the NPD process revealed that the concept design management arose out of the shift in importance of the NPD process factor types. By evolving to design management, the actual factors have not changed, but the importance of those factors, and the realisation that design can make a difference, arose. Therefore, design management can be viewed as a way of managing the NPD process. Subsequently, a comprehensive list of the most frequently referenced NPD process success factors was derived from 64 research studies on NPD process success factors [see Table 2.1]. In a following step, the list was limited to the nine most frequently referenced NPD process success factors [see Table 2.2]. Arguably, addressing all nine NPD process success factors will significantly increase the chances of a successful product outcome.

CHAPTER THREE

3. METHODOLOGY

This chapter describes how the research methods used within the thesis were selected. This includes establishing the research question, aims, objectives, approach and design. Furthermore, the methodological background for the literature and contextual review, the case study development and the case study analyses are presented.

3.1 INTRODUCTION

The literature review on the evolution of design management and the NPD process research was conducted and set the theoretical framework and scope of the study.

The methodology chapter is subdivided into six sections:

1. Research Question
2. Research Approach
3. Literature/Contextual Review
4. Case Study
5. Analysis – Case Study
6. Research Design

The first section introduces the research question, including the research aim and research objectives. The subsequent sections from ‘Research Approach’ to ‘Analysis – Case Study’ discuss the choice of research methodologies for the PhD research, the

literature and contextual review, conducting case studies and the analysis of case studies. The section 'Research Design' presents an overview of the structure of the PhD research and discusses the appropriate methodological approach for the relevant chapters of the thesis.

3.2 RESEARCH QUESTION

A chronological literature review on NPD process success factor research has shown the development of the research and the evolution of the design management field from the NPD work. In addition, it is deduced from the literature that the understanding of design in the NPD process underwent a significant shift from being seen as a sub-process to becoming the driver of the whole NPD process, evolving into the concept of design management. The derived NPD process success factors allow an assessment of the NPD process. There has been much research to demonstrate that addressing these factors adequately in an NPD process improves the likelihood of a successful product outcome. However, there is a lack of similar research studies on design management success factors and there are very few design management assessment models. A range of design or design management models exist, but these design management models either aim to assess the design function within organisations or highlight the value and benefit of design management (e.g. Hayes, 1990, Mozota, 2006, Ramlau and Melander, 2004). Further models concentrate on assessing the design process itself, and therefore fail to assess design management. However, the literature review highlights that design management evidently refers to the management of the NPD process (e.g. Moultrie and Fraser, 2004, Preddy and Conte, 2000). Hence, an adequate assessment of design management capabilities, or

a prediction of which design management factors promote success, is currently still unexplored. The PhD research aims to fill this gap in knowledge by addressing the following research question:

Which factors promote design management success and how can design management capabilities in businesses and organisations be assessed?

3.2.1 RESEARCH AIM

Given the research question, the aim of the research is to improve the current knowledge in the field of design management capability assessment. Identifying success factors for design management and how these factors can be used to assess design management capabilities may be a crucial step for design management as an academic discipline. The results will inform further research into design management and its best practice based on a deeper understanding of which factors may ultimately lead to successful outcomes.

The results lay the foundations for improved practical implementation and development of design management in industry. Providing insight and knowledge and practical tools for the self-assessment of design management capabilities may improve understanding of how to achieve design management success, ultimately leading to the wider recognition and application of design management.

3.2.2 RESEARCH OBJECTIVES

To achieve the aim of the research and to answer the research question, a set of research objectives were identified. The research objectives are summarised in Table

3.1. Further explanation regarding the structure of the research is provided in the section 3.7 RESEARCH DESIGN.

Number	Research Objective	Research Question	Analysis	Discussion
1	Literature review to identify the current state of knowledge, identifying gaps in the literature and relevant tools and metrics	Are NPD process success factors also predictors for design management success?	Chapter 2 - LITERATURE REVIEW	Chapter 10.2 - AN INVESTIGATION INTO DESIGN MANAGEMENT SUCCESS FACTORS
2	Establish a common success factor list of the NPD process from literature	Which NPD process success factors are the most important factors?	Chapter 2.3.1 - NPD PROCESS SUCCESS FACTOR LIST	Chapter 10.2 - AN INVESTIGATION INTO DESIGN MANAGEMENT SUCCESS FACTORS
3	Investigation of the Design Management Staircase Model structure and its five underlying factors	Is the Design Management Staircase Model level and factor structure appropriate and covering vital points for the design management capability assessment?	Chapter 4.4 - DECONSTRUCTION OF THE DESIGN MANAGEMENT STAIRCASE MODEL	Chapter 10.3 - AN INVESTIGATION INTO THE DESIGN MANAGEMENT STAIRCASE MODEL
4	Investigation of the DME Award questionnaire	Does the underlying questionnaire of the Design Management Staircase Model deliver adequate information for the assessment?	Chapter 4.5 - THE DESIGN MANAGEMENT STAIRCASE MODEL QUESTIONNAIRE	Chapter 10.3 - AN INVESTIGATION INTO THE DESIGN MANAGEMENT STAIRCASE MODEL
5	Empirical validation of the established success factors based on the DME Award dataset	How are these factors utilised in high-performing design management companies?	Chapter 6.3 - RESULTS	Chapter 10.2 - AN INVESTIGATION INTO DESIGN MANAGEMENT SUCCESS FACTORS
6	Analyse the obtained case studies	Do all case studies utilise the NPD process success factors? Are the nine success factors exclusive? Which success factor is considered the most important factor?	Chapter 8 - ANALYSES II – CASE STUDIES	Chapter 10.2 - AN INVESTIGATION INTO DESIGN MANAGEMENT SUCCESS FACTORS
7	Analyse the trend of the design management capabilities of businesses and organisations reflected in the Staircase scores 2009-2012	What are the trends of design management capabilities of businesses and organisations 2009-2012? Does the Design Management Staircase Model function as proposed in its description? What are the interdependencies between the Design	Chapter 9 - ANALYSES III – THE DESIGN MANAGEMENT STAIRCASE MODEL -	Chapter 10.3 - AN INVESTIGATION INTO THE DESIGN MANAGEMENT STAIRCASE MODEL

		Management Staircase Model factors? Is the position of the person who submitted the DME Award questionnaire influencing the Design Management Staircase Model score?		
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Table 3.1: Research Objectives

3.3 RESEARCH APPROACH

Teddlie and Tashakkori (2009) and Bryman and Bell (2003) outline three basic methodological approaches for research: quantitative, qualitative and mixed methodology. These three main methodology approaches are described as:

- **Quantitative methodology:** This approach is mainly concerned with methods related to the collection of statistical data, its analysis, interpretation and presentation. It is primarily a post-positivistic approach involving, i.e., the prediction of outcomes based on theory, the prediction of relationships, testing for significant differences amongst groups or simply describing occurrences.
- **Qualitative methodology:** This approach is mainly concerned with methods related to the collection of open-ended data, its analysis, interpretation and presentation. It is primarily a constructivist approach typically emerging into the development of themes from the data.
- **Mixed methodology:** This approach combines both quantitative and qualitative methods in one study. It is primarily a pragmatic approach that is typically problem-oriented versus method-oriented, and the problem determines the method rather than the method determining the problem.

Bryman and Bell (2003, p. 482) suggest three justifications for the approach of a mixed methodology:

- *Triangulation: This refers to the use of quantitative research to corroborate qualitative research findings, or vice versa.*
- *Facilitation: This approach arises when one research strategy is employed in order to aid research using another research strategy.*
- *Complementarity: This approach occurs when the two research strategies are employed in order for different aspects of an investigation to be dovetailed.*

According to Bryman and Bell (2003), the triangulation approach can strengthen the research results as quantitative methods can be enhanced with supporting qualitative methods. This PhD accesses pre-existing questionnaire data from the DME Award. Due to the nature of this questionnaire, which combines qualitative and quantitative data, a mixed methodology was chosen as the appropriate research approach for this study. Furthermore, following the triangulation justification for a mixed methodology, the choice of a mixed method will allow supporting of the findings from the analysis of the questionnaire data with qualitative data. This approach not only strengthens the findings from the questionnaire analysis but is also necessary to address bias inherent in the pre-existing questionnaire.

3.4 LITERATURE/CONTEXTUAL REVIEW

The general purpose of a literature review is to examine the current state of knowledge in a particular field or topic and present the results in an inclusive

overview (Green et al., 2006). Baumeister and Leary (1997) assert that literature reviews may be classified according to five different objectives:

- Theory development
 - Development of an original concept or theory
 - The literature review provides the context and evaluation for the new theory
- Theory evaluation
 - Critical review of the literature regarding the validity of an existing theory
- Evaluation of the current state of knowledge on a particular topic
 - Provision of overviews on a particular topic
 - Minimal theoretical contribution
- Problem identification
 - Reveal problems, weaknesses, contradictions or controversies
 - Mostly informative
- Historical development of theory and research on a particular topic
 - Chronological mapping of a particular topic (adapted from: Baumeister and Leary, 1997, p. 312)

Green et al. (2006) describe an additional basic classification of literature reviews:

- Narrative literature review
- Qualitative systematic literature review
- Quantitative systematic literature review

These classifications are based on the method of the literature review rather than on its objective. The narrative review, commonly referred to as traditional review, in its most basic definition, is described as a critical description or assessment of available

information on a particular topic. The main emphasis lies in the objective to explore a particular issue and identify research gaps. However, this approach also faces the criticism of presenting a biased view on a particular topic as it does not follow a rigorous methodology for the data selection, and is purely based on the author's subjective views (Jesson et al., 2011). In further detail, Green et al. (2006) explain that the narrative literature review can be further sub-classified into three types: editorial, commentary and narrative reviews. Editorial reviews typically focus on a limited number of research articles, and offer a short recapitulation or simply comments from the author. The commentary review is typically very short and predominantly expresses the author's point of view. Finally, narrative overviews or unsystematic narrative reviews are described as inclusive reviews of previously published knowledge, summarising the main findings of each source. This type typically presents an overview or introduction into a particular topic, pulling available information together. However, narrative reviews tend to lack any systematic methods and open any results and findings to bias, and thus criticism. In contrast, qualitative systematic literature reviews employ a rigorous set of methods to minimise or remove bias. Typically, this type of literature review is conducted around a specific research question, and aims to include all published literature on the specific research question (Green et al., 2006). The quantitative systematic literature reviews builds on the same methods as the qualitative systematic literature review; however, it is extended by a statistical research technique called meta-analysis. For such an analysis, original data from the different utilised studies is gathered and statistically analysed to balance the influence from different studies with different variables (Green et al., 2006). A range of authors follow the same definitions and

classifications of the methods for a literature review and further expand on this (e.g. Jesson et al., 2011, Jones and Evans, 2000, Nightingale, 2009, White and Schmidt, 2005). For instance, Jesson et al. (2011) state that the methodologies for literature reviews are subject to constant change and evolution. In particular, combining both the review of qualitative and quantitative data in one review has been a relatively recent development. This meta-narrative mapping analysis aims to demonstrate the development of a particular topic over time by linking the analytical narrative literature review with the rigorous methodology of a systematic review. This results in capturing qualitative changes over a particular period of time as well as incorporating quantitative data (Jesson et al., 2011).

Due to the different sets of objectives and sections within the literature review, there was a mixture of different approaches and methods for the literature chosen. The literature review in this PhD identified the development of NPD process success factor research, and the evolution of the design management field. This included compiling a theoretical list of NPD process success factors from the literature and a meta-narrative mapping analysis. Utilising this method allowed the presentation of the development of both research fields over the chosen time period, while simultaneously examining the quantitative data of the NPD process success factor research studies. The incorporation of rigorous methodologies regarding the selection of research articles ensured comprehensive insight into both developments and thus reduced bias.

The objective of the contextual review is to understand the basic model construction of the Design Management Staircase Model, because it has been identified as the only current model to attempt to assess design management capabilities. Thus it is

important to understand if the underlying questionnaire offers appropriate insight into design management capability, and whether the factors considered are both appropriate and comprehensive. Hence, both the literature review and the contextual review followed the objective of evaluating an existing theory, as described by Baumeister and Leary (1997). Due to the explorative nature of the objectives, the approach of a narrative literature review was chosen.

3.5 CASE STUDY

3.5.1 RESEARCH STRATEGY

According to Yin (2003), a range of research strategies exist which can all be used to fulfil exploratory, descriptive or explanatory purposes. This comprises five research strategies: experiment, survey, archival analysis, history and case study. Although these strategies are comprised of individual characteristics that make each suitable for particular purposes, they also display strong overlap. Yin (2003) categorises the five research strategies depending on the relevant situation:

Strategy	Form of Research Question	Requires Control of Behavioural Events?	Focuses on Contemporary Events?
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case study	How, why?	No	Yes

Table 3.2: Relevant Situations for Different Research Strategies

Source: Yin (2003, p. 5)

Like Yin (2003), Voss et al. (2002) state that a case study as the research strategy is suitable predominantly for explanatory studies with the questions ‘how’ and ‘why’ as a central focus in a contemporary context. Case study research is particularly suited for explanatory research to gain deeper insight into a particular problem or research area. This research method is most applicable when the knowledge of the particular problem or research area is limited (Kumar, 2011). Accordingly, Voss et al. (2002) describe multiple case studies as appropriate for theory testing and theory extension or refinement. General research questions for both are described as ‘*How generalizable is the theory?*’ or ‘*Did we get the behaviour that was predicted by the theory or did we observe another unanticipated behaviour?*’ (Voss et al., 2002, p. 198). Hence, case studies build on existing theories and provide the means to test and extend the theories. In particular, multiple case studies are suited for these purposes as they deliver more convincing arguments and conclusions due to the larger sample, and are considered as more robust (Voss et al., 2002, Yin, 2003). However, multiple case studies can become very time and resource intensive. For this reason, Yin (2003) and Voss et al. (2002) state that determining the sample size for multiple case studies largely depends on factors such as time constraints, results of previously conducted case studies and the judgement of the researcher. Considering the aim of this study, the research strategy of conducting multiple case studies was chosen. The study seeks to increase the knowledge about the application of the NPD process success factors, as the information provided by the DME Award questionnaire is limited. In addition to building on existing theory, this study intends to test and extend the theory and initial results in the NPD factor analyses chapter.

3.5.2 METHOD

The method chosen to conduct the multiple case studies for this research was semi-structured interviews, with a mixture of open and closed questions. Interviews can be carried out in a structured, unstructured or semi-structured way. The main types of interviews in qualitative research are unstructured and semi-structured interviews (Bryman and Bell, 2003). Unstructured interviews follow a conversational structure and nature. The researcher typically opens the interview with one question, and then follows up on what appears to be relevant (Bryman and Bell, 2003). A semi-structured interview approach follows a pre-set structure and number of questions but still allows a great degree of flexibility regarding the wording of questions, potential follow-up questions and the order of the questions. Despite a general structure, the interview process remains flexible whilst specifically targeting a certain topic or particular area of interest (Bryman and Bell, 2003). Choosing the method of conducting semi-structured interviews in this PhD allowed the interview to focus on very specific areas while maintaining flexibility for follow-up questions.

For the execution of the semi-structured interview, a questionnaire or interview guide with open and closed questions was developed. Both types of questions offer advantages and disadvantages. Open questions are of an exploratory nature and generally give the respondents the most freedom to answer in their preferred way, and therefore often offer unexpected answers and insight. On the negative side, answers to open questions are more time consuming and difficult to analyse. Closed questions provide a very narrow framework and often only require 'yes' and 'no' answers as they help to validate the interviewer's thoughts. Furthermore, they are easier to analyse as they significantly reduce the unpredictability of the answers,

which can also be a disadvantage, particularly in explanatory studies (Bryman and Bell, 2003).

A semi-structured interview method was chosen. This approach was the logical method given the aim of the research study. The purpose of conducting case studies was to verify if the respondents address the previously identified NPD process success factors, and to gain further insight into how these factors are addressed and utilised. Furthermore, it was intended to discover any additional factors which are considered as being important and influential. Therefore, the choice of a semi-structured interview facilitated a structure that covered all nine NPD process success factors and at the same time gave sufficient flexibility for potential follow-up questions. This choice of method was further strengthened by choosing a mixture of open and closed questions for each of the nine NPD process success factors. The first question about each factor typically consisted of a closed question inquiring if the factor is addressed, followed by open questions to gain further insight into how they were addressed.

3.5.3 LIKERT SCALE

A Likert scale is a frequently employed rating scale in qualitative data collection in order to obtain opinions, attitudes and views in a statistically relevant data format. Respondents are asked to rate their agreement or disagreement about a particular statement or question. The rating ranges typically from 'strongly agree' to 'strongly disagree' on a recommended four- to seven-point scale whereby every statement of the ranking has equal attitudinal value (2008, Kumar, 2011). In order to obtain a

statement which clearly goes into one direction of the scale, rating scales with an even number of ratings have been increasingly employed (2008).

In order to support the findings of the qualitative semi-structured interviews and to determine the relative importance of the NPD process success factors, respondents were asked to rate the factors on a Likert scale. Respondents were asked to rank each NPD process success factor on a six-point scale ranging from 'not influential' to 'very influential'.

3.6 ANALYSES – CASE STUDY

3.6.1 CASE STUDY – APPROACH

Bryman and Bell (2003) state that no clear rules exist on how to analyse qualitative data. Hence, the analyses of qualitative data will always largely depend on the researcher's approach and desired outcome. Two general approaches on how to conduct qualitative data analyses are described as 'inductive analysis' and 'deductive analysis'. The inductive analysis approach is concerned with finding emerging themes in the data itself (Patton, 2002). This approach is commonly referred to as 'grounded theory' as themes are 'grounded in the data itself' (Bryman and Bell, 2003, Patton, 2002). A deductive approach relies on an existing framework for the data analysis and is known as 'analytic induction'. This pre-existing framework or hypothesis is derived from theory, and the qualitative data analysis is used to validate the framework or hypothesis (Bryman and Bell, 2003, Patton, 2002). This type of analysis is first deductive by applying the existing framework onto the data and then inductive by examining the data for further reoccurring themes (Patton, 2002).

Following this classification, an analytical induction approach was selected. This analytical approach was chosen because of the nature of the semi-structured interview questionnaire. This approach ensures that the existing framework, the nine NPD process success factors, can be applied to the data for further analysis, and further emerging themes can be obtained.

3.6.2 DATA MANAGEMENT

All semi-structured interviews were transcribed from audio recordings, producing over 290 minutes of audio data. In order to analyse this data, it was essential to manage the data in an orderly fashion. Data management is fundamentally linked to data analysis and ensures that the data is stored in an accessible and structured way, and that conducted data analyses are documented and retained for any future use (Miles and Huberman, 1994). All transcribed semi-structured interviews were transferred into the qualitative data analysis (QDA) computer software package NVivo Version 10.

3.6.2.1 DATA REDUCTION/CODING

Data reduction refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written-up field notes or transcriptions (Miles and Huberman, 1994, p. 10).

This data reduction is part of the qualitative data analysis as the choices for the data reduction narrow and organise the data. Several approaches to data reduction exist, namely writing summaries, coding, teasing out themes, making clusters, making partitions and writing memos (Miles and Huberman, 1994). In particular, assigning codes to qualitative data is a commonly used method to assign a connotation to certain reoccurring themes within the datasets. These codes aim to organise and categorise the data relating to particular research topics (Bryman and Bell, 2003, Miles and Huberman, 1994). Bryman and Bell (2003) and Mason (2006) state that there is no right or wrong way of coding the data. However, it is recommended to reappraise the codes during the analysis and to ensure consistency in all codes throughout the entire dataset. A common problem with the coding approach for analysing qualitative data is that the data might be analysed without considering the wider context. This analysis of data fragments can incur the danger of changing the meaning of any results (Bryman and Bell, 2003).

Following the analytical induction approach, all semi-structured interviews were coded according to the nine examined NPD process success factors. A second inductive scan of the data was performed to identify further emerging themes, and the data was coded accordingly.

3.6.3 CASE STUDY – ANALYSIS

For the analysis of case studies via the analytical induction approach, Patton (2002) describes cross-case analysis as one of the most important strategies. The cross-case analysis is seen as one of the most appropriate methodologies to analyse conflicting or opposing findings and establishing a theoretical framework (Patton, 2002). In order to conduct a cross-case analysis, first individual case studies should be analysed independently. Only if the single case studies are analysed and fully understood is it appropriate to group the case studies and conduct a cross-case analysis across all case studies (Patton, 2002).

3.7 RESEARCH DESIGN

'A research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The plan is the complete scheme or programme of the research.' (Kerlinger, 1986, p. 279)

The research question was derived from the literature and contextual review. In the literature review it was argued that NPD process success factors can predict success for the concept design management. Hence, a comprehensive list of the most frequently referenced NPD process success factors was derived as part of the literature review. In order to validate the hypothesised NPD process success factor list against empirical data, questions from the DME Award questionnaire that corresponded to the NPD process success factors were identified. Due to an unbalanced distribution of questions, a ranking system was developed to eliminate

these inequalities. The extent to which the DME Award dataset utilises the nine NPD process success factors was determined with the help of the ranking system. Semi-structured interviews were conducted and analysed for further insight, and to strengthen the achieved results. As the only current model for assessing design management capabilities, the Design Management Staircase Model was reviewed. The review includes the deconstruction of the Design Management Staircase Model structure, its factors and the underlying questionnaire, which informs the Design Management Staircase Model calculation. Subsequently, the model was empirically analysed based on the DME Award dataset. The review of the Design Management Staircase Model complements the investigation into what factors are important for design management success by providing insight into how design management capabilities might be measured and improved in the future.

The research design of the thesis is outlined in Figure 3.1.

Research Design

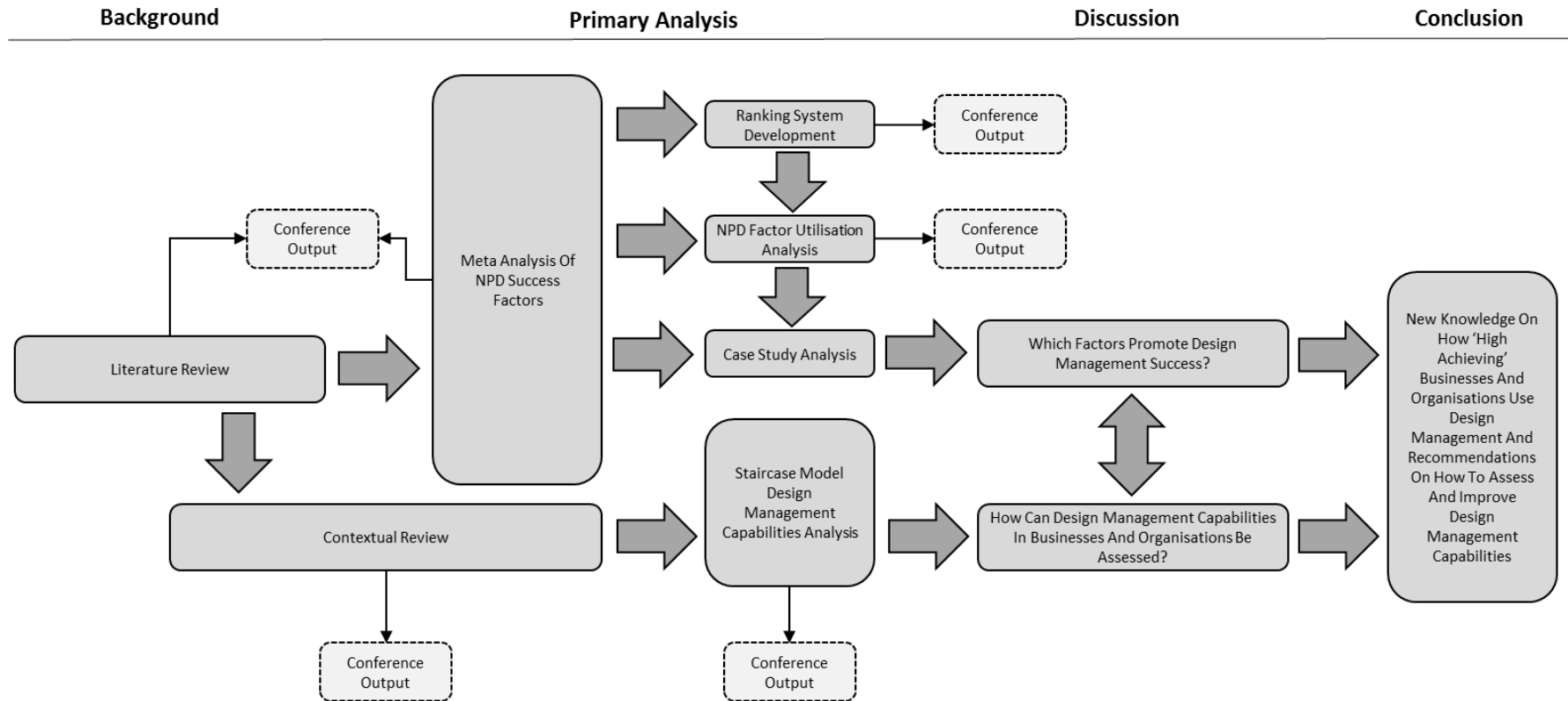


Figure 3.1: Research Design Diagram

The research aim and objectives were presented in section 3.2.1 and 3.2.2 of this chapter. The appropriate research approach for the PhD thesis was discussed in section 3.3. The methodological choice for the literature and contextual review was discussed in section 3.4. The options for conducting the case studies and the analysis were reviewed in section 3.5 and 3.6.

The following sections provide a detailed overview of the chosen chapter approaches for each stage of the research.

3.7.1 CHAPTER APPROACH – LITERATURE REVIEW

A systematic literature review on NPD process success factors was performed. The primary sources for the literature review were the databases Emerald, JSTOR and Business Source Premier. The search terms ‘New Product Development’ and ‘Success’ were used for all three database searches, using the Boolean logic approach (Oliver, 2012). All three databases were searched within journal articles titles. Emerald produced ten results in journal article titles. Business Source Premier generated 57 academic journal articles, which contained both search terms in their title. A search for the terms ‘New Product Development’ and ‘Success’ displayed no results for the database JSTOR. Hence, the search was extended to article abstracts and produced 39 results.

The database search findings contained two articles – Montoya-Weiss and Calantone (1994) and Ernst (2002) – that reviewed and analysed existing literature on NPD process success factor analyses. A further 45 references were derived from the bibliography of the two aforementioned articles.

The aim of this literature review was twofold. Firstly, the development in the NPD process research from 1974 to 2009 was mapped out, including the sub-process of design, which evolved into design management. Secondly, derived from the literature on NPD process success factors, a theorized listing of particular NPD process factors was established. These factors were proven to promote successful product development. According to Montoya-Weiss and Calantone (1994), the existing research about NPD process success factors can be summarised in three main research strings: NPD factors with a positive correlation to the project outcome; NPD factors with a negative correlation to the project outcome; and NPD factors that differentiate between a positive and negative correlation to the project outcome. The scope of the analysed papers was limited to studies with empirical analyses of the correlation between NPD factors and product success based on large-scale studies. In total, 64 studies on NPD process success factors were considered for the literature review. Each of the 64 studies on NPD process success factors was examined, and the presented NPD process success factors of each study were compiled in a comprehensive list. Further, from each study the definition of the different NPD process success factors was examined and terms were clustered and grouped according to definition. The results of the amalgamated terms and the derived definitions are presented in Table 2.1 and Table 2.2.

A literature review on design management was performed. Erichsen and Christensen (2013) searched the databases Ingentaconnect, Wiley and EBSCO with the search term 'Design Management'. The search terms 'Design' with 'Management' were used for a supplementary search in the same databases. Eight journals publishing relevant articles in the field of design management were identified. The most prominent

journals were the Design Management Journal and the Design Management Review. Furthermore, six journals were identified which publish relevant articles about design management on an irregular basis (Erichsen and Christensen, 2013):

- The Design Journal
- Design Issues
- Design Studies
- Journal of Marketing Management
- Journal of Product Innovation Management
- Creativity and Innovation Management.

These journals were the main source for the literature review on design management. Further relevant articles and books were identified through reference scanning.

3.7.2 CHAPTER APPROACH – ANALYSES I – DEPLOYMENT OF THE NPD PROCESS SUCCESS FACTORS

The nine NPD process success factors derived through the Meta-analysis within the literature review are verified and analysed against the DME Award company dataset. The DME Award is the only European business award dedicated to the management of design. Participants are challenged to present their design management structures and processes, and demonstrate the impact of these elements on their commercial prosperity in the form of a freely designed poster. As part of the registration process for the DME Award, participants are required to fill out a research questionnaire. This research questionnaire was developed with the intention to serve research purposes in order to develop state-of-the-art design management knowledge (2015a, 2015b).

A detailed overview of the DME Award data is provided in Chapter 5 DATA GATHERING I – DME AWARD DATA.

The objectives of Chapter 6 ANALYSES I – DEPLOYMENT OF THE NPD PROCESS SUCCESS FACTORS are:

- Correlate corresponding questions from the DME Award questionnaire to the NPD process success factors.
- Establish a ranking system to calculate the effective utilisation of the NPD process success factors.
- Analyse the effective utilisation of the nine NPD process success factors in the DME Award dataset.

3.7.2.1 IDENTIFICATION OF CORRESPONDING QUESTIONS

The DME Award questionnaire was analysed, and any corresponding questions to the nine NPD process success factors were identified based on their definitions. Each of the nine success factors corresponded to at least one question in the DME Award questionnaire from 2009-2012. Table 6.1 through Table 6.9 list each of the nine factors, including the identified corresponding questions. All questions were selected based on the information given in the factor definitions. However, since the design of the questionnaires pre-dates the present research, it was not feasible to identify corresponding questions for all points in the factor definitions. For instance, two questions for the factor 'cross-functional project teams' were identified as corresponding questions [see Table 6.2]. These two questions fail to provide insight as to whether project team is accountable for the project as set out in the definition of the factor.

3.7.2.2 DEVELOPMENT AND CALCULATION OF THE RANKING SYSTEM

The existing design of the DME Award questionnaires results in an unequal distribution of questions to factors, e.g. some factors have only one corresponding question while others have up to four. This inequality is exacerbated by the variation in the number of answer options for the multiple choice questions, with some questions allowing the selection of multiple answers while others allow the selection of only one answer. In order to mitigate the effect of this inequality, a ranking system was developed. The development of the ranking system is described in detail below. With this ranking system, each corresponding question for each factor has an equal weight on the final score for each factor. The scores are calculated in percentages and represent the extent of how each company addresses the different factors, the effective utilisation of the nine factors.

The overall score, or effective utilisation score, across all nine factors is calculated in four different steps:

1. According to the quality of the answer for each question, each answer was ranked in ascending numerical order, with the highest number allocated to the 'best answer'. The 'best answers' were defined by the pre-designed DME Award questionnaire. The number given to each answer equates to that answer's score value.

2. Percentage scores were calculated for each answer. The answer score was divided by the number of the total possible answer scores for the particular question, then multiplied by 100. The end result was the percentage score for each question.

$$\left(\frac{\text{Answer score}}{\# \text{ of total possible answer scores}} \right) * 100$$

= Percentage score for each question

3. The average percentage score for each factor was calculated by summing up the percentage scores for each question of the different factors and dividing it by the number of questions corresponding to that factor. The result was multiplied by 100 to calculate the average percentage score for each factor.

$$\left(\frac{\text{SUM of percentage scores for each question}}{\# \text{ of questions corresponding to the factor}} \right) * 100$$

= Average percentage score for each questions

4. The overall percentage score for effective utilization for all nine factors was calculated by summing the average percentage scores for each factor and dividing it by the total number of factors. The result, multiplied by 100, represents the overall score.

$$\left(\frac{\text{SUM of average percentage scores for each factor}}{\# \text{ of total factors}} \right) * 100$$

= Overall score

This methodology equalizes the weight of all factors, with all factors having the same influence on the overall score. This overall score was designed to show the effective utilisation of all factors for each company, with the better use of each factor receiving a higher percentage score.

3.7.2.3 ANALYSIS OF THE EFFECTIVE UTILISATION OF THE NPD PROCESS SUCCESS FACTORS

In order to test the effective utilisation of the NPD success factors on the DME Award dataset, the overall scores for the effective utilisation were calculated as described in section 3.7.2.2 DEVELOPMENT AND CALCULATION OF THE RANKING SYSTEM.

Sequentially, the average percentage scores for the effective utilisation of each factor over the four-year period from 2009-2012 were calculated. The results are presented in Figure 6.1.

Figure 6.2 represents the development of the effective utilisation of all factors combined for each year over the period 2009-2012. The mean across all factors for each year was calculated.

The development of the effective utilisation of each factor from 2009-2012 is presented in Figure 6.3.

In order to obtain more detailed and specific results, the dataset was divided according to the Staircase level scores. The achieved DME Award ranking and company size and the effective utilisation for each group were calculated. The results are presented in Figure 6.4 to Figure 6.6.

3.7.3 CHAPTER APPROACH – ANALYSES II – CASE STUDIES

In the subsequent qualitative data analysis, the nine NPD process success factors are verified and analysed against the pilot interview. The data gathering for the pilot interview and all further case studies is described in Chapter 7 DATA GATHERING II – CASE STUDIES. All results are presented in Chapter 8 ANALYSES II – CASE STUDIES.

The objectives for this analysis are:

- Deductive and inductive coding of reoccurring themes in the pilot interview.
- Analysis of the suitability of the semi-structured interview guide.
- Amendment of the semi-structured interview guide for further interviews.
- Analysis of the utilisation of the nine NPD process success factors.

3.7.3.1 PILOT INTERVIEW – DEDUCTIVE CODING

The pilot interview was transcribed and transferred into the qualitative data analysis (QDA) computer software package NVivo Version 10. To transform the data into a manageable format, the pilot interview was coded according to themes in NVivo. Following the deductive approach of the analytical induction methodology, the pilot interview was coded according to the nine NPD process success factors. Furthermore, the semi-structured interview questionnaire contained a general question asking for a personal definition of design management. Accordingly, a separate code for design management was created. Each code is defined according to the definitions set out in Table 2.1. The deductive codes are presented in Figure 3.2.

3.7.3.2 PILOT INTERVIEW – INDUCTIVE CODING

A second inductive scan of the transcription was performed to identify additional emerging themes. Further emerging themes were identified and additional inductive codes were created. The inductive codes and the final code structure for the analysis of the semi-structured pilot interview are presented in Figure 3.2.

3.7.3.3 PILOT INTERVIEW – CRITICAL REFLECTION

The semi-structured pilot interview guide was assessed regarding its suitability to provide further insight into the application of the examined nine NPD process success factors. Subsequently, further amendments to the semi-structured interview guide were undertaken. The results are presented in section 8.2.2 CRITICAL REFLECTION.

3.7.3.4 PILOT INTERVIEW – CODING

Eight additional themes were identified using the inductive method. These inductive codes were combined with the previously established deductive codes. The inductive analysis of the pilot interview revealed three strategy-related themes, namely *alignment of company and product strategy*, *company strategy* and *product strategy*. Hence, in the final codes, a new code *strategy* with the sub-codes *alignment of company and product strategy*, *company strategy* and *product strategy* were established. Furthermore, the inductive codes *testing/prototype testing* and *feedback generation* were classified as sub-codes for the theme *customer test, involvement, focus*, providing further facets and insight into this theme. All remaining inductive codes were classified as their own themes, and codes were created accordingly [see Figure 3.2].

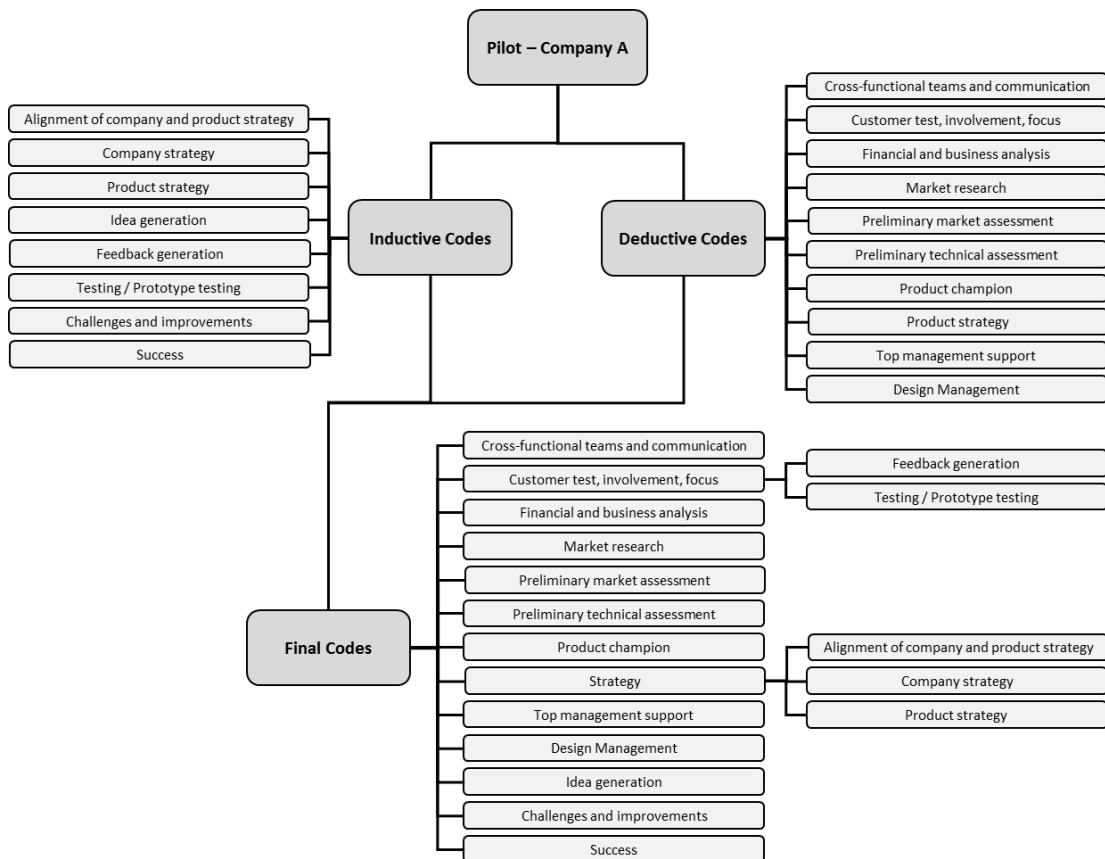


Figure 3.2: Company A – Pilot Interview Coding Structure

3.7.3.5 CASE STUDIES – DEDUCTIVE CODING

All semi-structured interviews, including the pilot interview, were transcribed from the recording, adding up to transcripts of over 290 minutes of interviews. All transcribed semi-structured interviews were transferred into the qualitative data analysis (QDA) computer software package NVivo Version 10.

A further two companies proposed that they would prefer to respond to the semi-structured interview guide in writing rather than conducting a semi-structured interview [see Chapter 7 DATA GATHERING II – CASE STUDIES]. Both questionnaires were also transferred to NVivo 10. This resulted in eight transcribed interviews and two questionnaires.

Following the deductive approach of the analytical induction methodology, all data was coded according to the nine NPD process success factors. Furthermore, the semi-structured interview questionnaire contained a general question asking for a personal definition of design management. Accordingly, a separate code for design management was created. The deductive codes are presented in Figure 3.3.

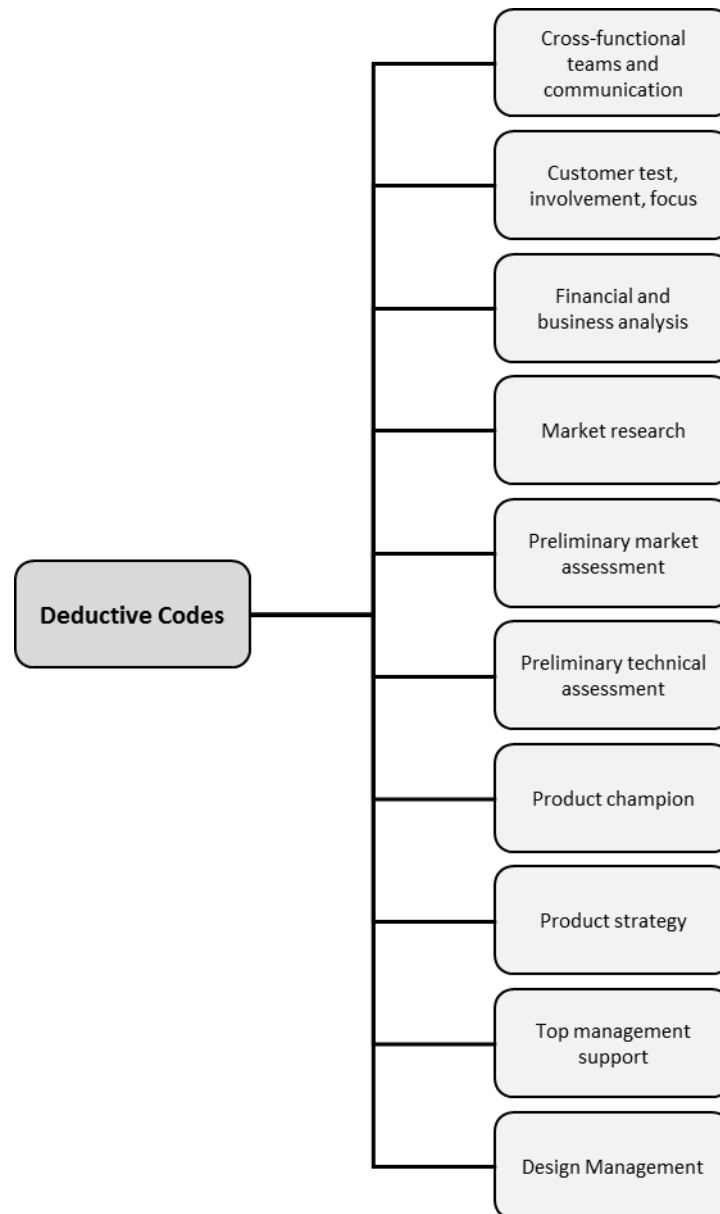


Figure 3.3: Deductive Codes

3.7.3.6 CASE STUDIES – INDUCTIVE CODING

A subsequent inductive analysis identified further emerging themes in the semi-structured interviews. Further codes were developed according to the emerged themes and presented in Figure 3.4.

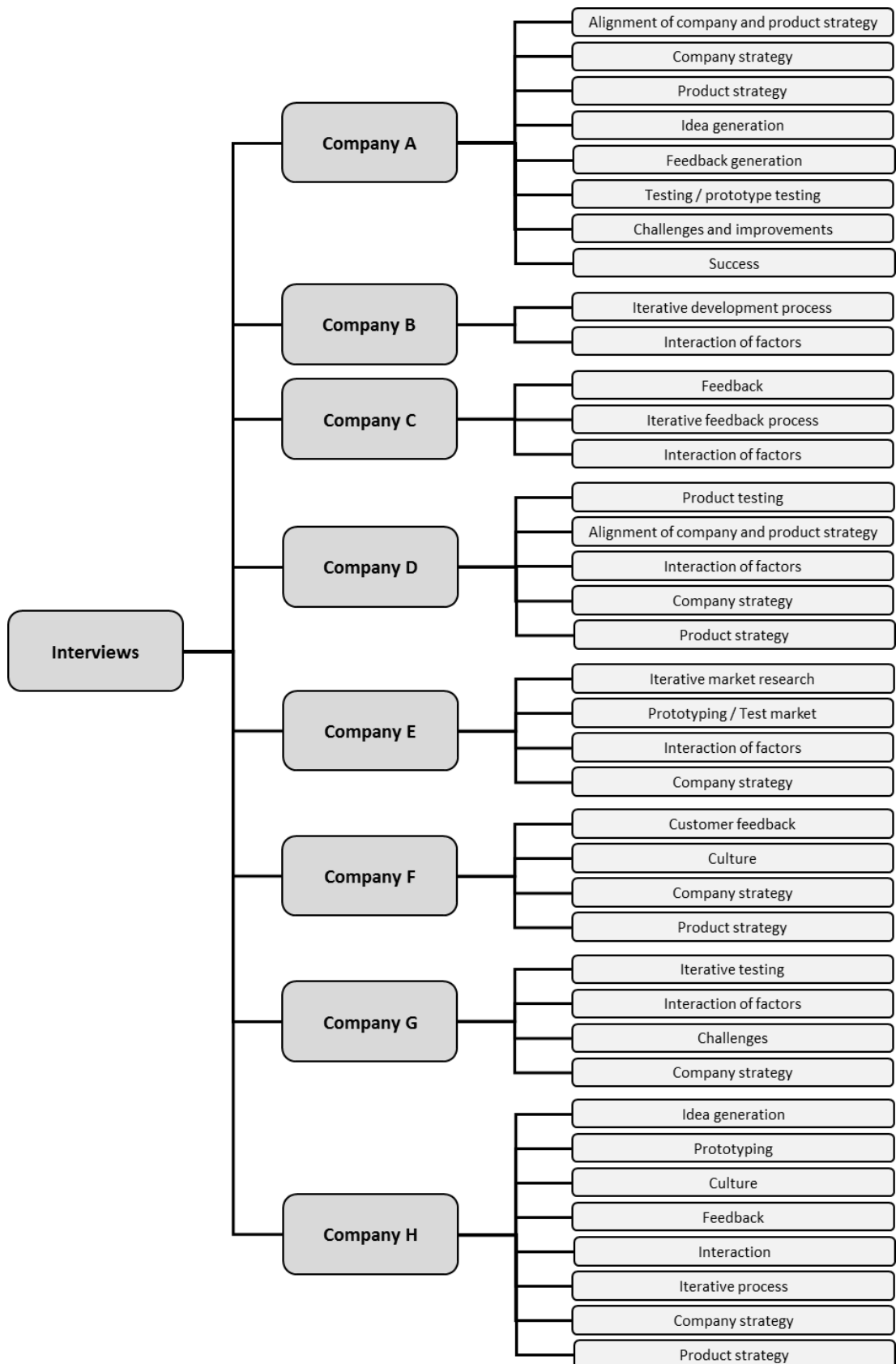


Figure 3.4: Semi-structure Interviews – Inductive Codes

Furthermore, an inductive analysis was performed on the two questionnaires. The results are presented in Figure 3.5.

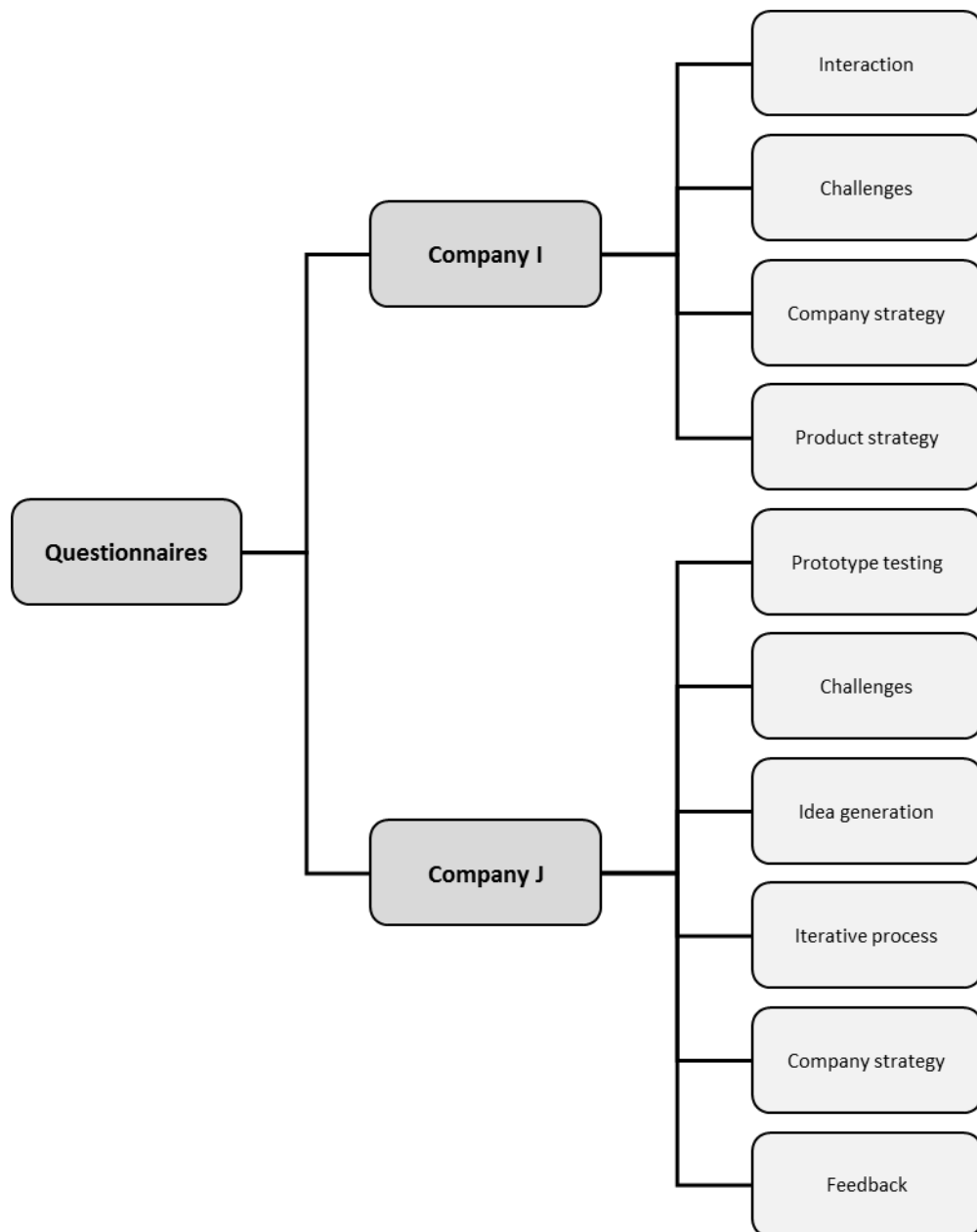


Figure 3.5: Questionnaires – Inductive Codes

All observed inductive codes from the semi-structured interviews and questionnaires were further grouped, and a final list of inductive codes is presented in Figure 3.6.

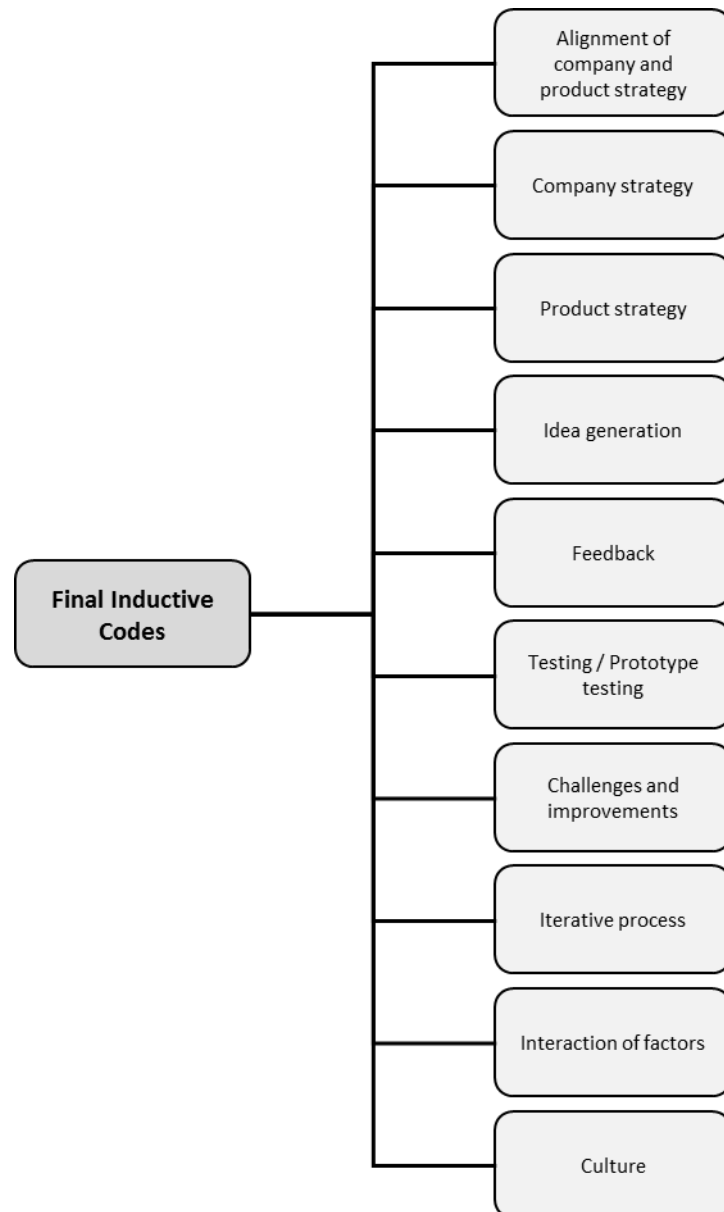


Figure 3.6: Final Inductive Codes

3.7.3.7 CASE STUDIES – CODING STRUCTURE

Both, the deductive codes and inductive codes were combined and further summarised. The final coding list for the case study analysis is displayed in Figure 3.7.

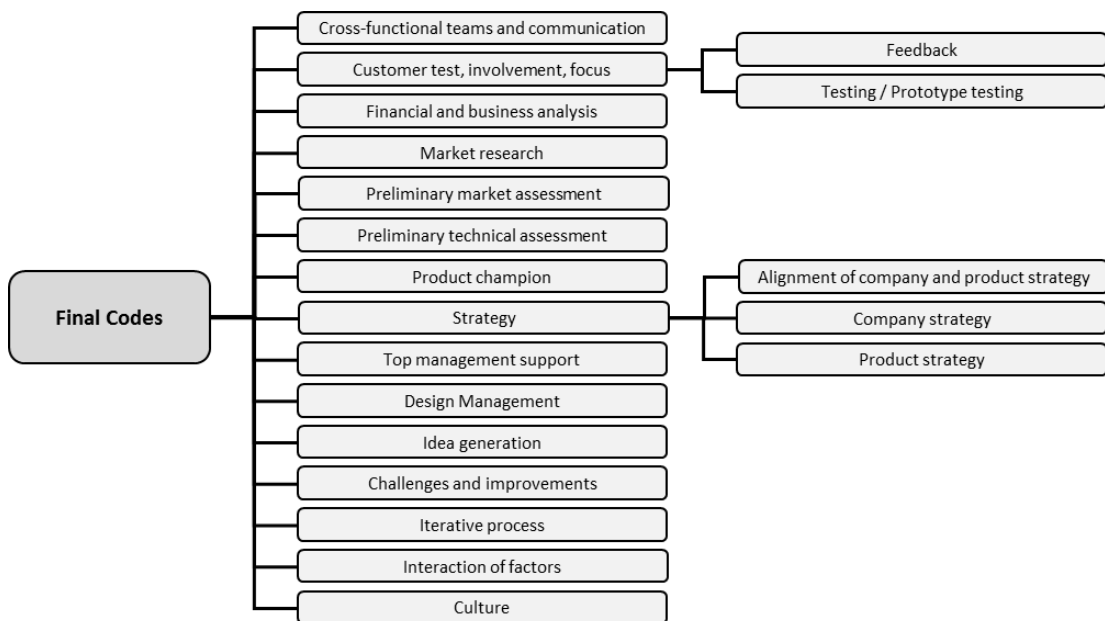


Figure 3.7: Final Coding Structure

3.7.3.8 CASE STUDIES – SUCCESS FACTOR RANKING

Respondents were asked to rank all nine NPD process success factors on a scale from one to six, with one being the least important and influential and six being the most important and influential. All results have been recorded and summarised in Table 8.1. In addition, an average for each factor has been calculated.

3.7.4 CHAPTER APPROACH – CONTEXTUAL REVIEW

The Design Management Staircase Model was developed as part of the DME Award. In the absence of a validated model to assess businesses' design management capabilities, the Design Management Staircase Model was developed (Kootstra,

2009). The contextual review introduced the origins and functions of the Design Management Staircase Model. It included a review of the functionality of the model based on a critical investigation of the Design Management Staircase Model structure and its underlying questionnaire.

The literature for the contextual review was derived from six journals which publish relevant articles about design management on an irregular basis. These journals were:

- The Design Journal
- Design Issues
- Design Studies
- Journal of Marketing Management
- Journal of Product Innovation Management
- Creativity and Innovation Management.

The contextual review built on the above-listed journals as a starting point to identify relevant literature. Further relevant articles and books were identified through reference scanning.

3.7.5 CHAPTER APPROACH – ANALYSIS III – THE DESIGN MANAGEMENT STAIRCASE MODEL

Chapter 9 ANALYSES III – THE DESIGN MANAGEMENT STAIRCASE MODEL investigates the Design Management Staircase Model in its practical application. It aims to provide insight into the design management capabilities of the dataset based on the Design Management Staircase Model and analyses the functionality of the model itself.

In summary, this analysis drew upon the following approaches:

1. Application of the Design Management Staircase Model to the DME Award datasets of European business gathered from the years 2009-2012.
2. Analysing the trend of the design management capabilities of European businesses reflected in the Staircase scores 2009-2012 based on different parameters.
3. Analysing the influence of the position of the person who submitted the questionnaire on the Design Management Staircase Model level scores.
4. Analysing the performance of businesses recognizing design and design management as an important tool for innovation reflected in the Staircase scores.
5. Analysing the interdependencies of the five underlying Staircase factors.

3.7.5.1 THE DATA

The data are derived from the DME Award entry questionnaires from 2009, 2010, 2011 and 2012. The DME Award entry questionnaire is largely identical to the original

Design Management Staircase Model questionnaire, and features the same questions that underlie the calculation of the Design Management Staircase Model scores. The DME Award received 64 completed questionnaires in 2009, 60 in 2010, 44 in 2011 and 24 in 2012.

3.7.5.2 CALCULATION OF THE DESIGN MANAGEMENT STAIRCASE MODEL SCORES

For the calculation of the Design Management Staircase Model level score, and for the scores of each of the five underlying factors, numbers were assigned to each question. All five factors were calculated as the weighted average of these numbers. The Design Management Staircase Model level score is subsequently derived from the average of the five factor scores.

3.7.5.3 DATA SAMPLE

Businesses were grouped following a standard set in the DME Award questionnaires [see APPENDICES - 3. DME AWARD QUESTIONNAIRE]. These groups are according to the entry categories of the DME Award and are defined as:

- Micro Companies (1-9 employees)
- Small Companies (10-49 employees)
- Medium Companies (50-249 employees)
- Large Companies (250+ employees)
- Non-Profit Organisations (NPO)

The sample size according to the DME Award entry categories for 2009-2012 is displayed in Figure 9.1.

3.7.5.4 DEVELOPMENT OF THE DESIGN MANAGEMENT STAIRCASE MODEL FACTOR AND LEVEL SCORES 2009-2012

The average Design Management Staircase Model scores for each of the Staircase Model factors and the Staircase Model level scores were calculated for each year. The development of the Staircase Model factor scores and the Staircase Model level score for 2009-2012 is presented in Figure 9.2.

3.7.5.5 DISTRIBUTION OF THE DESIGN MANAGEMENT STAIRCASE MODEL LEVEL SCORES 2009-2012

For each year, from 2009 to 2012, the Design Management Staircase Model level scores were calculated. In a subsequent step it was calculated which percentage of the yearly sample size achieved which Design Management Staircase Model level score. The results are displayed in Figure 9.3.

3.7.5.6 DEVELOPMENT OF THE DESIGN MANAGEMENT STAIRCASE MODEL LEVEL SCORES ACCORDING TO DME AWARD ENTRY CATEGORIES 2009-2012

The sample size was broken down into the different DME Award entry categories, and the Design Management Staircase Model level scores were calculated for each year from 2009 to 2012. The development of the Design Management Staircase Model level scores according to the entry categories over the four-year period is presented in Figure 9.4.

3.7.5.7 DESIGN MANAGEMENT STAIRCASE MODEL LEVEL SCORES OF THE DME AWARD AWARDEES

The dataset from 2009-2012 was grouped according to the achieved result in the DME Award. Three groups were created: DME Award Winners, DME Award Honourable Mentions, and not-awarded entrants. The average Design Management

Staircase Model level score for each group in each year was calculated and is presented in Figure 9.5.

3.7.5.8 POSITION INFLUENCING THE DESIGN MANAGEMENT STAIRCASE MODEL LEVEL SCORES

The dataset from 2009-2012 was grouped according to the answer options of question 1 of the DME Award questionnaire – ‘Please indicate your position in the company’ [see APPENDICES - 3. DME AWARD QUESTIONNAIRE].

The answer options included:

- R&D Manager / Product Manager / Engineer
- General Manager / President / CEO
- Marketing Manager / Brand Manager
- Design Director / Chief Designer / Design Manager
- Owner-Manager
- Other.

The mean of the Design Management Staircase Model level scores for the six groups was calculated. The results are displayed in Figure 9.6.

3.7.5.9 DESIGN MANAGEMENT AS A TOOL FOR INNOVATION

Datasets for 2009-2012 included additional information regarding the DME Award entrants' recognition of design and design management as important tools for innovation. For each year from 2009 to 2012 the dataset was split into two different groups depending on if the DME Award entrant recognised design as a tool for innovation or not. The results are presented in Figure 9.7.

All statistical analyses were performed using SPSS Statistics 20, IBM.

Before commencing any statistical comparisons, all data was tested for normality using the Kolmogorov-Smirnov and Shapiro-Wilk tests of normal distribution. With a P-value set at $\alpha=0.05$, none of the data showed a normal distribution, therefore all statistical analyses commenced using non-parametric tests.

A Mann-Whitney test was used to compare the Design Management Staircase Model factor scores of the DME Award entrants that did or did not recognise design as an

important tool for innovation for each year [see Table 9.1 and Figure 9.8 to Figure 9.11].

3.7.5.10 INTERDEPENDENCIES OF THE DESIGN MANAGEMENT STAIRCASE MODEL FACTORS

All Design Management Staircase Model factor and level scores from 2009 to 2012 were compiled as one dataset. A Spearman Rank Correlation was used to assess if a relationship between any of the factors exists. Any significant R-value that was ≥ 0.70 was deemed as strongly correlated. The results are displayed in Table 9.2.

CHAPTER FOUR

4. CONTEXTUAL REVIEW

This chapter continues to set the theoretical framework and scope for the study. The purpose of the chapter is to introduce the origins and functions of the Design Management Staircase Model. The following review of the functionality of the model includes a critical investigation of the Design Management Staircase Model structure, and its underlying questionnaire. Results show that the Design Management Staircase Model is largely built upon three major sources: The Design Atlas, The Design Process Audit and the Danish Design Ladder. The assessments of the findings lead to the development of the research question for this study.

4.1 INTRODUCTION

The results from the literature review lead to the conclusion that NPD process success factors are equally important for success in both the NPD process and design management. The Design Management Staircase Model was developed to assess the design management capabilities of businesses and organisations. Both the NPD process success factors and the Design Management Staircase Model fulfil similar objectives. The NPD process success factors are a way to achieve success, while the Design Management Staircase Model is a way to *evaluate* success. Hence, the Design

Management Staircase Model represents a potentially important alternative source to gain further insight into potential design management assessment methods. However, the Design Management Staircase Model had never undergone an academic review, which left it open to criticism regarding its validity and usability. It was unknown if the Design Management Staircase Model structure, including the chosen levels and factors, are appropriate and cover the vital points for design management capability assessment. Furthermore, it remains unknown if the questionnaire, which is used to calculate the design management capabilities of businesses and organisations, delivers adequate information for such assessment. In order to address this ambiguity it was necessary to analyse the existing structure, factors, levels and the underlying questionnaire of the Design Management Staircase Model. Understanding the Design Management Staircase Model and addressing its ambiguity will substantially increase the gained knowledge about design management assessment methods, and forms a crucial step of this PhD research. This is particularly important as the Design Management Staircase Model was identified as the only model to assess design management capabilities. Most importantly, validating the Design Management Staircase Model will raise further questions regarding the relationship between the Design Management Staircase Model and the examined NPD process success factors as predictors for design management success. Hence, this chapter will:

- Introduce the Design Management Staircase Model level and factor structure
- Deconstruct the Design Management Staircase Model level and factor structure based on literature

- Analyse the Design Management Staircase Model questionnaire.

4.2 THE DESIGN MANAGEMENT STAIRCASE MODEL

The Design Management Staircase Model was developed as part of the DME Award. The DME Award was initiated as part of the two-year Award for Design Management Innovating and Reinforcing Enterprises (ADMIRE) project in the European PRO-INNO programme of the Directorate-General for Enterprise and Industry of the European Commission. From 2007 until the end of the ADMIRE programme in February 2009, the DME Award was organised by 18 participating organisations under the coordination of the City of Eindhoven. Since the end of the funding period, the former ADMIRE partners have been organising the DME Award on a voluntary basis. The key objectives of the ADMIRE project was to improve the competitive edge and innovation capabilities of European businesses, with a particular focus on small and medium enterprises (SMEs). This was to be achieved by raising the awareness of design management, and by promoting and stimulating the implementation of good design management processes. The key activity in order to fulfil this objective was the establishment of the DME Award. The DME Award is the only European business award dedicated to the management of design. Participants are challenged to present their design management structures and processes, and demonstrate in the form of a freely-designed poster the impact of these elements on their commercial prosperity. As part of the registration process for the DME Award, participants are required to fill out a research questionnaire. This research questionnaire was developed with the intention to serve research purposes in order to develop state-of-the-art design management knowledge (DME Award, DME Award, Wikipedia).

In the absence of a validated model to assess businesses' design management capabilities, the Design Management Staircase Model was developed (Kootstra, 2009). The Design Management Staircase Model is based on the DME Award questionnaire and was tested on a large-scale study amongst 605 European businesses. The results of this study are presented in the Kootstra (2009) report 'The Incorporation of Design Management in Today's Business Practices'. Several publications have been produced regarding the DME Award and the DME Award research (e.g. Best et al., 2010, Brazier and Cruz, 2009).

The Design Management Staircase Model aims to enable European businesses to assess and improve their design management capabilities in order to increase their effective use of design and improve their competitive edge and business success. To assess design management capabilities a process perspective was taken, classifying the design management capabilities of businesses into four different levels, ranging from an immature stage, level 1, through to level 4, where design is managed strategically. All four levels are further defined by five factors influencing the success or failure of design and thus indicating the quality of design management. The level ranking is dependent on the extent to which businesses implemented these five factors. Each of these factors is explored through three to four multiple-choice questions. The DME Award registration questionnaires from the years 2008-2012 have been made accessible for this research and represent a key dataset for this study [see Chapter 5 DATA GATHERING I – DME AWARD DATA].

4.3 DESIGN MANAGEMENT STAIRCASE MODEL STRUCTURE

4.3.1 DESIGN MANAGEMENT STAIRCASE MODEL LEVELS

Kootstra (2009) describes the structure of the Design Management Staircase Model. He states that the Design Management Staircase Model is based on a method comparable to the Design Ladder (Ramlau and Melander, 2004) of the Danish Design Centre. The Design Management Staircase Model describes the characteristic design management behaviour and capability of businesses at four levels. The level classification ranges from the lowest level 'No Design Management' to the highest level where design management is used strategically and is part of the business culture [see Figure 4.1]. This ranking implies that businesses reaching higher levels of the model employ design more strategically than those in lower levels. However, businesses do not necessarily have to strive for the highest level, as various external factors determine the particular needs of each business, and the most appropriate level of the Design Management Staircase Model (Kootstra, 2009).

The four levels as adapted from Kootstra (2009) are presented as:

- Level 1: No Design Management
- Level 2: Design Management as a Project
- Level 3: Design Management as a Function
- Level 4: Design Management as a Culture.

4.3.1.1 LEVEL 1: NO DESIGN MANAGEMENT

In this level, businesses make no use of design management. Design has no role in the business objectives and is only applied occasionally with no or limited objectives. All design results are highly unpredictable and inconsistent due to a lack of a clearly

defined process. Design knowledge and experience is accordingly absent or very limited (Kootstra, 2009).

4.3.1.2 LEVEL 2: DESIGN MANAGEMENT AS A PROJECT

In this level, the use of design is limited to meeting direct business needs. Design is not recognised as a tool for innovation, or implemented in any systematic way in the NPD process. Therefore, the use of design is restricted to adding value to existing products through styling, packaging et cetera, and is only used as a marketing tool with a minimum of coordination. The responsibility of design remains at an operational level (Kootstra, 2009).

4.3.1.3 LEVEL 3: DESIGN MANAGEMENT AS A FUNCTION

In this level, businesses start to recognise design as a tool for innovation. Design is integrated into the NPD process, and several disciplines and specialists become involved in the design process. The formal responsibility for design lies with an assigned staff member or department managing all involved groups (Kootstra, 2009).

4.3.1.4 LEVEL 4: DESIGN MANAGEMENT AS A CULTURE

In this level, businesses are highly design-driven and potentially established market leaders through design-driven innovations. Design is an essential part of their differentiation strategy, generating a distinct competitive advantage. For this reason, design is an integral part of the business processes with the involvement of a wide range of different departments. A design-literate top management is reinforcing the support and significant value of design across the entire business. This results in design being a part of the businesses' corporate culture (Kootstra, 2009).

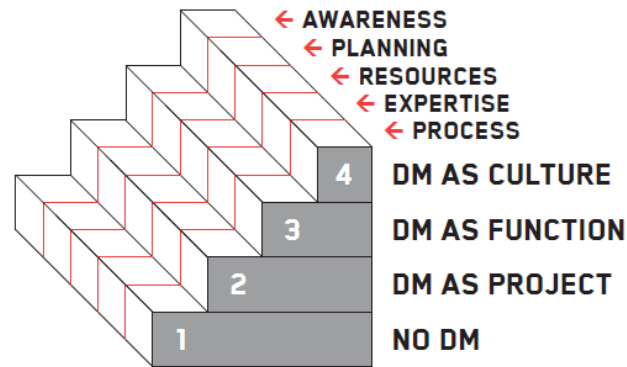


Figure 4.1: Design Management Staircase Model

Source: Kootstra, Gert (2009, p. 12)

4.3.2 DESIGN MANAGEMENT STAIRCASE MODEL FACTORS

All four levels of the Design Management Staircase Model are further defined by five factors influencing the success or failure of design, and indicating good design management [see Figure 4.1 and Table 4.1]. The level ranking is dependent on the extent to which businesses have implemented these five factors.

The five factors as adapted from Kootstra (2009) are presented as:

4.3.2.1 FACTOR AWARENESS

‘The extent to which businesses are aware of the benefits and the potential value that design and Design Management can offer.’

(Kootstra, 2009)

The attitude of the management towards design is a crucial point for this factor. It needs to incorporate both design support and design awareness and instil this awareness within the company as a whole. The lack of design education and knowledge proves to be a major barrier (Kootstra, 2009).

4.3.2.2 FACTOR PLANNING

‘The extent to which businesses have developed a strategy for design, articulated in business plans and communicated widely.’

(Kootstra, 2009)

The factor *planning* describes the formal documentation of business plans and objectives leading to the establishment of a corporate strategy. This includes the integration of design aligned to the strategy and contributing to achieving the business plans and objectives (Kootstra, 2009).

4.3.2.3 FACTOR RESOURCES

‘The extent to which businesses invest in design. Resources are considered as the sum of all design investment.’ (Kootstra, 2009)

The factor *resources* refer to the design investments. This is the dedicated design budget for the allotment of staff, staff training and facilities to be used specifically for design projects (Kootstra, 2009).

4.3.2.4 FACTOR EXPERTISE

‘The quality of the design staff and the range of tools and methods applied.’ (Kootstra, 2009)

The factor *expertise* describes the range and quality of employed design experts and applied design tools and methods (Kootstra, 2009).

4.3.2.5 FACTOR PROCESS

'The extent to which businesses follow a professional and effective design management process, embedded in core business processes.' (Kootstra, 2009)

This factor is asking for the implementation of design into the development process. Design should be formally integrated from the beginning to the end of the development process and link all involved parties (Kootstra, 2009).

FACTORS	DESIGN MANAGEMENT CAPABILITY LEVELS			
	LEVEL 1: NO DM	LEVEL 2: DM AS PROJECT	LEVEL 3: DM AS FUNCTION	LEVEL 4: DM AS CULTURE
AWARENESS (OF BENEFITS)	Not aware of benefits and potential value of design (unconscious use or no use)	Some functional specialists are aware	Most are aware that it is important to remain competitive	All are aware that it is fundamentally important to gain a leadership position
DM PROCESS	No idea where design fits within current processes	Performed inconsistently and late in the development process; not repeatable across projects	Performed consistently and early; formal DM process drives performance	Ongoing activity; business is engaged in continuously improving DM process
PLANNING	Company / marketing plans do not mention the use of design	Limited plans and objectives exist at the individual project level	Plans and objectives exist which set direction and integrate design in various activities	Design is part of strategic plans; design planning is a dynamic process that drives the business
DM EXPERTISE	Little or no skills to handle design activity; no DM tools applied	Some skills; basic DM tools applied inconsistently; lots of room for improvement	Standard DM tools applied consistently; some room for improvement	Appropriate expertise; use of advanced DM tools; appropriate metrics used
DESIGN RESOURCES	The business has not committed resources to design activity	Limited resources are allocated for individual projects; one-off design investments with no review of potential returns	Sufficient resources are allocated on the basis of potential return, but with limited procedures in place to assist in decision making	Substantial resources are allocated, with financial procedures in place to assist in appraising investments, assessing risk and tracking returns

Table 4.1: Design Management Staircase Model maturity grid

Source: Kootstra, Gert (2009, p. 15)

4.4 DECONSTRUCTION OF THE DESIGN MANAGEMENT STAIRCASE MODEL

As a first step, the structure of the Design Management Staircase Model is assessed based on a literature review. The literature review is presented in the following sections, 4.4.1 and 4.4.2. Section 4.4.1 concentrates on the interpretation of the general working concept of the Design Management Staircase Model. Section 4.4.2 will investigate the Design Management Staircase Model level structure and factor choice.

4.4.1 MATURITY GRID

The Design Management Staircase Model was developed to address the lack of knowledge concerning the way businesses in Europe manage design. The main research question formulated by Kootstra is:

‘How do European SMEs manage design in practice, and how can they further develop their (design management) skills to increase the effectiveness of their design activities?’ (Kootstra, 2009, p. 16)

The Design Management Staircase Model framework is based on a process maturity model. Each level of the model builds on the previous level. It suggests that each business can undergo a development process to reach the subsequent level. A wide range of maturity and growth models can be found in the literature (Nolan and Gibson, 1974, Greiner, 1998, Crosby, 1979). These models commonly classify development in different stages. Each of the stages has its own challenges to overcome, and reaching the subsequent level results in better control. However, it is

not essential for businesses to attempt to reach the highest level, but rather to settle with the best fit for their specific needs (Nolan and Gibson, 1974).

4.4.2 THE DESIGN MANAGEMENT STAIRCASE MODEL STRUCTURE

Various studies have shown that design makes a positive contribution to business performance. For example, Kotler and Rath (1984) argued that design can create a distinct competitive advantage for businesses, and Gemser and Leenders (2001) analysed how industrial design affects the performance of businesses. Despite finding evidence for a general positive effect of industrial design on performance, it was found that this impact depends upon certain conditions. In fact, the impact of industrial design depends largely on the industry, and in particular on the strategy by which industrial design is integrated into the NPD process. Similarly, Hertenstein, Platt and Veryzer (2005) were able to show that good industrial design which enhances the value, utility and appearance of a product also improves the performance of businesses in a range of metrics. Industrial design is hereby understood as a process in liaison with multiple departments and stakeholders. The emphasis is clearly that industrial design has to be seen as a design process. Kotler and Rath (1984) alike argued that design is an active planning and decision-making process which results in a finished product. This design process is seen as a part of the NPD process with the involvement of designers from early stages such as idea generation onwards. Although the design process is closely related to the NPD process, there is a clear difference between the two. The design process can be applied to all types of creative activities and focuses on the generation, evaluation and implementation of solutions. It forms the set of technical factors within the NPD

process to meet marketing and business aims (Moultrie et al., 2006, Moultrie et al., 2007). Giving designers a more fundamental role can enhance the entire NPD process, creating a more synergistic versus individualistic environment. However, once a part of this process, it will also be necessary to implement management skills such as motivation and persuasion, relationship management and negotiation, and the ability to effectively market a product (Perks et al., 2005). This highlights the importance of management at any level. The article of Ahire and Dreyfus (2000) showed that managing the design process has a positive input on product-design performance and process-quality management. It appears that good design emerges as a result of well-managed processes, such as a development process that embeds organisational activities, practices and skills. Such a managed process might be considered as design management. This view is supported by Chiva and Alegre (2009) in their assessment of the effect of design investment on business performance, and how this effect is mediated by design management. It was revealed that design management improves business performance and that design investment is positively related to design management. However, it is emphasized that purely investing in design does not consequentially lead to improved business performance, but rather a well-managed and effective process.

According to Mozota (2003, p. 70), design management has two objectives:

1. 'To train partners/managers and designers;
2. To develop methods of integrating design into the corporate environment.'

According to Peter Gorb (cited in Mozota, 2003), design management primarily concentrates on allocating all available design resources to businesses to achieve

their strategic objectives. This discipline oversees and directs a business's creativity and manages the business itself in accordance with their design principles. Therefore, design management has a design-educating role by communicating the value of design and integrating it into the business strategy, and also a managerial task by allocating necessary resources to design and managing the design process.

The management, and foremost the integration, of design can take place on three different levels in any business: the operational level, the functional level and the strategic level. Design on an operational level is considered as the initial stage towards integrating design into the business structure. The second level is presented as creating a design function in the business. The strategic level is characterised by the transformation of the business strategy through design. Each of the design integration levels are characterised by eight underlying factors, which vary in their specification and execution depending on the levels (Mozota, 2003). The factors are presented as:

- Strategy (Design strategy)
- Planning (Defining design procedures and briefs)
- Structure (Design process)
- Finances
- Human Resources
- Information (Developing a design understanding in business)
- Communications
- R&D.

Possible impacts on the business have been identified in four key areas. Firstly, design can act as a facilitator, bringing the cost, quality and time-to-market into rough parity

with competitors. Secondly, it can act as a differentiator, making products more attractive, distinctive, relevant and easier to use. Thirdly, it can act as an integrator, implementing design effectively with other functions. And finally, design can act as a communicator, articulating a business's personality, purpose, and standards to internal and external audiences. However, the impact of design on these four key areas is largely dependent on the way in which design is managed, the employment of the right expertise, and the allocation of the right resources (Hayes, 1990).

Further influential factors for the effective management of the design process have been uncovered. In particular, a set of five skills have been found as essential to the design process. These include the general ability to manage the factors within the design process. This can be on a very basic level, such as managing the design process to produce high-quality products, but also the ability to manage specialised factors such as the ability to assess manufacturability. Further, essential skills are the ability to involve different stakeholders such as customers and suppliers in the design process. Closely related is the ability to manage change, which can refer to general organisational change but also to the ability to manage cross-functional teams. Foremost is the ability to manage innovation. This skill is also related to cultural factors, and in particular awareness, as it involves the establishment of a creative environment, raising the awareness and generating ideas for innovation (Dickson et al., 1995). Montana, Guzman and Moll (2007) describe in their brand design management model how creating a design management culture is crucial to unleash the full potential of design. A key point in creating a design culture is the strong involvement of the top management to manage the design process efficiently. Awareness and understanding of the potential of design is hereby a vital

precondition. Four further factors have been identified as important design management factors. These are concept generation, design strategy, resource allocation and implementation. Olson, Slater and Cooper (2000) developed a process approach for managing design. The first step in the process is raising the awareness by articulating the business objectives and strategies amongst the entire business. The second step involves the understanding of the design requirements but foremost identifying what skills, resources and financial requirements have to be allocated to the design process. The third step is mainly concerned with ensuring good communication between different involved departments. The fourth step consists of finalising a detailed design brief that takes into account the business strategy, design specifications and positioning against rival products. The final step is the measurement of design performance. This can include both the evaluation of the output product and the evaluation of the design process itself.

Several attempts have been made to classify design factors and capabilities. The Design Ladder presented by Ramlau and Melander (2004), and in the report of the Danish Design Centre (2003), developed a framework to assess the degree of design activity implemented by businesses. The ladder categorises the design factors into four different levels. An important finding of the framework was that the performance of businesses improves relative to their ranking on the Design Ladder. However, the model fails to explain the criteria for placing businesses on the ladder. The levels are presented as:

- **No use of design.**

In these businesses, design is a hidden aspect of product development. It is generally the task of non-design disciplines to develop the functionality and aesthetics of a product (Ramlau and Melander, 2004, p. 50).

- **Design as styling.**

Design is seen as the final styling of a product. The task may or may not be undertaken by professional designers (Ramlau and Melander, 2004, p. 50).

- **Design as process.**

Design is not an end result, but rather a work method adopted at an early stage of product development and requiring the involvement of several different disciplines, including design (Ramlau and Melander, 2004, p. 50).

- **Design as strategy.**

Design has been adopted as a central aspect of the company's business base, used as a means of encouraging innovation, for instance (Ramlau and Melander, 2004, p. 50).

The Design Atlas was developed to assess business capabilities and the contribution of design (Summers, 2000). It assesses businesses in five key design areas. These are planning, process, resources, skills and design culture. These five factors are assessed based on 15 underlying questions. Depending on the answers given, businesses can score between one to four points for each answer, with 1 as the lowest and 4 as the highest (Inns, 2002).

Moultrie and Fraser (2004) contributed the Design Process Audit model. This design audit is based on process maturity principles where design performance is classified

into four levels. Each level is further defined by five factors. These factors respond to 24 key design factors in which businesses can achieve scores from one to four according to the levels. Maturity is defined as:

‘The degree to which processes and activities are executed following “good practice” principles and are defined, managed and repeatable.’ (Moultrie and Fraser, 2004, p. 34)

The maturity levels are defined as:

Factors/Levels	Level 1: Not performed or ad hoc	Level 2: Partially performed	Level 3: Formally performed	Level 4: Culturally embedded
Degree of awareness of benefits	Not aware of the benefits	Some are aware of the benefits	All are aware of the benefits	Fundamentally important to success
The people involved	Individual heroics	Functional specialists	X-functional or core team involvement	Extended team including external specialist
The timing of the activity	Typically not performed	Performed inconsistently or late	Performed consistently and early	On-going activity
Whether an effective process is followed	No process	Partial process — not repeatable across projects	Formal process drives performance	Continuously improving process
The level of expertise	Little or no expertise No tools applied	Some skills Basic tools applied inconsistently Lots of room for improvement	Standard tools applied consistently Not ingrained across the business Some room for improvement	Use of advanced tools and methods Culturally embedded Appropriate metrics used

Table 4.2: Design process maturity model

Source: Moultrie and Fraser (2004)

FACTORS	DESIGN MANAGEMENT CAPABILITY LEVELS			
	LEVEL 1: NO DM	LEVEL 2: DM AS PROJECT	LEVEL 3: DM AS FUNCTION	LEVEL 4: DM AS CULTURE
AWARENESS (OF BENEFITS)	Not aware of benefits and potential value of design (unconscious use or no use)	Some functional specialists are aware	Most are aware that it is important to remain competitive	All are aware that it is fundamentally important to gain a leadership position
DM PROCESS	No idea where design fits within current processes	Performed inconsistently and late in the development process; not repeatable across projects	Performed consistently and early; formal DM process drives performance	Ongoing activity; business is engaged in continuously improving DM process
PLANNING	Company / marketing plans do not mention the use of design	Limited plans and objectives exist at the individual project level	Plans and objectives exist which set direction and integrate design in various activities	Design is part of strategic plans; design planning is a dynamic process that drives the business
DM EXPERTISE	Little or no skills to handle design activity; no DM tools applied	Some skills; basic DM tools applied inconsistently; lots of room for improvement	Standard DM tools applied consistently; some room for improvement	Appropriate expertise; use of advanced DM tools; appropriate metrics used
DESIGN RESOURCES	The business has not committed resources to design activity	Limited resources are allocated for individual projects; one-off design investments with no review of potential returns	Sufficient resources are allocated on the basis of potential return, but with limited procedures in place to assist in decision making	Substantial resources are allocated, with financial procedures in place to assist in appraising investments, assessing risk and tracking returns

Source
 Design Ladder
 Design Atlas
 Design Process Audit

Table 4.3: Sources of the Design Management Staircase Model Structure

Consulting the extant literature indicates that the Design Management Staircase Model follows fundamentally the same principles, structures and factors as the Design Ladder, the Design Atlas and the Design Process Audit [see Table 4.3]. All three underlying models are robust, established and widely cited working models in the academic and business environment alike. This leads to the conclusion that the

Design Management Staircase Model can be accepted as a valid model to assess design management capabilities. However, it still remains unclear if the questionnaire which is used to calculate the Design Management Staircase Model scores is appropriate to give adequate insight into the five Design Management Staircase Model factors, and can therefore be used as evidence to classify design management capabilities.

4.5 THE DESIGN MANAGEMENT STAIRCASE MODEL QUESTIONNAIRE

Section 4.4 revealed that the Design Management Staircase Model is largely built on three sources: the Design Atlas, the Danish Design Ladder and the Design Process Audit. It follows the same principles, structures and factors as the three established models. However, it still remains unclear if the questionnaire of the Design Management Staircase Model offers adequate insight in order to calculate the Staircase Level scores and to classify businesses' design management capabilities based on the gained insights. As the Design Management Staircase Model features large intersections with the three aforementioned models, it appears logical to assess the questionnaires, which are being used for the three models for further consistencies. The Danish Design Ladder frames a widely-recognised and -utilised model to classify design on four different levels. However, the published literature regarding the Danish Design Ladder does not offer any information about the questionnaire, which underlies the model. The report 'Design Atlas: A tool for auditing design capability' by Preddy and Conte (2000) offers insight into the questionnaire which underlines the Design Atlas. In addition, Moultrie and Fraser

(2004) provide detailed information about the questionnaire for the Design Process Audit.

The report on the Design Atlas provides descriptions of the underlying questions in the five categories:

- Planning for design
- Process for design
- Resources for design
- People for design
- Culture for design.

All five categories are further subdivided into two to five sections. A general short introduction for each of these sections is provided, including hints for evidence which could be assessed to gain insight into the sections. Furthermore, a question is formulated for each section together with four answer possibilities for the four different levels of the Design Atlas. These questions form the questionnaire of the Design Atlas and companies can be classified on the basis of the chosen answer (Preddy and Conte, 2000).

The questions underlying the Design Process Audit are divided into five subcategories:

- Design Execution: Requirements capture
- Design Execution: Concept design
- Design Execution: Implementation
- Design Management: Project generation
- Design Management: Project management.

All five categories contain a further four to six subcategories which give insight into the five categories. All subcategories contain ranked answer choices for the four levels of the Design Process Audit (Preddy and Conte, 2000).

The questions 1 to 11e of the DME Award questionnaire concern business and financial data which has no impact on the Design Management Staircase Model level ranking. These 15 questions in the first part of the questionnaire are not reflected in the Design Atlas or the Design Process Audit questionnaire. The same applies to question 30 of the DME Award questionnaire. This question, regarding barriers for design management, is not reflected in the Design Atlas or the Design Process Audit and is also not used for the calculation of the Design Management Staircase Model level scores.

DME Award Question	Source
Q12. Has your company over the last 3 years engaged in design activities with regard to the following?	<ul style="list-style-type: none"> • Not Identified
Q13. Which of the following does your company exploit to optimise/maximise design capability?	<ul style="list-style-type: none"> • Design Atlas
Q14. What level of resources (staff, budgets and means of production or implementation) are allocated to design activity and how?	<ul style="list-style-type: none"> • Design Atlas
Q15. Which statement best describes who is managing design activities in your company?	<ul style="list-style-type: none"> • Design Atlas
Q16. To what extent are design activities being coordinated?	<ul style="list-style-type: none"> • Design Atlas
Q17. What place has design in the process when something new is developed, i.e. when are designers typically involved?	<ul style="list-style-type: none"> • Design Process Audit
Q18. Is design part of company or marketing plans and objectives?	<ul style="list-style-type: none"> • Design Atlas
Q19. Please rate the following statements that best describe how design research is conducted in your company/organisation:	<ul style="list-style-type: none"> • Design Atlas • Design Process Audit
Q20. Is competitors' analysis part of the design planning process in your company?	<ul style="list-style-type: none"> • Design Process Audit
Q21. How do evaluation and selection of the best design solutions – to satisfy business, market and consumer needs – take place?	<ul style="list-style-type: none"> • Design Process Audit
Q22. Does your company evaluate or monitor design performance before and/or after market launch?	<ul style="list-style-type: none"> • Design Process Audit
Q23. Please indicate how the design process in your company takes place.	<ul style="list-style-type: none"> • Design Atlas
Q24. Please rate how the tools and methods listed below are applied to design activities in your company?	<ul style="list-style-type: none"> • Design Atlas
Q25. Over the last 5 years, to what extent would you say that design has improved the following within your company?	<ul style="list-style-type: none"> • Not Identified
Q26. To what extent do you personally believe the following statements to be true?	<ul style="list-style-type: none"> • Not Identified
Q27. To what extent does your company foster a design culture & environment that encourages creativity, originality and novelty?	<ul style="list-style-type: none"> • Design Process Audit
Q28. In your view, what are the benefits for your company when managing design effectively?	<ul style="list-style-type: none"> • Not Identified
Q29. To what extent are people in the company aware of the benefits of managing design effectively?	<ul style="list-style-type: none"> • Design Atlas

Table 4.4: Overview – Sources of the DME Award Questionnaire

The majority of the remaining questions in the DME Award questionnaire corresponded to questions in the Design Atlas and Design Process Audit. Only question 12, 'Has your company over the last 3 years engaged in design activities with regard to the following?', question 25, 'Over the last 5 years, to what extent would you say that design has improved the following within your company?', question 26, 'To what extent do you personally believe the following statements to be true?', and question 28, 'In your view, what are the benefits for your company when managing design effectively?' were not identified in the Design Atlas or Design Process Audit.

Question 13 of the DME Award questionnaire offers ten multiple choice answers regarding the design capabilities and which options are exploited to maximise them. A corresponding question can be found in the Design Atlas questionnaire under the section 'People for design'. Comparably, this question is asking for available skills to handle design activities with answer possibilities on four levels. Likewise, both questions aim to determine if appropriate design capabilities exist (Preddy and Conte, 2000).

Question 14 of the DME Award questionnaire was also identified in the Design Atlas under 'Resources for design'. Both questions offer four answer choices plus the answer option 'Other/don't know' in the DME Award questionnaire. The DME Award question is generally asking for the allocation of resources, while the Design Atlas question explores to which degree budget allocation exists (Preddy and Conte, 2000).

Apart from this, the answer options are identical, e.g.:

- **Design Atlas**

Budgets are allocated on the basis of potential return with financial procedures in place to help assist in appraising investments, assessing risk and tracking returns (Preddy and Conte, 2000, p. 21).

- **DME Award questionnaire**

Significant resources are allocated on the basis of potential return, with financial procedures in place to help assist in appraising investments, assessing risk and monitoring returns.

Question 15 of the DME Award questionnaire is similar to question 13. Equally, it offers seven answer choices in regard to who is managing the design activities, while the corresponding question from the Design Atlas (section 'Culture for design') presents one answer for each of the four levels. Both questions are aiming to gain insight into by whom and how the design activities are managed. The Design Atlas question is therefore concentrating on the commitment of the senior management. The DME Award question goes one step further and provides a range of options, with the highest ranked answer being a cross-functional team with the full support and integration of senior management (Preddy and Conte, 2000). Questions 16 to 18 of the DME Award questionnaire again follow the structure of providing four answer choices which correspond to the four Staircase Levels plus the option 'Other/don't know'. DME Award question 16 asks for the extent to which design activities are being coordinated. The corresponding question from the Design Atlas in the section 'People for design' discloses information on four levels regarding the organisation of design activities for a successful outcome (Preddy and Conte, 2000). Hence, both questions

aim to give insight into the coordination and organisation of conducted design activities.

Question 17 of the DME Award questionnaire, regarding the time point of design involvement in the development process, is reflected in the Design Process Audit questionnaire under 'Specialist design involvement'. Rather than asking for general design involvement in the development process, this question examines when specialist designers are typically involved. However, the ranking of the answers remains the same, ranging from no involvement of design on level one to 'Design-led innovation' and involvement of design from the origins of the project on level four (Moultrie and Fraser, 2004).

Question 18 of the DME Award questionnaire is reflected in a mix of three different questions from the Design Atlas questionnaire under the section 'Planning for design'. The DME Award question is inquiring if design is included in the company and marketing plans and objectives. The three questions from the Design Atlas aim to gain insight regarding a general planning awareness, a design planning awareness, and if the planning is widely communicated (Preddy and Conte, 2000). A mix of all three questions or directly copied answers can be found in the DME Award question 18, e.g.:

- **Design Atlas**

Company plans and objectives do not mention the use of design

(Preddy and Conte, 2000, p. 14).

- **DME Award questionnaire**

Company or marketing plans and objectives do not mention the use of design.

Question 19 of the DME Award questionnaire, regarding how design research is conducted, relates to the section 'Planning for design' in the Design Atlas. Similarly to question 13 and 15, question 19 lists ten different tools and methods for design research which can be ranked on a three-point scale ranging from 'sometimes' to 'standard procedure'. The Design Atlas question generally asks if any tools and methods are used and categorises the extent into four answers according to the levels (Preddy and Conte, 2000). A partial overlap for the answer choices of question 19 can be found in the Design Process Audit, e.g. in the section 'Investigating user needs' (Moultrie and Fraser, 2004).

Question 20 of the DME Award questionnaire, regarding if competitors' analysis is part of the design planning, links to the section 'Competitive analysis' in the Design Process Audit. Both classify the answers into four ranked answer choices regarding the degree of competitor analysis (Moultrie and Fraser, 2004). Thereby, the answer choices are somewhat similar, e.g.:

- **Design Process Audit**

Formally consider competitive strengths & weaknesses at the start of a project (Moultrie and Fraser, 2004, p. 50).

- **DME Award questionnaire**

We formally consider competitive strengths and weaknesses at the start of a design project.

Question 21 from the DME Award questionnaire is directly copied from the section 'Concept evaluation & selection' of the Design Process Audit. Both questions ask how the best solutions are chosen in order to meet the different demands and are separated into four different answer choices corresponding to the four levels (Moultrie and Fraser, 2004). All four answer choices are almost exactly alike, e.g.:

- **Design Process Audit**

There is only one concept to choose from – no process needed!
(Moultrie and Fraser, 2004, p. 58)

- **DME Award questionnaire**

There is only one concept to choose from – no process is needed.

Question 22 of the DME Award questionnaire regarding evaluation and monitoring procedures of the own performance offers five answer possibilities plus the option 'Other/don't know'. However, the first two answer choices state that evaluation or monitoring does not take place. Again, this question is reflected in the Design Process Audit in the section 'Evaluation' as this question also inquires about the evaluation of

performance (Moultrie and Fraser, 2004). Furthermore, the answer choices are largely congruent with the DME Award question 22, e.g.:

- **Design Process Audit**

Rigorous testing before launch

Post launch evaluation of project success (Moultrie and Fraser, 2004, p. 62)

- **DME Award questionnaire**

Rigorous evaluation and testing before launch; post-launch monitoring of project success

Question 23 of the DME Award Questionnaire asks how the design process is built and what management mechanisms are in place. In the same manner as question 19, 11 different process management mechanisms are listed. These process management mechanism can be ranked on a three-point scale ranging from 'sometimes' to 'standard procedure'. The corresponding question was found in the Design Atlas under the section 'Process for design'. This question assesses on four levels if process management mechanisms are in place (Preddy and Conte, 2000).

Question 24 of the DME Award questionnaire follows the same structure as the previous question. This question asks which design tools and methods are utilised, aiming to gain information. 13 different tools and methods are listed which can be ranked on a three-point scale ranging from 'sometimes' to 'standard procedure'. Again, the corresponding question was found in the Design Atlas questionnaire under the section 'Process for design'. This particular question examines the degree to

which tools and techniques are used for structured information gathering, establishing design guidelines and their implementation (Preddy and Conte, 2000).

Question 27 of the DME Award questionnaire, regarding the promotion of a design culture, is almost exactly reflected in the Design Process Audit under the section 'Creative culture & environment'. Both questions provide answer choices on the four different levels of both models (Moultrie and Fraser, 2004). The answer possibilities and questions are almost congruent, e.g.:

- **Design Process Audit**

Creativity is expected but not encouraged or rewarded (Moultrie and Fraser, 2004, p. 64)

- **DME Award questionnaire**

Creativity is expected but not explicitly encouraged or rewarded

Question 29 of the DME Award questionnaire appraises to what extent people are aware of any design management benefits based on four answer possibilities. The corresponding question in the Design Atlas was found under the section 'Culture for design'. This question assesses how design is recognised in the company and equally provides four answer choices (Preddy and Conte, 2000).

Consulting the Design Atlas and Design Process Audit questionnaires indicates that the Design Management Staircase Model questionnaire fundamentally follows the same structure and questions. All questions of the DME Award questionnaire which underlie the Design Management Staircase Model were identified in one or both questionnaires of the Design Atlas and Design Process Audit. The only exceptions are

three questions which are used to calculate the Design Management Staircase Model score for the factor awareness, namely, questions 25, 26 and 28. In addition, question 12, regarding in which areas design was applied and used over the last three years, could not be identified. This leaves four out of 18 questions unidentified. As previously concluded, both the Design Atlas and the Design Process Audit are robust, established and accepted working models in the academic and business environment alike. This leads to the conclusion that the Design Management Staircase Model questionnaire can be accepted as a valid questionnaire to provide insight into the assessment of design management capabilities.

4.6 SUMMARY/CONCLUSION

This chapter introduces the Design Management Staircase Model level and factor structure as the initial step for its validation. The contextual review revealed that the Design Management Staircase model level and factor structure as well as the underlying questionnaire builds on three established sources:

- The Danish Design Ladder
- The Design Atlas
- The Design Process Audit

This has validated the Design Management Staircase Model due to its origin and approach, and it is postulated that the Design Management Staircase Model can be accepted as a valid approach to assess design management capabilities. This provides initial insight that two possible ways might exist in order to assess design management capabilities: the Design Management Staircase Model and an assessment based on the identified NPD process success factors. It remains unclear

how or if the NPD process success factors relate to the Design Management Staircase Model or potentially inform the model. This question will be picked up again and further discussed in Chapter 10 DISCUSSION. Furthermore, it remains unclear if the theoretical perspective offered by the Design Management Staircase Model is reflected in its practical application to actual business data, and can be used as evidence to classify design management capabilities.

CHAPTER FIVE

5. DATA GATHERING I – DME AWARD DATA

This chapter introduces the data gathered via the Design Management Europe (DME) Award.

5.1 INTRODUCTION

The contextual review revealed that the Design Management Staircase Model was developed based on a combination of the Design Ladder, the Design Process Audit and the Design Atlas, as it follows fundamentally the same principles, structures and factors. Also, the questionnaire, which underpins the Design Management Staircase Model, is largely the same as those of the Design Process Audit and the Design Atlas. Hence, it was concluded that the Design Management Staircase Model and its underlying questionnaire can be accepted as a valid approach to assess design management capabilities. However, it remains unclear if the theoretical perspective offered by the Design Management Staircase Model is reflected in its practical application to actual business data and can be used as evidence to classify design management capabilities. The questionnaire data for the Design Management Staircase Model is derived from the DME Award, and is used to analyse the practical application of the Design Management Staircase Model. The following chapter introduces the purpose and origins, the volume of the available data and the content of the questionnaire.

5.2 DME AWARD QUESTIONNAIRE

5.2.1 PURPOSE AND ORIGINS

The DME Award questionnaire serves two different purposes. In the first instance, it is used as an entry requirement for the DME Award, and functions as the official registration for the award. Secondly, it is utilised by the DME Award as a tool for research into current design management practices of European businesses, and builds the basis for the calculation of the Design Management Staircase Model.

Three different versions of the DME Award questionnaire have been developed since 2008. The original version of the questionnaire was developed as part of the research project leading to the development of the Design Management Staircase Model. This original questionnaire was developed to test the Design Management Staircase Model and to permit the calculation of the Design Management Staircase Model scores. This questionnaire and the Design Management Staircase Model were tested on a large-scale study with 605 European businesses. A shortened version of this original questionnaire has been incorporated as an entry requirement for registration for the DME Award since the second edition in 2008. This 2008 DME Award registration questionnaire is largely identical to the original Design Management Staircase Model questionnaire, and features the same questions which underlie the calculation of the Staircase scores. In 2009 the DME Award registration questionnaire was restructured, keeping the questions for the calculation of the Design Management Staircase Model scores the same. Exemplarily, the DME Award questionnaires from 2008 and 2009-13 are displayed in the APPENDICES.

5.3 VOLUME OF QUESTIONNAIRE DATA

The DME Award registration questionnaire from the years 2008-2012 have been made available for this PhD investigation. The original dataset containing 605 questionnaires, which were used to develop and test the questionnaire and the Design Management Staircase Model, is not accessible.

Four hundred and thirty-three (433) DME Award registration questionnaires were made available in total. Split into the different years these were:

- 2008: 163 questionnaires
- 2009: 84 questionnaires
- 2010: 83 questionnaires
- 2011: 61 questionnaires
- 2012: 42 questionnaires

However, not all of the questionnaires were completed, and therefore contained incomplete data. All questionnaires with insufficient data were excluded. This resulted in a total of three hundred and forty-four (344) valid questionnaires. Split into the different years these were:

- 2008: 152 questionnaires
- 2009: 64 questionnaires
- 2010: 60 questionnaires
- 2011: 44 questionnaires
- 2012: 24 questionnaires

5.4 QUESTIONNAIRE CONTENT

The questionnaire data relates to the design management practices employed by the entrants, their economic performance and business details. Though the questionnaire sets from 2008 and 2009/10/11/12 do not feature identical questions, the questionnaire structure and the questions for the calculation of the Design Management Staircase scores remain largely the same. The questionnaires from all five years give data that can be broken down into four subcategories. These subcategories are:

1. Business data
2. Financial data
3. Design approach
4. Self-assessment.

5.4.1 DIFFERENCES BETWEEN THE DME AWARD QUESTIONNAIRES

DIFFERENCES BETWEEN THE QUESTIONNAIRES	
DME Award Registration Questionnaire 2008	DME Award Registration Questionnaire 2009-12
28 questions in total	30 questions in total
Not included	Question 14: What level of resources (staff, budgets and means of production or implementation) are allocated to design activity and how?
Not included	Question 17: What place has design in the process when something new is developed, i.e. when are designers typically involved?
Not included	Question 18: Is design part of company or marketing plans and objectives?
Question 21: Which of the listed tools and methods are applied with regard to design activities in your company? 25 multiple choice answers	Question 24: Please rate how the tools and methods listed below are applied to design activities in your company? 13 multiple choice answers
Question 22: Over the last 3 years, which of the following methods has your company been using to protect its products and services?	Not included
Not included	Question 23: Please indicate how the design process in your company takes place.
Question 24: How is the importance of innovation* valued in your company?	Not included
Not included	Question 30: To what extent are the following factors hindering your company to manage design more effectively?

Table 5.1: Differences between the DME Award Questionnaire 2008 and 2009-12

Both versions of the DME Award registration questionnaire feature identical questions in the first two sections covering business and finances. However, the sections regarding design approach and self-assessment exhibit different and altered questions for each questionnaire. The questionnaire from 2008 consists of 28 questions in total, split up into 11 questions regarding business and financial data and 17 questions regarding design approach and self-assessment. The questionnaire for the years 2009-2012 consists of 30 questions in total, split into 11 questions regarding

business and financial data and 19 questions regarding design approach and self-assessment.

The 2009-2012 questionnaire features four questions (#s 14, 17, 18, 23) in the design approach section which are not featured in the 2008 questionnaire. These questions refer to the allocation of resources, role of design in the development process, role of design in company plan, and objectives and design methodology, respectively. Furthermore, 2009-2012 contains one additional question (#30) regarding obstacles in design management in the self-assessment section. But, 2009-2012 lacks one question from the design approach (#22) and self-assessment (#24) sections contained in the 2008 questionnaire. These refer to product protection methods and the value of innovation, respectively. Lastly, one multiple choice question regarding the utilised tools and methods was significantly shortened in the 2009-2012 questionnaires.

Due to the level of disparity between the two questionnaires, a comparison of both sets for a coherent analysis is not feasible. Hence, work was performed exclusively with the datasets from 2009-2012 featuring 192 completed questionnaires.

5.5 DME AWARD CATEGORIES

Furthermore, the DME Award has five entry categories which are distinguished by company size and organisational nature. The entry categories are defined according to the guide of the European Commission (European Commission). The DME Award entry categories as adapted from the DME Award questionnaire 2009-2012 are presented as:

- AWARD FOR DESIGN MANAGEMENT IN A LARGE COMPANY

This category is open to private companies with 250 employees or more.

- AWARD FOR DESIGN MANAGEMENT IN A MEDIUM-SIZED COMPANY

This category is open to private companies with 50 to 249 employees.

- AWARD FOR DESIGN MANAGEMENT IN A SMALL COMPANY

This category is open to private companies with 10 to 49 employees.

- AWARD FOR DESIGN MANAGEMENT IN A MICRO COMPANY

This category is open to private companies with nine employees or fewer.

- AWARD FOR DESIGN MANAGEMENT IN A PUBLIC OR NON-PROFIT ORGANISATION

This category is open to all public or non-profit organisations.

CHAPTER SIX

6. ANALYSES I – DEPLOYMENT OF THE NPD PROCESS SUCCESS FACTORS

This first analysis chapter sets out to explore the utilisation of the nine NPD process success factors based on the DME Award dataset. Corresponding questions from the DME Award questionnaire to the nine NPD process success factors are identified, and a ranking system to calculate the effective utilisation of the NPD factors is established. Subsequently, the effective utilisation of the nine NPD process success factors is analysed.

6.1 INTRODUCTION

A systematic literature review on the NPD process was performed with two aims in mind: firstly, to map out the development of NPD process research from 1974 to 2009; and secondly to establish a list of the most frequently referenced NPD process success factors from literature. The literature review demonstrated that the research on NPD process success factors evolved from highlighting the importance of activities of execution to recognising the importance of NPD process management. From this literature, 64 research studies on NPD process success factors were used to establish a comprehensive list of the most frequently referenced NPD process success factors. Table 2.1 lists the most frequently referenced success factors listed in descending order from the most referenced. This table includes the study sources where the

success factors were identified. Additional adjustments were made to ensure concentration on the main activities within the NPD process. The final list of the most frequently referenced NPD process success factors are presented in Table 2.2, and include nine different factors. The most frequently referenced NPD process success factors are:

- User involvement and testing
- Cross-functional project teams
- Top management
- Market research
- Preliminary technical assessment
- Preliminary financial analysis
- New product strategy
- Product champion
- Preliminary market analysis.

Arising from this is the hypothesis that these particular NPD process success factors also represent the most important factors for the concept of design management. However, it remains unclear if businesses utilising the concept of design management also address the nine NPD process success factors derived from the literature. The dataset originating from the DME Award offers the unique opportunity to verify the theoretical NPD process success factors against quantitative data from companies who are recognising and applying the concept of design management.

6.2 OBJECTIVES – ANALYSES I – DEPLOYMENT OF THE NPD PROCESS SUCCESS FACTORS

In a subsequent analysis, the elaborated nine NPD process success factors will be verified and analysed against the DME Award company dataset. The identification of corresponding questions and the development and calculation of the ranking system were described in the research design section of the methodology chapter [see section 3.7.2.3 ANALYSIS OF THE EFFECTIVE UTILISATION OF THE NPD PROCESS SUCCESS FACTORS].

The objectives for this analysis chapter are:

- Correlate corresponding questions from the DME Award questionnaire to the NPD process success factors.
 - The DME Award questionnaire is analysed to identify questions which give insight into the nine NPD process success factors based on their definitions.
- Establish a ranking system to calculate the effective utilisation of the NPD process success factors.
 - A ranking system for balancing inequalities in the distribution of the corresponding questions is developed. The ranking system enables the calculation of a percentage score for each factor. This percentage score represents the extent of the utilisation of this factor: the effective utilisation score.
- Analyse the effective utilisation of the nine NPD process success factors in the DME Award dataset.
 - Hypothesis 1: The NPD process success factors are effectively utilised by the entire dataset.

- Hypothesis 2: Companies with a higher Design Management Staircase Model ranking score show a higher effective utilisation of the NPD process success factors.
- Hypothesis 3: DME Award Winners show a higher effective utilisation of the NPD process success factors than the DME Award Honourable Mentions. The DME Award Honourable Mentions show higher effective utilisation of the NPD process success factors than non-awarded companies.
- Hypothesis 4: Large companies show the highest effective utilisation of the NPD process success factors compared to all other DME Award entry categories.

6.3 RESULTS

6.3.1 CORRESPONDING QUESTIONS

The corresponding DME Award questions to the nine NPD process success factors were identified and matched as described in Chapter 3 METHODOLOGY [see section 3.7.2.1 IDENTIFICATION OF CORRESPONDING QUESTIONS] and are presented in Table 6.1 to Table 6.9.

User involvement and testing				
<p><i>User involvement and testing</i> refers to the understanding that a new product has to respond to user needs. A frequent interaction with users is required in order to gain all necessary information regarding their needs, to understand what benefits are desired, what superior performance is, what quality means and what the user value depends on. A verification that the product responds to the customers' needs and the customer acceptance is obtained through testing the product or prototype before the full-scale launch or development. Hereby, testing can refer to the technical inspection in a lab or under controlled conditions or field trials, in collaboration with the end users.</p>				
Corresponding Question	Answer choices			
Q 19: We ask wholesale or trade partners.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use internet-platforms for contact with end user.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We interview a representative sample of users.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We create personas to guide the design process.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We systematically observe and analyse user processes in target groups.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use the Lead User Method.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: Customers are actively involved in the development of new products and services.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use user feedback to develop and test prototypes or to refine services.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: User-centred design research.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.1: Corresponding questions for factor 'user involvement and testing'

Cross-functional project teams				
<p><i>Cross-functional project teams</i> refers to having a core project team with members from different functions within the company. This <i>cross-functional team</i> is committed to and accountable for the project from the beginning to the end, and all team members have an overall business understanding. Good internal communications within the <i>cross-functional teams</i> are essential to ensure the close interaction between the different team members and functions within the company. It is suggested to install adequate and formal communication channels just as a feedback mechanism, and regular meetings to ensure high-quality interdepartmental coordination and cooperation.</p>				
Corresponding Question	Answer choices			
Q 23: We hold review meetings on a regular basis.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 23: Determine the skill requirements of the project team, including all interdisciplinary contributions.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.2: Corresponding questions for factor 'cross-functional project teams'

Top management				
The factor <i>top management</i> refers to the strong involvement of the <i>top management</i> in the NPD process, with a high level of support from the beginning to the end. By involving the <i>top management</i> , which is accountable for the project outcome, it is ensured that all necessary resources are committed to the project and that it receives the necessary support for a successful product launch.				
Corresponding Question	Answer choices			
Q 15: Which statement best describes who is managing design activities in your company?	Owner manager/ managing director or CEO	Central coordinator/ manager	Interdisciplinary/ multifunctional project team, including design specialist(s) and some senior management	Extended team including design specialist(s) on strategic level, with fully integrated directorship
Q 23: We appoint a project leader or manager who is given responsibility.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.3: Corresponding questions for factor 'top management'

Market research				
<i>Market research</i> refers to undertaking a detailed assessment of the market. The aim of <i>market research</i> is to obtain a qualitative and quantitative understanding of the market, the customer needs and wants, and the competitive situation.				
Corresponding Question	Answer choices			
Q 19: An engineer or marketer delivers the expert knowledge.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use market reports, but no standard methods.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We ask wholesale or trade partners.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use internet-platforms for contact with end user.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We interview a representative sample of users.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We create personas to guide the design process.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We systematically observe and analyse user processes in target groups.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use the Lead User Method.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: Customers are actively involved in the development of new products and services.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 19: We use user feedback to develop and test prototypes or to refine services.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 20: Is competitor's analysis part of the design planning process in your company?	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: Trend research.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: User-centred design research.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.4: Corresponding questions for factor 'market research'

Preliminary technical assessment				
<i>Preliminary technical assessment</i> precedes the development phase of the new product idea. It is concerned with the technical feasibility of the proposed product to eliminate technical problems and uncertainties before development and manufacturing. Key questions of the assessment are: Can it be developed? What technical solutions are required? At what costs? Can it be manufactured?				
Corresponding Question	Answer choices			
Q 23: We incorporate a requirements capture process.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 23: Plan research for concept/prototype testing.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: Portfolio analysis.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: Design process audit.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.5: Corresponding questions for factor 'preliminary technical assessment'

Preliminary financial analysis				
<i>Preliminary financial analysis</i> refers to the activity of developing an economical plan and budget for the new product. Costs, a sales forecast, a potential return on investment and the payback period are assessed. This analysis is typically performed before the development stage and thereafter repeatedly performed to adjust to changed circumstances.				
Corresponding Question	Answer choices			
Q 24: Portfolio analysis.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: Future scenario building.	Sometimes	Frequently	Standard procedure	NA/don't know
Q 24: Unit cost analysis.	Sometimes	Frequently	Standard procedure	NA/don't know

Table 6.6: Corresponding questions for factor 'preliminary financial analysis'

New product strategy					
<p><i>New product strategy</i> refers to the development of an appropriate strategy for the new product. This strategy is defined early on in the development process and sets out the new product goals and objectives, the target market and the product concept. This strategy has to be aligned to the company strategy and defines how the new product contributes to achieving the company objectives. Furthermore, the <i>new product strategy</i> describes the new product and non-product advantages to be achieved.</p>					
Corresponding Question	Answer choices				
Q18: Is design part of company or marketing plans and objectives?	Company or marketing plans and objectives do not mention the use of design.	Limited plans and objectives exist at the project level; design is considered in the short term as a means of delivering on individual business objectives.	Plans and objectives exist which set direction for design and integrate design in various activities.	Design is included as part of strategic plans; design planning is a dynamic process that drives the business; plans and objectives are communicated widely.	Other/don't know
Q 23: We define a strategy for design.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 23: Define clear design objectives.	Sometimes	Frequently	Standard procedure	NA/don't know	

Table 6.7: Corresponding questions for factor 'new product strategy'

Product champion							
<i>Product champion</i> refers to the leader of the cross-functional NPD teams. This individual leads and drives the new product development from the beginning to the end of the project. He has sufficient authority and power to efficiently coordinate the different involved parties and to integrate them into a continuous process. He typically possesses technical competence and a deep knowledge of the company and market.							
Corresponding Question	Answer choices						
Q 15: Which statement best describes who is managing design activities in your company?	Individual design buyers who use design occasionally, as for individual projects.	External design suppliers who are hired occasionally for projects.	Owner manager/ managing director or CEO.	Central coordinator/ manager.	Interdisciplinary/ multifunctional project team, including design specialist(s) and some senior management.	Extended team including design specialist(s) on strategic level, with fully integrated directorship.	Other/don't know
Q 16: To what extent are design activities being coordinated?	No need to coordinate design activities.	Limited coordination within boundaries of departments or functions	Coordination of total design process in the company, including design outputs.	Continuous coordination at a high level to achieve design management excellence.	Other/don't know		
Q 23: We appoint a project leader or manager who is given responsibility.	Sometimes	Frequently	Standard procedure	NA/don't know			

Table 6.8: Corresponding questions for factor 'product champion'

Preliminary market analysis					
<i>Preliminary market analysis</i> refers to the activity of undertaking a first and quick assessment of the market to gain initial insights about the market size and potential, customer interest and needs, requirements and value, and the competitive situation. The scope of this analysis is limited and makes use of, e.g., focus groups, key customers and experts.					
Corresponding Question	Answer choices				
Q 19: We use market reports, but no standard methods.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 19: An engineer or marketer delivers the 'expert' knowledge.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 19: We ask wholesale or trade partners.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 19: We use the Lead User Method.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 24: Trend research.	Sometimes	Frequently	Standard procedure	NA/don't know	
Q 20: Is competitor's analysis part of the design planning process in your company?	We are not sure about our competitors' design and design usage, we have little or no competitive information.	We gather some knowledge about our competitors when developing our own designs and design usage.	We formally consider competitive strengths and weaknesses at the start of a design project.	We systematically observe our competitors, their design policies, usage and market performance.	Other/don't know

Table 6.9: Corresponding questions for factor 'preliminary market analysis'

6.3.2 EFFECTIVE UTILISATION OF THE NPD PROCESS SUCCESS FACTORS

Figure 6.1 displays the average effective utilisation percentage scores from 2009-2012. On average over the four-year period, each of the nine factors is effectively utilised by greater than 50%. The factor *new product strategy* represents the most effectively utilised factor, with 87%, while the least effectively utilised factor is *preliminary market analysis* with 59%. All remaining factors achieved within 60% to 76%.

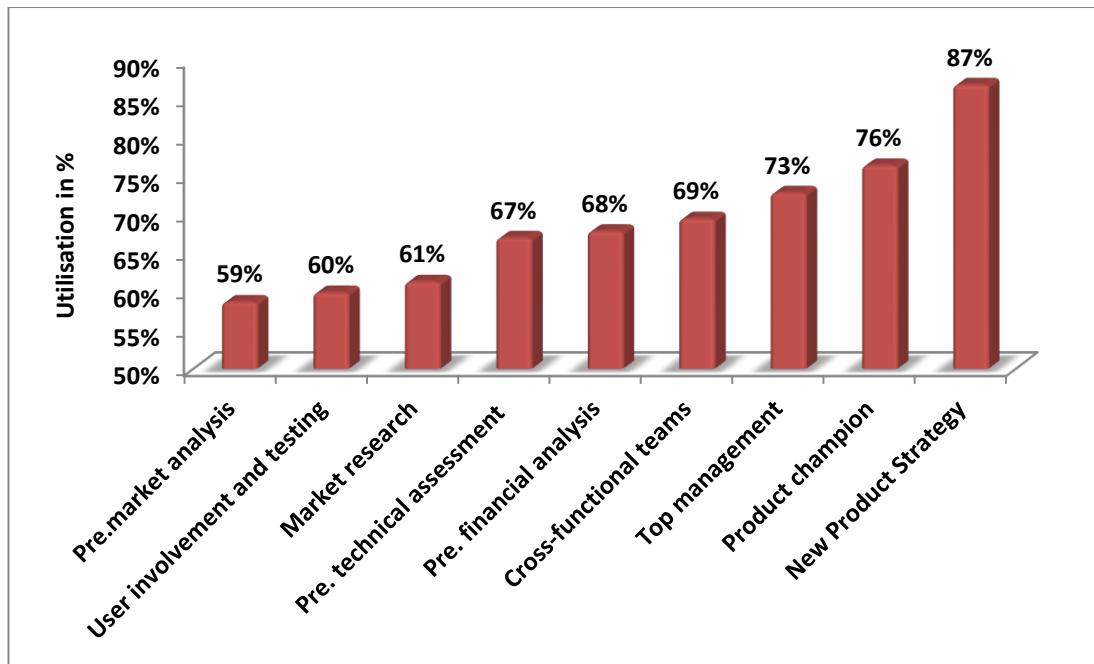


Figure 6.1: Average effective utilisation of the NPD process success factors over the period 2009-2012

Figure 6.2 presents the average effective utilisation scores for all factors combined for the years 2009-2012. The average effective utilisation scores are above 50% for each year, with 66% in 2009 and 73% in 2012. There is a general positive trend over the four-year period, with an average increase in effective utilisation by 10.6%.

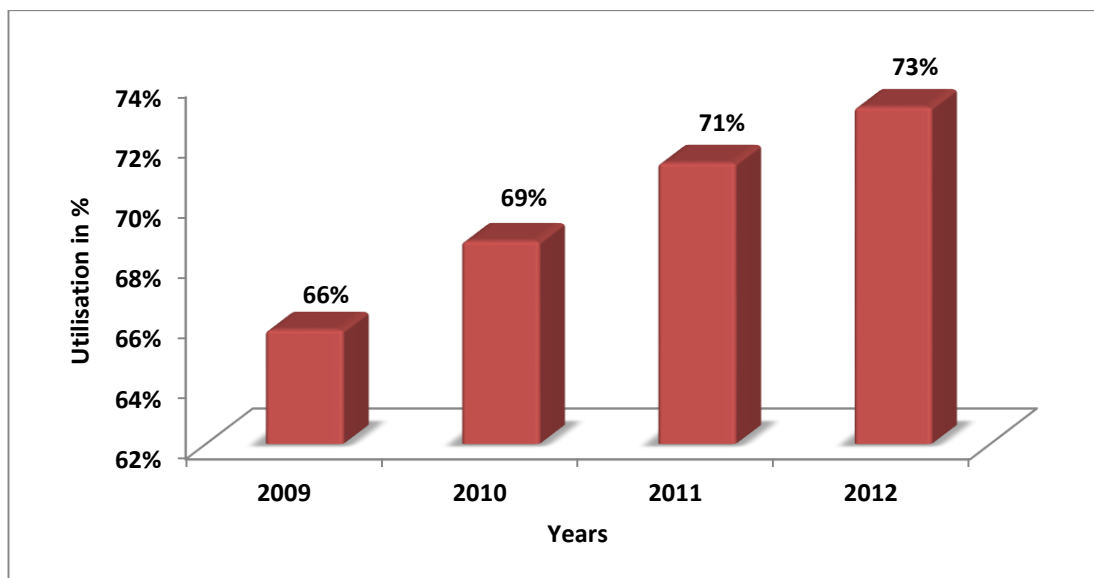


Figure 6.2: Average effective utilisation scores for all NPD process success factors combined each year for the period 2009-2012

Figure 6.3 displays the percentage score for the effective utilisation of the nine NPD process success factors for the DME Award dataset 2009-2012. This percentage score is well above 50% for each factor in all four years. The lowest score obtained for the effective utilisation is recorded in 2009 under the factor *customer focus*, with 53%. The highest score is recorded in 2011 under *new product strategy*, with 90%. All factors, except for *new product strategy*, show a positive linear trend. *New product strategy* remains stable on the highest level compared to all other factors. This applies despite several fluctuations in the evolution of the effective utilisation percentage scores for the factors *customer focus*, *market research*, *cross-functional teams* and *preliminary market analysis*.

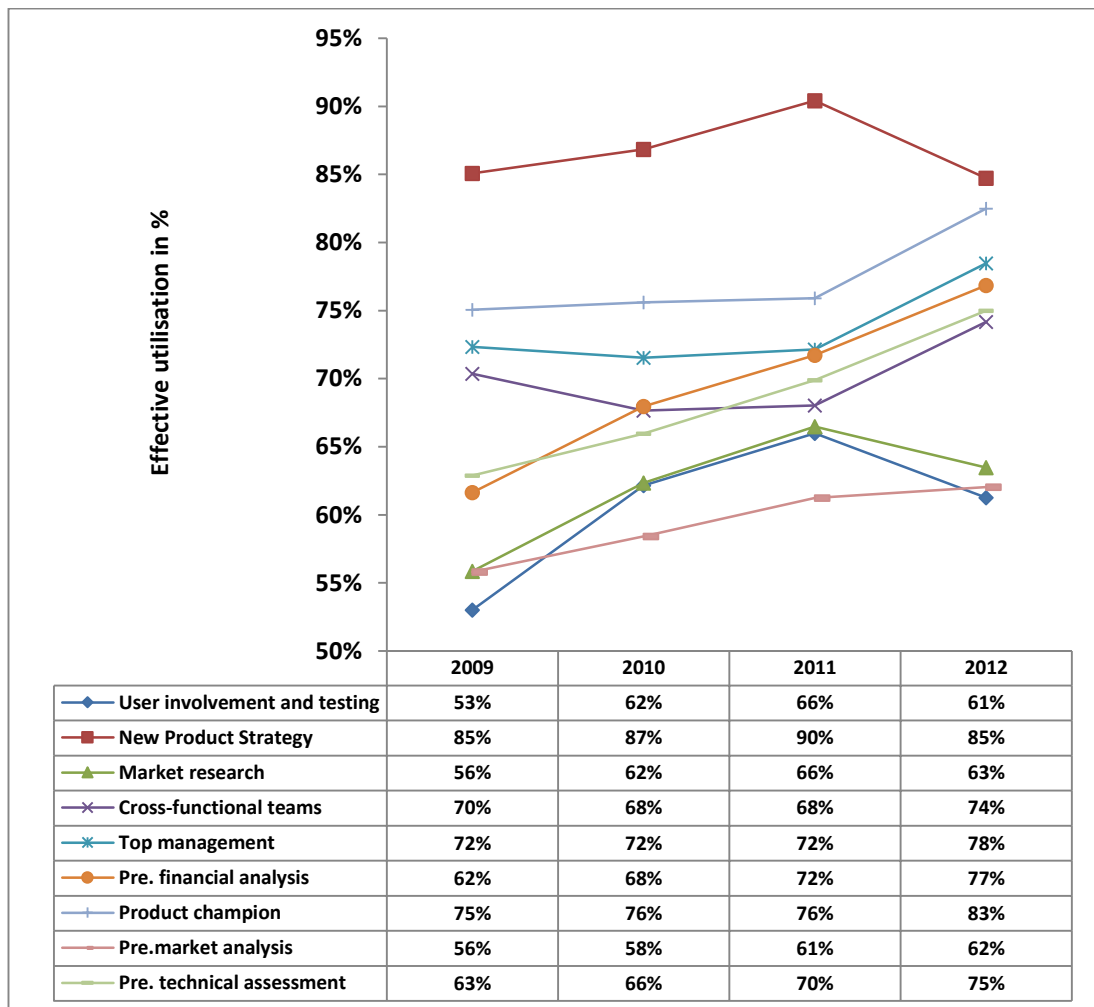


Figure 6.3: Development of the effective utilisation scores of the NPD process success factors over the period 2009-2012

Split up into groups according to the Design Management Staircase Model levels, Figure 6.4 shows that the effective utilisation of the NPD process success factors has a positive correlation with the achieved Design Management Staircase Model level over the four-year period.

All companies that scored level 3 on the Design Management Staircase Model achieved effective utilisation percentage scores of over 50% for all four years. The factors *customer focus* and *preliminary market analysis* show the lowest effective utilisation score at 57%, and the factor *new product strategy* shows the highest score at 87%. All effective utilisation scores for the level four companies lie above 70%, with 71% as the lowest score for *preliminary market analysis* and 96% as the highest score for *new product strategy*. Companies that achieved level 2 on the Design Management Staircase Model attained scores of over 50% for the factors *new product strategy*, *cross-functional teams*, *product champion*, *top management* and *preliminary technical assessment*. The scores for all remaining factors on level 2 are lower than 50%, ranging from 37% to 45%. Equally, all level 1 companies achieve lower scores than 50% for all factors, ranging from 27% to 49%.

The most effectively utilised factor for every Design Management Staircase Model level is *new product strategy*.

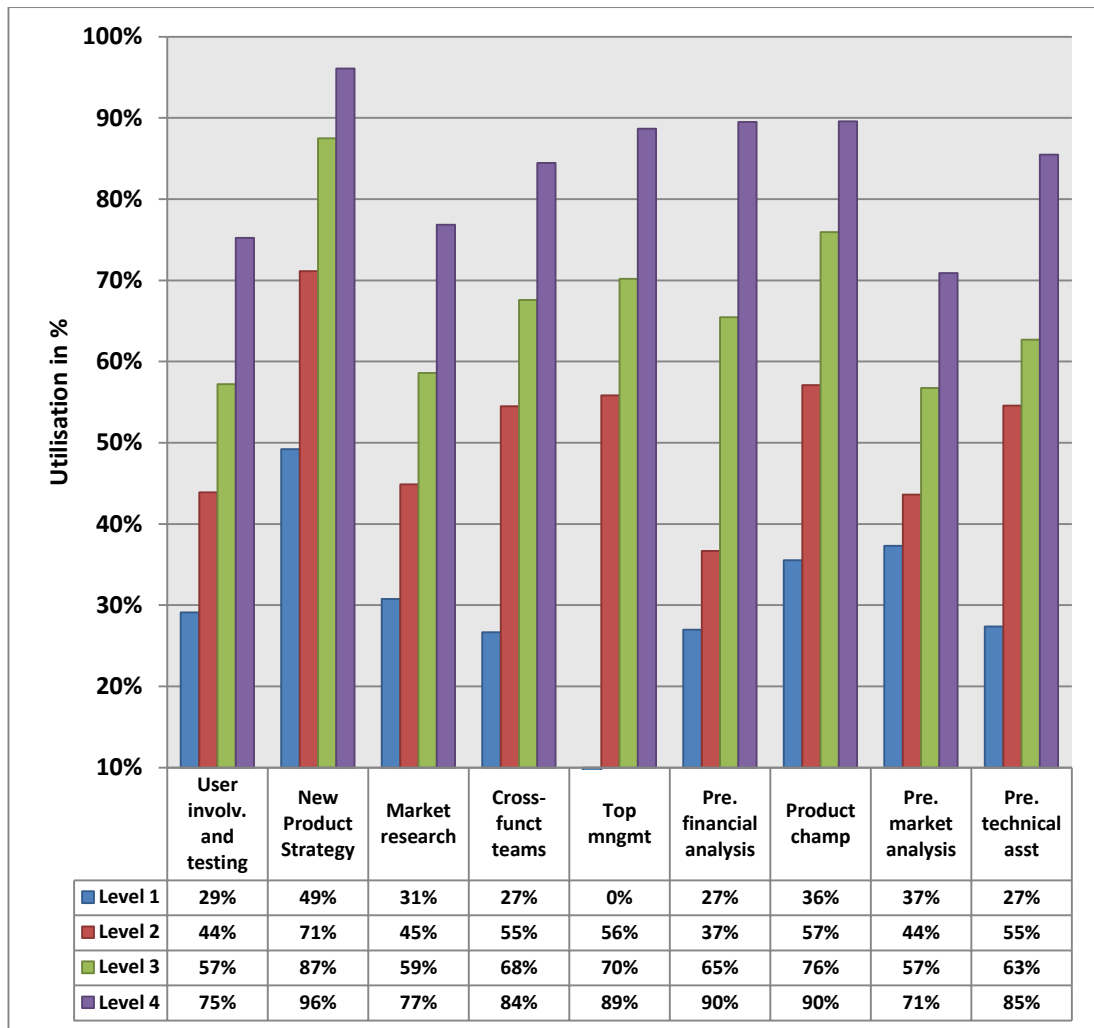


Figure 6.4: Average effective utilisation (2009-2012) of the NPD process success factors according to Design Management Staircase Model levels

Separated according to their DME Award results, Figure 6.5 reveals that the DME Award winners show the most effective utilisation for each factor over the period 2009 to 2012. All effective utilisation scores for all nine factors are greater than 60%. The factor *preliminary market analysis* is the lowest score at 67%, and *new product strategy* the highest at 93%.

The effective utilisation scores for all factors for the Honourable Mentions and non-awarded companies are above 50%. For both, the factor *new product strategy* has the highest utilisation score with 86%. The factor *customer focus* achieved the lowest

score at 55% for the Honourable Mentions and *preliminary market analysis* for the non-awarded companies at 58%.

The Honourable Mentions achieved higher effective utilisation scores for *cross-functional teams*, *top management* and *product champion* than the non-awarded companies. The average effective utilisation score of all factors for both groups is 67.77%.

The most effectively utilised factor for each DME Award result group is *new product strategy*.

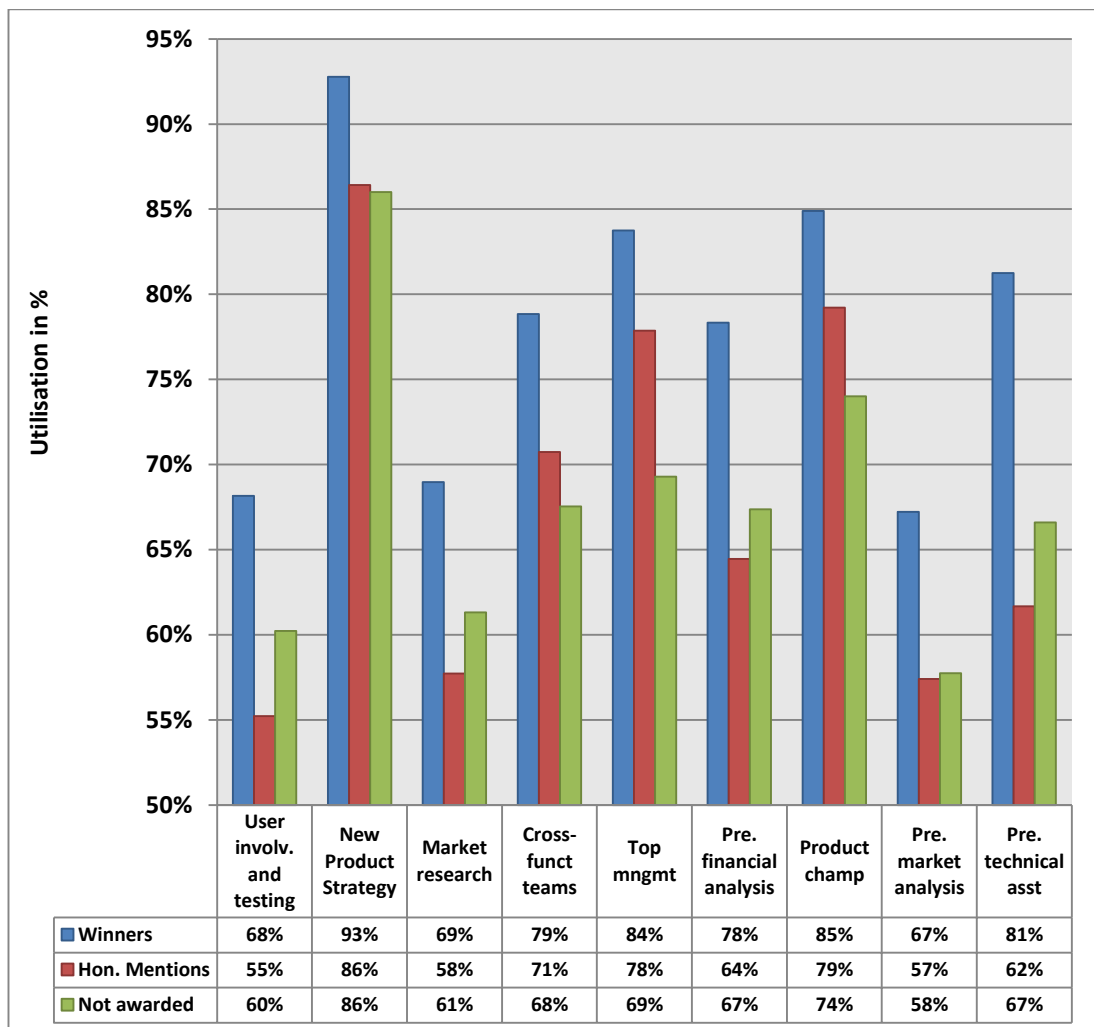


Figure 6.5: Average effective utilisation (2009-2012) of the NPD process success factors according to DME Award ranking

Grouped according to company sizes, Figure 6.6 shows that the Medium-sized companies achieved the highest effective utilisation scores for each factor. All effective utilisation scores for all company sizes are greater than 50%, except for NPOs' score for *preliminary financial analysis*, which achieved a score of 49%. The highest effective utilisation scores for all groups are achieved in *new product strategy*, which range from 81% to 90%.

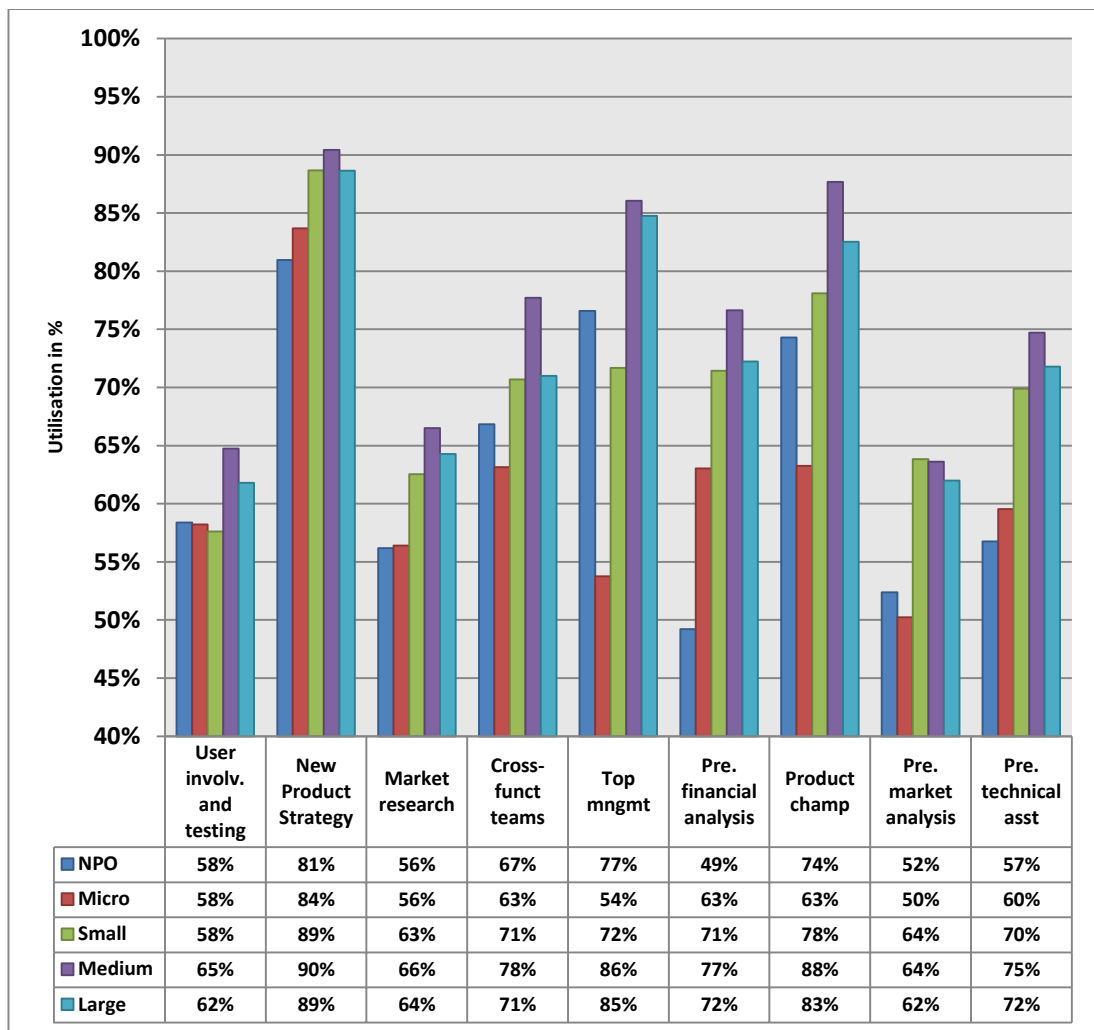


Figure 6.6: Average effective utilisation (2009-2012) of the NPD process success factors according to company size

6.4 CONCLUSION/ SUMMARY

The aim of this first analysis chapter was to explore the deployment of the nine NPD process success factors based on the DME Award dataset. Hence, the objectives of this chapter were outlined as:

- Identify corresponding questions from the DME Award questionnaire to the NPD process success factors.
- Establish a ranking system to calculate the effective utilisation of the NPD process success factors.
- Analyse the effective utilisation of the nine NPD process success factors in the DME Award dataset.

Corresponding questions from the DME Award dataset to the NPD process success factors were identified based on the definitions of the NPD process success factors as outlined in section 3.7.2.1 and section 6.3.1. In a subsequent step, a ranking system was developed. This ranking system fulfilled two objectives. Firstly, the ranking system eliminated existing inequalities that arose out of unequal distribution of corresponding questions to the NPD process success factors. Secondly, effective utilisation scores were calculated with the help of the ranking system. These scores represent the extent to which the companies utilise the nine different NPD process success factors based on the information from the DME Award questionnaire [see 3.7.2.2 DEVELOPMENT AND CALCULATION OF THE RANKING SYSTEM].

Figure 6.1 to Figure 6.3 analyse the extent of the effective utilisation of the NPD process success factors. The aim was to confirm the importance of the theorised nine factors against quantitative data from companies utilising the concept of design management. All three figures confirmed that the effective utilisation of the NPD

process success factors for the whole dataset is above 50% for all years. The development of the effective utilisation scores shows a general positive trend for both the factors combined [see Figure 6.2] and for each factor alone [see Figure 6.3]. *New product strategy* is the most effectively utilised factor for both the average over the period 2009-12 and for each year. Hence, the first hypothesis can be confirmed that the entire dataset effectively utilises all NPD process success factors.

The second hypothesis can be confirmed. Figure 6.4 shows that the effective utilisation of the NPD process success factors increases with the Design Management Staircase Model level ranking. Again, the factor *new product strategy* is the best-utilised factor on each Design Management Staircase Model level.

Likewise, the DME Award Winners show higher effective utilisation scores compared to the DME Award Honourable Mentions and non-awarded companies [see Figure 6.5]. Here too, the factor *new product strategy* is the best utilised factor in all three groups. Interestingly, the not-awarded companies show better effective utilisation scores in five out of nine factors than the DME Award Honourable Mentions.

The fourth hypothesis is not supported. The large company category shows the second highest effective utilisation scores across the DME Award entry categories. The medium-sized companies achieved the highest effective utilisation scores across all factors.

All results substantiate the importance of the theorised nine factors for the concept of design management, and it can be reasonably concluded that the nine NPD process success factors also cover vital points under the concept of design management. The most important factors according to the degree of effective utilisation are:

- New product strategy
- Product champion
- Top management.

CHAPTER SEVEN

7. DATA GATHERING II – CASE STUDIES

This chapter introduces the second data-gathering phase – semi-structured interviews with previous DME Award entrants. It describes the content development for the semi-structured interview guide, the participant recruitment process and introduces each participant.

7.1 INTRODUCTION

The application of the NPD process success factors in Chapter 6 ANALYSES I – DEPLOYMENT OF THE NPD PROCESS SUCCESS FACTORS gives insight into the effective utilisation of the nine success factors derived from the meta-analysis [see Table 2.2]. However, due to the pre-existing questionnaire design, the questions and answer choices of the DME Award questionnaire are limited in the extent to which they can offer insight into the application and complexity of the NPD process success factors. For example, the factor *market research* is assessed on the basis of 13 questions listing different market research tools and methods and the frequency of their application. Nevertheless, a whole range of market research tools and methods might not have been covered in this assessment, leaving the assessment vulnerable to bias. Hence, additional data gathering was seen as necessary to strengthen and support the previously obtained results. The aim of the study is to gain further insight

into the application of the NPD process success factors under scrutiny, and to enable further refinement.

This introduces the second data-gathering phase – the deployment of semi-structured interviews. It describes the content development for the semi-structured interview guide, the participant recruitment process and introduces each participant.

7.2 CHAPTER APPROACH

7.2.1 SEMI-STRUCTURED INTERVIEW GUIDE

A semi-structured interview guide containing five sections has been developed. The entire semi-structured interview guide is displayed in the APPENDICES [see 2. SEMI-STRUCTURED INTERVIEW GUIDE].

- Section 1 – Company details
- Section 2 – General questions
- Section 3 – Success activities
- Section 4 – Self-assessment
- Section 5 – Success measurement

The first section covers a range of general information about each participant. To open the semi-structured interview, two open questions regarding the new product development and general understanding of design management were asked. Section three entails two to four questions for each of the examined NPD process success factors. Each set of questions for each NPD process success factor starts with a closed question inquiring if the factor is addressed, followed by one to three mostly open questions to gain further insight about the application of the particular factor. Furthermore, this included an additional question enquiring about any other factor

which is addressed by the interviewee but not included in the nine NPD process success factors. In the fourth section, the participants were asked to rank all nine NPD process success factors and any additional factors on a Likert-scale ranging from 1 (not influential) to 6 (very influential). In addition, two more questions were added, asking about which of the mentioned NPD process success factors is the most challenging and which factor has not been implemented in their company but should be in future. The final section was developed in order to gain insight about the measurement of success. A list with different success measures was provided. The timeframe for each interview was estimated as 30 to 45 minutes. The final semi-structured interview guide is presented in the APPENDICES [see 2. SEMI-STRUCTURED INTERVIEW GUIDE].

7.2.2 PARTICIPANT RECRUITMENT

Two methods were used for the recruitment of the interview partners and questionnaire respondents. All partners and respondents were recruited from a cohort of previous DME Award participants. Firstly, for the pilot interview the relationships between PDR and Welsh businesses were explored. A United Kingdom-based previous entrant of the DME Award was identified and agreed to participate in a face to face interview. All remaining partners and correspondents were derived from the DME Award participants 2011. In order to increase the interview sample, all 44 DME Award participants were invited to contribute via interviews. All 44 companies were approached via email. Within two weeks, two further email reminders were sent out. In total, seven companies out of the cohort of the DME

Award 2011 entrants agreed to participate in the interview. This equals a response rate of 15.91% [see Table 7.1].

Further two companies proposed that they would prefer to respond to the semi-structured interview guide in writing rather than conducting an interview via Skype. This equals a response rate of 4.55% [see Table 7.1].

All interviews and questionnaires were conducted with senior managers or the owners of the selected companies.

Study	Number of Companies	Response Rate
Pilot Interview	1	100%
Semi-structured interview	7	15.91%
Questionnaire	2	4.55%

Table 7.1: Response rates for Semi-structured interview and Questionnaire

As previously expressed, Yin (2003) and Voss et al. (2002) state that determining the sample size for multiple case studies largely depends on factors such as time constraints, results of previously conducted case studies and the judgement of the researcher. Hence, it was decided to analyse the existing semi-structured interviews and questionnaires first regarding the emergence of clear patterns in the data. In a subsequent step it was to be decided if further semi-structured interviews would be necessary and beneficial for the research. The results revealed a clear pattern and relationship between the different case studies. Therefore, it was refrained from conducting any further case studies.

7.2.3 PILOT INTERVIEW

The pilot interview was conducted in person and lasted for 55 minutes. The entire interview was recorded and subsequently transcribed. A critical reflection of the pilot

interview confirmed the suitability of the semi-structured interview approach and interview guide [see 8.2.2 CRITICAL REFLECTION].

7.2.4 SEMI-STRUCTURED INTERVIEWS

A further seven semi-structured interviews were conducted via Skype as the distance over different European locations did not allow personal interviews. The interviews lasted between 20 to 100 minutes and were recorded and transcribed. All participants were informed about the study in the same manner as described for the pilot interview. All semi-structured interviews were conducted within one month to improve the juxtaposition of the results.

7.2.5 QUESTIONNAIRE

Both participants were given two weeks to return a questionnaire based on the semi-structured interview guide and returned the completed questionnaire within the given time frame.

7.3 PARTICIPANT INFORMATION SHEET

Prior to the interviews and questionnaires, all participants were fully informed about the study and the proposed research. Every participant was given a detailed 'participant information sheet' [see APPENDICES, 2. SEMI-STRUCTURED INTERVIEW GUIDE] and informed that the participation is voluntary and that the interview could be stopped at any time without any consequences.

To ensure the anonymity and confidentiality of all participants, all companies have been given code names. Furthermore, the transcriptions of the interviews and the original questionnaires are not included in the appendix of the thesis.

7.4 PILOT INTERVIEW

7.4.1 COMPANY A

The pilot interview was conducted with Company A, a design and manufacturing micro company⁵. This United Kingdom-based business was founded in 2007 and has since been engaged with design. Having previously won a DME Award, the company scored level 3 on the Design Management Staircase Model. The interview was conducted with the owner/manager of the company.

7.5 SEMI-STRUCTURED INTERVIEWS

Table 7.2 provides an overview with the basic information about each of the participating companies.

⁵ All companies were classified according to the guidelines provided in: EUROPEAN COMMISSION. *What is an SME?* [Online]. Available: http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/sme-definition/index_en.htm [Accessed 09.12.2014].

Company	Company Size	Company Type	Foundation	Utilising Design since	Country
Company A	Micro company	Design and manufacturing	2007	2007	United Kingdom
Company B	Micro company	Creative industries	2009	2009	The Netherlands
Company C	Large company	Manufacturing	1970	1970	The Netherlands
Company D	Large company	Manufacturing	1985	2004	Spain
Company E	Large company	Insurance sector	1845	1971	The Netherlands
Company F	Small company	Manufacturing	1979	2006	Belgium
Company G	Small company	Creative industries	2004	2004	Estonia
Company H	Micro company	Manufacturing	2002	2002	Austria
Company I	Micro company	Design and manufacturing	1998	1998	Spain
Company J	Small company	Service provider	2008	2008	Spain

Company	Position of Interview Partner	Interview / Questionnaire	DME Award Result	Staircase Model Level Score
Company A	Owner / Manager	Interview	Winner	3
Company B	Owner / Manager	Interview	Not awarded	4
Company C	Design Manager	Interview	Not awarded	3
Company D	Design Manager	Interview	Not awarded	4
Company E	Brand and Reputation Director	Interview	Not awarded	4
Company F	Owner / Manager	Interview	Not awarded	2
Company G	Partner	Interview	Honourable Mention	4
Company H	Owner / Manager	Interview	Winner	3
Company I	CEO	Questionnaire	Not awarded	3
Company J	Senior Industrial Designer	Questionnaire	Not awarded	4

Table 7.2: Participant recruitment – Company overview