

Cranfield University

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How companies embed Non-Quantifiable Product Qualities through their product development process

Doctor of Philosophy (PhD) thesis

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Cranfield University

School of Industrial and Manufacturing Science

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**How companies embed Non-Quantifiable Product
Qualities
through their product development process**

PhD Thesis

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**Prof. Peter Deasley
Prof. John Kay**

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of
Doctor of Philosophy**

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Abstract

Many consumer products have reached a high level of technical product quality. Rapid adoption of new technologies and access to a global market means that markets are getting saturated. This means that technical differentiation is often not enough to sell a product and products compete more and more on intangible product qualities – these are meant to delight, bring pleasure, be easy to use and to create an experience. These qualities are often difficult to measure in the product using scientific descriptions and numerical measures. This research studies these Non-Quantifiable Product Qualities and the thesis presents research into how companies embed these Non-Quantifiable Product Qualities into their products in an attempt to satisfy their customers.

The aim of this research was to gain insight into how large manufacturing companies embed product qualities that are difficult to quantify, by studying their product development process. This was done in two stages, firstly an exploratory study into five case organisations, secondly an in-depth study into three of the original five companies. Fifty interviews with designers, engineers and marketers formed the main source of data, supplemented with observations and document analysis. In the exploratory stage nine initial themes emerged out of data analysis, which then informed the data collection in the descriptive stage. The final output is seven confirmed themes, with 43 major findings and three conceptual models, that describe how companies embed Non-Quantifiable Product Qualities through their product development process.

The research has found that the researched companies have some common strategies for embedding Non-Quantifiable Product Qualities. One example is that they will typically seek to translate an emotional response in the customer into measurable product qualities that will evoke such response. It is also common to seek out customer reaction to products during development to ensure successful embedding of Non-Quantifiable Product Qualities.

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Glossary

CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CPE	Chief Project Engineer
MPV	Multi Purpose Vehicle
NQPQs	Non-Quantifiable Product Qualities
PDS	Product Design Specification
QPQs	Quantifiable Product Qualities
R&D	Research and Development
Spec	Product Specification
SUV	Sports Utility Vehicle
USP	Unique Selling Proposition

Chapter 1

Introduction

This chapter aims to provide the reader with an overview of the thesis and an understanding of its structure

1.0 Chapter structure

This chapter introduces the reader to the background and nature of the research presented in this thesis. The focus and objectives of the inquiry are introduced and the research process is briefly summarised. Finally the chapter concludes by providing an overview of the thesis structure and the contents of each chapter.

1.1 Background to the research

This section briefly describes the overall background for this research, emphasising gaps in existing knowledge.

Before the industrial revolution, product design and development was often done by one or a few designers, who were a part of the process which spanned the time between idea and sale. The line from product developer to the customer was much shorter than today. Today the journey from product development to the customer is much more complicated, often involving many people across several countries. Naturally this influences the process and methods used to manage this complexity. Companies have organised themselves into different functional groups to take care of different aspects of the product, with marketing, design and production being at the core. Since the industrial revolution companies have learned to define, construct and build products based on measurable qualities; these being functional or technical qualities, structure, dimensions or material specification. By using measurable qualities, companies minimise the likelihood of misinterpretation.

Today most products are of a high technical quality. Rapid adoption of new technologies and access to a global market means that markets are becoming

saturated, and products becoming similar in terms of technical performance. Products are often said to compete on more intangible qualities – they are meant to delight, bring pleasure, be easy to use and create an experience. It is said that customers are looking for products that not only serve a functional need, but also an emotional need. In recent literature this emotional need has even been described as more important than the functional (Norman, 2004). Customers want attractive products. It is not only about how the products look, but also how easy or even pleasurable they are to use. They might evoke memories of one's childhood or have other nostalgic qualities, or sound as if they are made with precision and of durable materials. The touch entices the perceiver into further interaction, and the handling can give the potential customer feelings of comfort and reassurance.

A shared characteristic of all these qualities are that they are difficult to measure in the product using scientific descriptions and numerical measures. Product qualities that are fulfilling an emotional need or desire rather than a purely functional need can be difficult to define in scientific terms. They are diverse, some related to perception through the five senses and others related to more cognitive aspects such as novelty, surprise and usability. One characteristic they seem to share is that they are difficult to measure in the product, or, as the author refers to them, they are Non-Quantifiable Product Qualities or NQPQs.

Recent research has started to investigate what it means for a product to have emotional qualities. The focus has mainly been on *how* products can evoke positive emotions like pleasure, surprise and delight in the customer. The research focus has been on what occurs between the customer and the product. Most research findings derive from looking at existing products and accessing their emotional qualities. A number of assessment systems have been developed, and it has been suggested that products which score highly on, for example, the pleasure scale have embedded qualities that we can copy into other products and get a similar customer reaction. None of these tools seem to have been developed with large companies in mind, they are often set out as an assessment tool, or a tool for single designers.

In literature there has been a call for research into the importance of these less tangible product qualities. Some popular literature has focussed on methods that inform the development of products which lead to higher emotional customer satisfaction, but it has been small scale and often presented in retrospect using examples of (financially) successful products. There has not been any attempt to research how it is actually done by manufacturers.

This research was motivated by the fact that our empirical understanding of how manufacturers design and embed less tangible product features is very limited. This research, therefore, aimed at gaining an understanding of the *process* of creating and embedding NQPQs. The focus is between the designer and manufacturer of the product during the process of creation.

This research does not cover the subject of branding. Brand qualities impact upon design and decisions about NQPQs, but this research is not focussed on the

link between the companies brand qualities and how they might seek to match this by embedding NQPQs into the product.

1.2 Industry context

This section presents the current situation in industry and illustrates the need for the research.

Industry aims to satisfy customers in a profitable way. In the past, competitive advantage and profitability was centred on minimising cost through design and process optimisation. Many products looked alike, so the main reason behind customer purchase was functionality, size, price or because it looked better than alternative products. The product qualities in focus were mostly quantifiable and easy to specify – often driven by technological advantage. More intangible features such as product appearance were often instigated by looking at competitors and copying what seemed to be more successful. This competitive focus on well specified product qualities has led to the use of product development processes that are suited to handling functional or technical product qualities. This emphasises the use of numerical targets and measures to guide and control the product development process, as can be seen in the stage-gate process.

The situation today is that products have become similar, and competition harder. Manufacturers have access to and incorporate the same technical qualities into their products (Parry-Jones, 1999). Many organisations have over recent decades matured and optimised their technical capabilities and can rapidly copy and deliver these quantifiable product qualities (QPQs). These are therefore not useful product differentiators anymore. New ways of differentiating products are needed, preferably in a way that is difficult to copy.

Industry is therefore increasingly talking about product qualities such as appearance, usability, product identity, semantic value, ‘surprise and delight’, pleasure, comfort, ergonomics, accessibility, and environmental issues. These qualities are often difficult to define, specify and embed in a quantifiable way. They can be said to be non-quantifiable product qualities (NQPQs) and fall into the area of interest for this research project.

Customers are learning to differentiate products in more subtle ways, they look for attractiveness and qualities that evoke pleasure (Forlizzi, 2002). The maturity of many markets and industries also implies that we are on the edge of what has been named the ‘experience economy’ (Gilmore, 1998). In the experience economy products will not only be expected to meet functional needs, but will be expected to facilitate the overall experience of the interaction activity between user and product. It is suggested that customers will buy products that tell a story and signal product-specific values (Jensen, 1999). This means that offering products where a conscious and consistent approach has been taken to embed these NQPQs is likely to retain or gain competitive advantage.

Many, if not all, companies are already incorporating these NQPQs into their products, but previous research from industry shows a lack of consistency and explicit knowledge about their handling throughout the product development process (Illman et al., 2002a). Companies do not appear to have NQPQs explicitly addressed in briefs or in assessment methods in their product development process. Most companies rely on employees' experience, holding reviews by using tacit knowledge of when the NQPQs are 'right'. This means that companies do not normally have explicit methods to ensure that NQPQs arrive in their product (Illman et al., 2002b).

Industry needs a better understanding of how to embed NQPQs, and this research is therefore needed to help gain such knowledge.

1.3 Research approach

The focus of this research was determined by both the industrial context and review of the literature. The literature contained no research about how companies understand and embed NQPQs. Some literature address the importance of these product qualities, other more popular sources describe how some companies are developing strategies and applying methods that nurture the organisational awareness and prioritisation of less tangible product qualities. Literature that details or describes how companies deal with NQPQs through different phases of the product development process and how they are designed into the product is absent. As a result, the following objectives were identified for the research:

- Explore how manufacturers understand the NQPQs they embed into their products
- Identify stages in the product development process of embedding of NQPQs
- Learn how different organisations handle NQPQs in the product development process

Implicit in the objectives was a need to learn how companies understand their NQPQs. The term NQPQs was devised by the researcher due to the lack of a generally shared terminology within the field of product design and development. Gaining an insight of how companies communicate and understand their NQPQs was seen as fundamental to the research, as the process of embedding starts with conceptual understanding. Research into the product development process has been concentrated on managerial aspects of the process when the product specification is known, or the early design stages when the product is in the process of being conceptualised. Research into design processes has often focussed on the early creative and visionary stages, in settings far removed from that of industry. Much research has tried to apply and test methods or tools (often IT based) by using a group of, for example, design students as the testing ground (Desmet & Dijkhuis, 2002; Jordan, 2002; Reijneveld et al., 2002).

Research based on a constructed setting can give us insights, but the limitations of mirroring reality in a company setting are often overlooked. It was therefore important to gain empirical insight/data from many product development stages (from idea to finished product) and obtain the viewpoint of the process from the many functional groups (product planning, marketing, design, engineering etc.) that are a part of the process of embedding NQPQs. Therefore this research will be set in industry practice by developing knowledge from practice.

As a result the overall research and sub-questions were framed as follows:

How do companies embed non-quantifiable product qualities into their products through their product development process?

Sub-questions:

- *How do companies understand their NQPQs?*
- *Who is involved in the process of embedding and when?*
- *How is the customer influencing the process of finding, developing and embedding NQPQs?*

The objective and research question guided the research methodology (described in chapter 3). To achieve generic as well as detailed research findings, whilst maintaining the feasibility of the research, a qualitative research approach was applied and data collected from five companies in three different industries. By choosing complex products like cars, mobile phones and Hi-Fi, this research assumes that the understanding of NQPQs it produces can be generalised for the benefit of product developers working in other consumer product sectors.

1.4 Novelty and contribution to knowledge

This research aims to generate new knowledge in the form of an exploration of how companies understand and embed NQPQs in their daily practice. By using an inductive research method, deriving hypothesis or insight out of data, new knowledge is allowed to emerge directly from the data. The research demonstrates novelty in the following way:

- A phenomenological approach is applied to the study of the ill-defined field of embedding NQPQs
- By using a inductive research approach the research identifies new insights outside the constraints of current theoretical standpoints

- By following the product development process, rather than focussing on one particular phase, a longitudinal understanding of the process of embedding NQPQs is sought
- The scope of the research is novel. Previous research has focussed on testing concepts and tools for specific types of NQPQs, often in an academic setting. This research focusses on finding out what is actually happening to NQPQs during the product development process in manufacturing companies

As a result this research aims to contribute to knowledge by presenting novel observations, findings (hypotheses) and conceptual models in the process of answering the research objectives.

1.5 Guide to thesis structure

This thesis presents the research in seven chapters. The research is presented in four stages; firstly, the research is introduced through a review of literature, and a specification of the methodology presented. Then the processes of data collection and analysis for the two stages of the research are presented. The thesis concludes with a discussion of the research findings and the framing of their contribution in terms of the existing literature.

Chapter 1 – Introduction

This chapter provides an overview of the thesis, the industry context and a summary of the chosen research approach. The area of novelty is described.

Chapter 2 – Literature review

This chapter presents a diverse review of current literature that influences our understanding of the research background and objectives. Firstly a review of existing design and product development literature is presented to frame the research and present existing knowledge. Secondly a working definition of NQPQs is developed based on existing concepts used within product development. Finally literature from other fields is presented as it contributes to answering the research objectives.

Chapter 3 – Research Methodology

This chapter outlines the selection and justification of the methodology used to answer the research question. The Case Study methodology selected is described. The phenomenological (inductive) research approach applied in the two research stages (exploratory/descriptive) is presented together with author's consideration of validity throughout the study.

Chapter 4 – Exploratory stage

This chapter presents the research approach and analysis of data from the first exploratory stage. The inductive analysis results in 9 themes that are presented.

Chapter 5 – Descriptive stage

This chapter presents new data collected in the descriptive stage from three companies and the methodological reasoning behind it. New data are used to elaborate on the themes found in the exploratory stage while adding new themes and findings. Literature is enfolded under each theme and where new knowledge emerges research findings are concluded at the level of individual themes. Several conceptual models that illustrate aspects of NQPQ embedding are developed and presented.

Chapter 6 – Discussion of the research findings

This chapter discusses the findings and adds the author's perspective on them. A model of knowledge exchange is discussed in relation to the findings. Finally a model is developed to summarise answers to the research question.

Chapter 7 – Conclusion

This chapter concludes the thesis. The thesis findings are reviewed as a whole. Strengths and weaknesses of the research are discussed and the chapter concludes with suggestions for further research and practice.

Figure 1.1 on the following page outlines the aims and outcomes of the thesis.

Chapter	Aims	Outcomes
Chapter 1 Introduction	To give the reader an understanding of what the research is about and how the thesis is structured	➤ Thesis structure and research question
Chapter 2 Literature review	To describe the content for the research and address the gap in existing knowledge that this research is targeting.	➤ Validation of research question
Chapter 3 Research methodology	To select an appropriate research methodology through comparison of alternative approaches. Describe data collection methods and data analysis techniques used.	➤ Research methodology
Chapter 4 Exploratory stage	To describe the first stage of the research project and show the reader how themes emerged out of data	➤ 9 initial themes 3 examples of embedding NQPQs
Chapter 5 Descriptive stage	To describe the second stage of the research project and show how new data was used to elaborate on the initial themes/findings and add new findings	➤ 7 confirmed themes 3 models
Chapter 6 Discussion	To illustrate how the findings have answered the research objectives; to present the authors view on the research findings	➤ Model answering the research question
Chapter 7 Conclusion	To state the contribution to knowledge, address strengths and weaknesses of the research	➤ Contribution to knowledge. Recommendations for future research and for practitioners

Figure 1.1 Outline of the thesis aims and outcomes.

Chapter 2

Literature Review

This chapter grounds the research in the literature. Gaps in existing knowledge are addressed, as they form the basis for this research inquiry.

2.0 Chapter structure

The objective of this literature review is to present the current state of knowledge concerning the process of embedding NQPQs. This is driven by the research question *'How do companies embed non-quantifiable product qualities into their products through their product development process?'*

Current knowledge in the field of NQPQs and how they are embedded is shown to be immature. Relevant literature is sparse and spread across many different fields.

Section 2.1 describes the objective of the literature review and the methods used to find and present literature. Section 2.2 presents the background to the research field of NQPQs, showing how the customers' view of quality has evolved, while section 2.3 describes the concept of 'product' and introduces the notion of product qualities, elaborating specifically on Non-Quantifiable Product Qualities. Section 2.4 goes on to address current understanding and structuring of the product development process. Section 2.5 elaborates on the role of customers in product development, while section 2.6 introduces ideas about how product development teams communicate and make sense of aspect of the product that are difficult to define. Gaps in existing knowledge are presented and the research question is verified in section 2.7. Conclusions are summed up in section 2.8.

2.1 Objective and methods used for the literature review

This section will describe the objective of the literature review and the method used to fulfil this.

2.1.1 The purpose of the literature review

The objective of the literature review is to ground the research question in existing knowledge by addressing the gap it is aiming to close. By looking at existing knowledge several objectives are sought. Some of the most important are: to discover what other researchers have looked at in the research field; to learn about their theoretical and methodological approaches; what the outcomes are and how they inform this research inquiry. Reviewing existing knowledge adds perspective and foundation for this research inquiry.

The literature review will also address literature that lies outside the field of product development and NQPQs, but might contribute to an improved understanding of the topic.

2.1.2 Literature search and presentation

Commonly, a literature search starts out with a keyword search. This can be done because existing knowledge has already contributed to describing, defining and positioning the topic. Since this is not the case with NQPQs another approach had to be taken. Hence, the initial literature search on NQPQs emerged from a limited set of papers that touch upon the importance of NQPQs, although they were not described by this term nor were they the main topic of these papers. The literature search started out by using the bibliography references of these key papers and yet again using the references of these secondary papers.

By using references of references a picture emerged of how other researchers describe and research NQPQs. From papers already found it became apparent that a few international journals into design research or design management covered the subject, and these were used extensively. It also became clear that relevant research could come from various perspectives, such as product development process, customer research and knowledge management. Using this combined set of information the literature search continued into many different fields.

Academic databases have been used to find literature on, for instance, product design, product development, intangible or emotional product qualities etc. A traditional keyword search was used in an attempt to find literature outside already identified fields, although success was very minimal. A literature search using internet search engines has, very briefly, been used and selection of material was critically reviewed to ensure that it came from sources of good quality (mainly academic or recognised institutions such as the Design Council).

2.2 Background to the research field of NQPQs

The notion of product has existed for thousands of years; in early days products were merely produced and sold by one individual craftsman or family. Then the industrial revolution made it possible to process raw materials and manufacture products in more efficient ways, leading to the development of large manufacturing industries. This change has shaped the product and the product development and manufacturing processes in many ways. One of the more significant changes is that where once one or a few people were involved in the design and manufacturing process, many products of today are the result of hundreds or thousand of people's efforts, which makes the product development process ever more complex and challenging to manage (Ulrich & Eppinger, 1995).

The industrial revolution meant higher availability of affordable and reliable products. Over recent decades this continuous availability and technological advantage has shifted customer expectations of products from focussing on cost, reliability, safety and particular functionalities to more subtle and ill-defined product qualities, such as aesthetics, usability, fun value, ethical position, or symbolic value (Forlizzi, 2002; Burns et al., 2001; Bonapace, 2000; Gotzsch, 2000; Jordan, 1999a; Gilmore, 1998; Oliver et al., 1997).

Kano has observed this shift when describing the connection between product qualities and customer satisfaction (Kano, 1984). Kano argues that customer satisfaction deflates over time. This means that a new product quality is at first perceived as a 'delighter' giving high customer satisfaction, but it will eventually change into being a basic quality. An example of this is when car manufacturers started to sell cars with built-in radios. At first this was a delighter. However, as more and more car manufacturers incorporated a radio into their cars it quickly became a 'performance' feature and today it is regarded as a basic feature. Today it does not add much satisfaction to a car, but if there were no radio it would be seen as a dis-satisfier.

This means that functionality has become secondary; it is something that is almost taken for granted by customers. The implications of this for product development are the subject of this research.

2.2.1 Customers and customer responses

In the past most customer products were purchased primarily to fulfil a practical need. Products delivered a function at a price. The manufacturers focussed on making a profit by optimising the process by which they could deliver the desired functionality, and the technical quality of those, and keep cost down. Product quality was often associated with physical qualities such as durability of mechanical parts, functional reliability and overall product robustness. As manufacturers learned to ensure the physical or functional qualities of the product, and optimise the process of delivering these at a competitive cost/price balance, the competitive advantage moved from being purely price driven to

including the introduction of new functionalities often through the use of technology.

Over time access to technology has made it easy to provide a good technical product, with customers in the western world having increasing buying power and access to products of good technical quality. This has led to products that need to do more than just serving a practical need; the product needs to provide emotional responses such as ease of use, delight or a notion of pleasure.

In literature there seem to be a blurring between product quality and customer response. This is evident in terms like 'delight feature', 'product emotion' or 'emotional product' (Norman, 2004; Desmet, 2003). The emotional response, such as 'delight' is seen to be embedded in the product, rather than being shown as what it is – an emotional response in the customer. The product quality is the cause of an emotional customer reaction.

2.3 Products and their qualities

Our understanding of what constitutes a product has changed over time. From seeing products simply as a physical offering serving a basic human need, to today where many products are non-physical services purchases, not only due to their functional qualities, but also their ability to evoke emotional response in the customer. This section will elaborate on current knowledge and understanding of products and their qualities.

2.3.1 What is a product?

In literature the emphasis on what constitutes a product has evolved considerably in recent years. Current understanding of what constitutes 'a product' has emerged from being a purely physical object to today when it also includes less tangible or even non-material characteristics. As an example, Cagan & Vogel define a product as '*a device that provides a service that enhances human experience*' (Cagan & Vogel, 2002: 7). From the literature it seems that a product can be categorised within the spectrum of the following four core interpretations:

- Product as a physical object (a bag of coffee beans)
- Product with a service (a take-away coffee)
- Product as a service (car rental)
- Product as an experience (holiday package, theatre performance)

This shift can be characterised by focussing on the physical product as the offering to seeing the outcome of the interplay between the product and the customer as the offering. The latter focusses on the service or experience that the

product provides, rather than the physical product on its own. In a current encyclopaedia this more extended product view is reflected in the following definition: *'A product is anything that can be offered to a market that might satisfy a want or need. However it is much more than just a physical object. It is the complete bundle of benefits or satisfactions that buyers perceive they will obtain if they purchase the product. It is the sum of all physical, psychological, symbolic, and service attributes.'* (Wikipedia, 2006a). The inclusion of *symbolic attributes* leans on the understanding of products serving as signs of more than they immediately appear to be which will be discussed further in section 2.3.2.

2.3.2 Product qualities

Current understanding and knowledge of product qualities has its roots in the process of ensuring technical product qualities. Quality was embraced by the Japanese manufacturers in the 1950s, who used it as a driver for their product development process. Western manufacturers did not really gain insight into the importance of product qualities until the 1980s, following large losses in home markets as a result of customers' preference for the superior quality of Japanese and other Asian products. Following this, the principles of Total Design, and the methods and tools used by the Japanese manufacturers were studied, adapted and implemented by many western manufactures (Robotham & Guldbrandsen, 2000). In the beginning attention was directed at improving production quality (e.g. manufacturing cost, control, process optimisation etc.), but subsequently a focus on satisfying customers evolved. As a consequence, more attention was given to upstream activities of the product development process to ensure that product quality was built-in through design for quality (Mørup, 1993).

As product quality related to engineering and manufacturing reached a stage where they were no longer differentiating products, new understandings of product qualities emerged. Today the concept of product quality has evolved into multiple interpretations such as superior value to the customer, zero-defects, needs satisfaction, pride of ownership and engineering qualities (Mørup, 1993).

Although most quality perception is centred on the (end) customer, there are other stakeholders in the product that should be considered in product development according to Mørup (1993). He states that the product has to perform as well as possible in all its life phases (manufacture, sales, use, service and disposal) and that product quality should be perceived according to the different stakeholders. He proposes a division into external and internal stakeholders. External stakeholders are customers, users, approving authorities and external sales and service people (i.e. independent from the manufacturer). Internal stakeholders are all internal functions and employees in contact with the product, such as designers, engineers, production, quality control etc. Mørup's division of stakeholders has natural consequences for the definition of quality, as he suggests by defining the following two concepts (Mørup, 1993: 97):

- Q-quality (Big Q) – Q is the customer’s qualitative perception of the product
- q-quality (little q) – q is the internal stakeholder’s qualitative perception of the product in relation to his product-related tasks

Andreasen & Hein (1998) have added to the notion of Q and q by suggesting that there are different classes of quality. The model below illustrates how the life supporting qualities are presented as fundamental for the product; these are the little q’s. On top of these a triangle shows four types of big Q. Technical qualities of the product form the basis for Q-quality, while the three top layers of the model represent product qualities perceived by the customer as being obligatory, expectation or positioning (it is worth noting their similarity to Kano’s classes of qualities, which are discussed in 2.4.4).

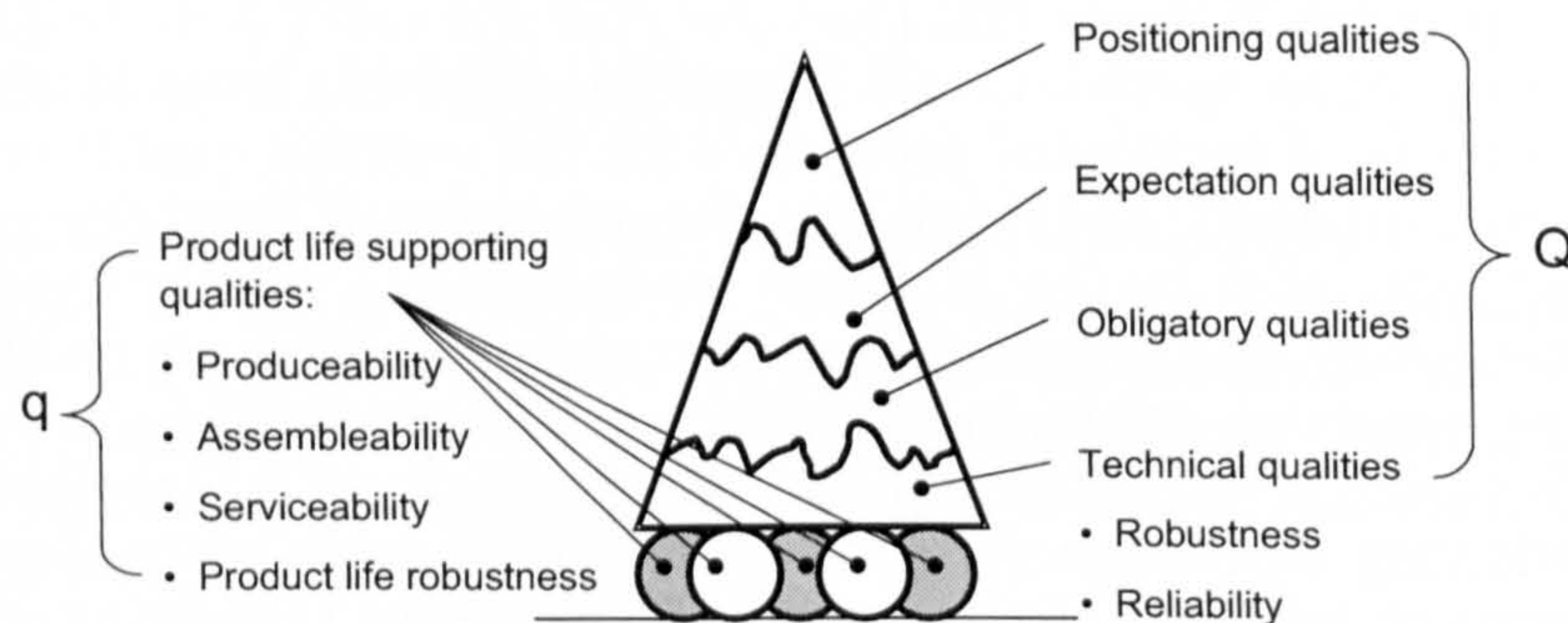


Figure 2.1 Classes of quality (Andreasen & Hein, 1998)

In recent literature on product quality, a major focus has been on customers looking more and more towards the higher classes of quality and taking the technical ones more or less for granted. In markets where functional and technical product qualities have reached a point where they can no longer work as product differentiators, customers are looking for products ‘to stage experience’ (Gilmore, 1998). This means that the customer of today no longer makes purchasing decisions solely on the basis of logical product assessment (Burns & Evans, 2001; MacDonald, 1998). Apart from the satisfaction of fulfilling a utilitarian function, it is increasingly recognised that products can give the customer pleasure, as stated by Chhibber et al. (2004: 2): ‘Consumers are now looking for more from the product that they buy: they are looking for pleasure and fulfilment of their emotional needs’. Weightman & McDonagh (2002) argue that customers gain pleasure from products that meet their functional and supra-functional needs. They describe the term ‘supra-functional needs’ as emotional, aspirational, cultural and social needs.

The focus on different types of product quality in relation to a higher order of customer need is something that has been addressed by several academic researchers (Bonapace, 2000; Gotzsch 2000; Jordan, 1999a).

The idea is based on Maslow's hierarchy of human needs (Boeree, 2000). According to Maslow, human needs and motivation can be classified into five levels, suggesting that when one lower level has been satisfied or partly satisfied, the human instinct is to seek fulfilment at the next level. The hierarchy of needs is: Physiological needs (i.e. food, water and shelter), safety needs, belonging and love needs, esteem and self-actualisation needs.

Bonapace (2000) and Jordan (1999a) build upon this idea of a hierarchy of needs, and links it to product by suggesting that when products fulfil basic needs, the user will start seeking satisfaction at the next level. Bonapace (2000) proposes four levels of user needs that product needs to fulfil: Safety and well-being, functionality, usability and pleasure. Figure 2.2. illustrates the structural similarities between Maslow's hierarchy of human needs and Bonapace's hierarchy of user needs to be satisfied by products.

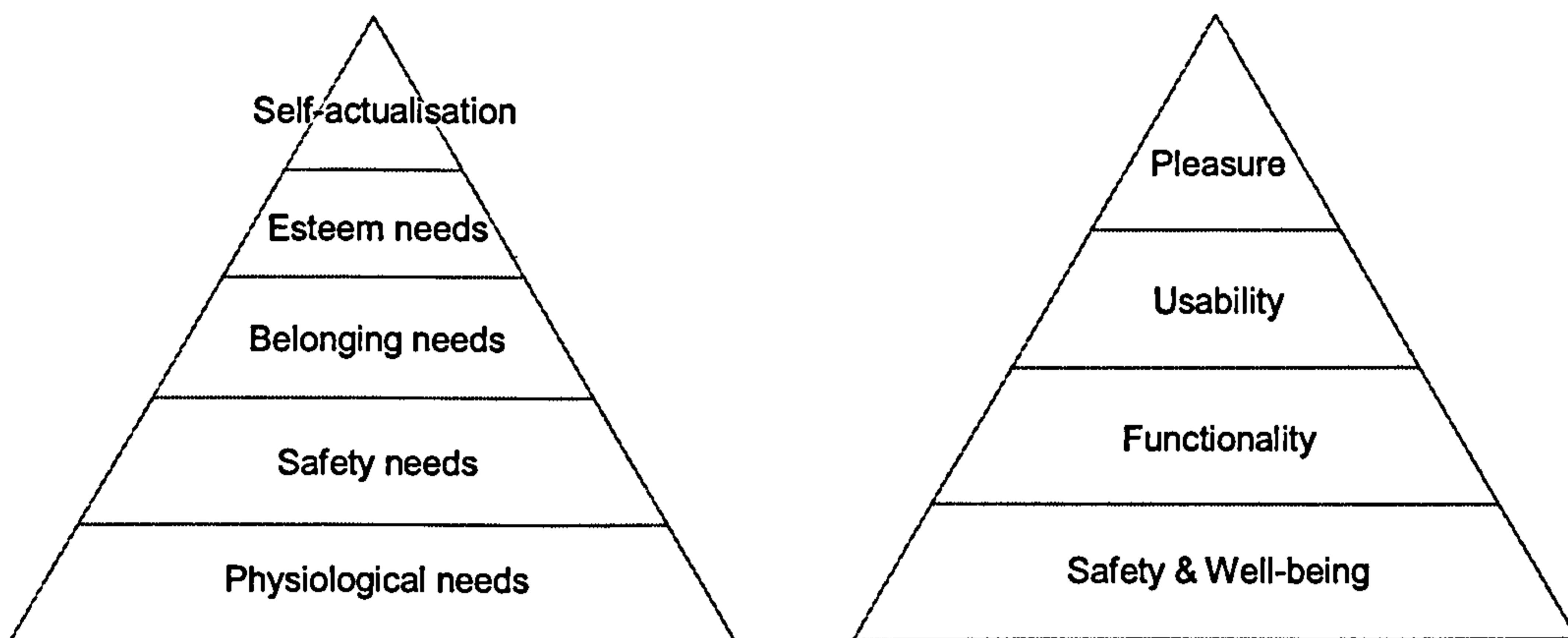


Figure 2.2 Maslow's hierarchy of needs (Boeree, 2000) and user needs satisfaction (Bonapace, 2000)

Gotzsch (2000) has linked products to the fulfilment of higher order needs by suggesting that products fulfil communicative needs. She argues that products create an affiliation between the user and the product, and hereby fulfil a need for love and belonging. This affiliation is created by the product's symbolic qualities, signalling for example historical, time-related or national codes. At the next level of need fulfilment products can contribute to the perception of status or position, of the user in society, adding to the individual's self-esteem. Finally Gotzsch (2000) believes that products can give the possibility of self-actualisation. This is observed in, for example, the personalising of mass-produced products such as cars or watches, allowing individuality to be exhibited through customisation.

The addressing of higher order user needs has introduced an awareness of product's ability to fulfil emotional needs. As Watson & McDonagh (2004) describe: *'Considering the emotional elements within product design and development is a growing activity based on the realisation that they can have a significant impact on product success. Product developers, manufacturers and designers are slowly identifying that qualitative aspects are crucial to product*

success.' In this literature the understanding of product's ability to evoke emotions has primarily been centred on product's ability to give the customer pleasure. The understanding of pleasure as a state of mind and the link to product qualities are still maturing, as researchers do not seem to have a clear distinction between *product qualities that evoke* pleasant emotions in the customer and the *emotional reaction* of pleasantness that occurs in the respondent (the customer). Jordan (1999a) was one of the first researchers to start applying the notion of pleasure to products. He used a classification of four types of pleasure developed by Tiger (1992). The four types of pleasure are physical, social, psychological and ideological (Jordan 1999a):

Physio-Pleasure is derived from the body through the senses, such as the pleasures connected with touch, smell, taste and hearing. The tactile pleasures concern holding or touching a product during interaction, such as a mobile phone handset. Acoustic feedback from a product, or simply the sound created from touching the product, are also examples of physio-pleasure (Bonapace, 2000).

Socio-Pleasure is the enjoyment derived from the company of others. It can be taking part in a social event or just having a conversation. Products can facilitate social interaction through, for example, providing a focal point for a social gathering. At a workplace it might be the coffee machine or it could be the computer that facilitates social interaction through chat rooms, phone services or online games with your friends. Products might also indicate belonging to a social group and thereby add to an individual's social identity.

Ideo-Pleasure is pleasure derived from 'theoretical' entities such as books, music and art. In relation to products it is, for example, the aesthetic of a product and the values that the product embodies (Jordan, 1999a). Another example is product's pleasure derived from products containing ideological qualities of importance to the individual, such as being ethnically or environmentally aware (fair-trade, organic or biodegradable products).

Psycho-Pleasure is defined by Tiger (1992) as the pleasure gained from accomplishing a task. It relates to the degree by which a product can help in this accomplishment through its usability, as stated by Jordan (1999a: 211): *'Psycho-pleasure relates to the extent by which a product can help in accomplishing a task and make the accomplishment of that task a satisfying and pleasurable experience.'* He continues by giving an example of a word processor which facilitates a quick and easy accomplishment of, for example, a formatting task, which then led to a higher level of psycho-pleasure than if the user were to do it manually.

As described by Jordan (1999a), products can provide more than just satisfying basic functional needs, they can fulfil emotional needs resulting in pleasure. This is supported by many researchers in recent years (Gomez et al., 2004; Gotzsch, 2004; Norman; 2004, Weightmann & McDonagh, 2004; Gilmore, 1998; Crosier, 1994). Design research literature often refers to pleasure as a product benefit that exceeds just proper functioning (Desmet & Hekkert, 2002). The term pleasure is

often used to describe products that are designed to evoke a positive response in the customer. Much recent literature has focussed on understanding product qualities *through* the understanding of product response. Often research has focussed on the response to aesthetic (primarily visual) product qualities, and even the response research is mainly centred on 'pleasure' as a response (for rare exceptions see Burns, 2003; Hekkert et al., 2003). A good overview of research into how customer response is affected by product design has been presented by Bloch (1995) and Crosier (1994).

Most research has been devoted to the *assessment* of user response (Burns, 2003) while very little research has been devoted to understanding why and how that emotional response was evoked by the product. One exception is Burns (2003) who has investigated how a product provides a delight reaction in the customer. Burns' research found that products delight customers when those products contain unexpected levels of desirable qualities. It was also found that product could delight customers at the level of the 'whole' product, as stated by Burns (2003: 220): *'The route to delight is characterised by customers citing multiple product attributes as the basis of a single delight reaction or by customers reporting a purely holistic appraisal.'*

The majority of research in this field has focussed on trying to assess product qualities from the viewpoint of the customer. This has led to a number of tools that categorise product characteristics based on customer responses. These responses have then been proposed in a format where they are argued to be able to help designers to design more emotionally pleasing products (Desmet, 2003, Antikainen et al., 2002; Chen et al., 2002; Desmet & Hekkert, 2002). Most prominent is an approach that assesses the customer reactions by categorising the emotional response. One example is the Product Emotion Measurement Instrument (PrEmo) developed by Pieter Desmet to measure specific emotions evoked by product design (Desmet & Dijkhuis, 2002; Reijneveld et al., 2002). PrEmo is a non-verbal computer-based assessment tool which is used to assess a product design by looking at the product and asking questions about the customer's emotional response. The tool uses 14 emotions that were found to be most often elicited by products. The measured emotions are represented by seven pleasant emotions (i.e. desire, pleasant surprise, inspiration, amusement, admiration, satisfaction and fascination) and seven unpleasant emotions (i.e. indignation, contempt, disgust, unpleasant surprise, dissatisfaction, disappointment and boredom). The 14 emotions are portrayed using animated cartoon manikins by means of dynamic facial, bodily and vocal expressions that present the emotion. The respondent is shown the product and is then asked to select the statement that fits their emotional state best: 'I feel this emotion', 'to some extent I feel this emotion' or 'I do not feel the emotion expressed by this animation' (Desmet & Dijkhuis, 2002). Another example of a method that tries to assess emotional response to product is by having respondents linking personality trait to products (Jordan, 2002). Through personality descriptors like such as honest/dishonest, extrovert/introvert, bright/dim, the respondent is asked to assess the product by answering a questionnaire. As in these two examples it is common to assess product's emotional response based on visual perception (Jordan, 2002; Desmet et al., 2000). One criticism is that both

methods are based on the respondent's evaluation of product appearance rather than on the total product experience when interacting with the product using haptic, auditory and olfactory qualities as well as visual qualities, and without actually using the product. This emphasis on narrow responses to primarily visual product qualities forms the majority of current research.

When trying to understand the less tangible qualities of products it is important to remember that such qualities lie in the eye of the beholder. When looking at the same product, a group of people will not see exactly the same. Even though they might receive the same visual information and interpret the image in basically the same way, the image will always be revised by the perceiver's personality and situation. A person can have several different points of view, which he consciously or unconsciously can bring in on a given situation (Monö, 1997). Factors such as social and cultural influences impact on customers' perception of product quality (Coelho, 2003; MacDonald, 2000).

Research into understanding products as a means for customer response has often focussed on the signs that products send out, called *product semantics*. Dittmar (1992) states that material possessions (such products) not only work to fulfil instrumental and utilitarian functions, but also a symbolic dimension which has important implications for the personal and social identity of the possessor. This is supported by Özlem (2004) who gives an example of the symbolic qualities in relation to social belonging: *'Products that people possess and use, functions as a system of symbols that locate them in a certain social category'* (Özlem, 2004: 1).

This understanding of products as symbols should be seen in relation to product semantics – the study of the meaning of signs (Monö, 1997). Or as described by Weightman & McDonagh (2002: 34): *'Emotional bonding, symbolic representation, tribal connections, subculture references and so on, all form part of the language of defining product personality and product semantics.'* Krippendorff (1995: 157) states that product semantics is *'...study of the symbolic qualities of man-made forms in the cognitive and social context of their use and the application of the knowledge gained to objects of industrial design.'*

Monö (1997: 81) argues that product signs, like linguistic signs have various functions. He has classified four semantic functions in product:

- To describe: purpose, mode of operation
- To express: properties
- To exhort: reactions
- To identify: a product, its origin, kinship, location, nature or category

Producer side

User side

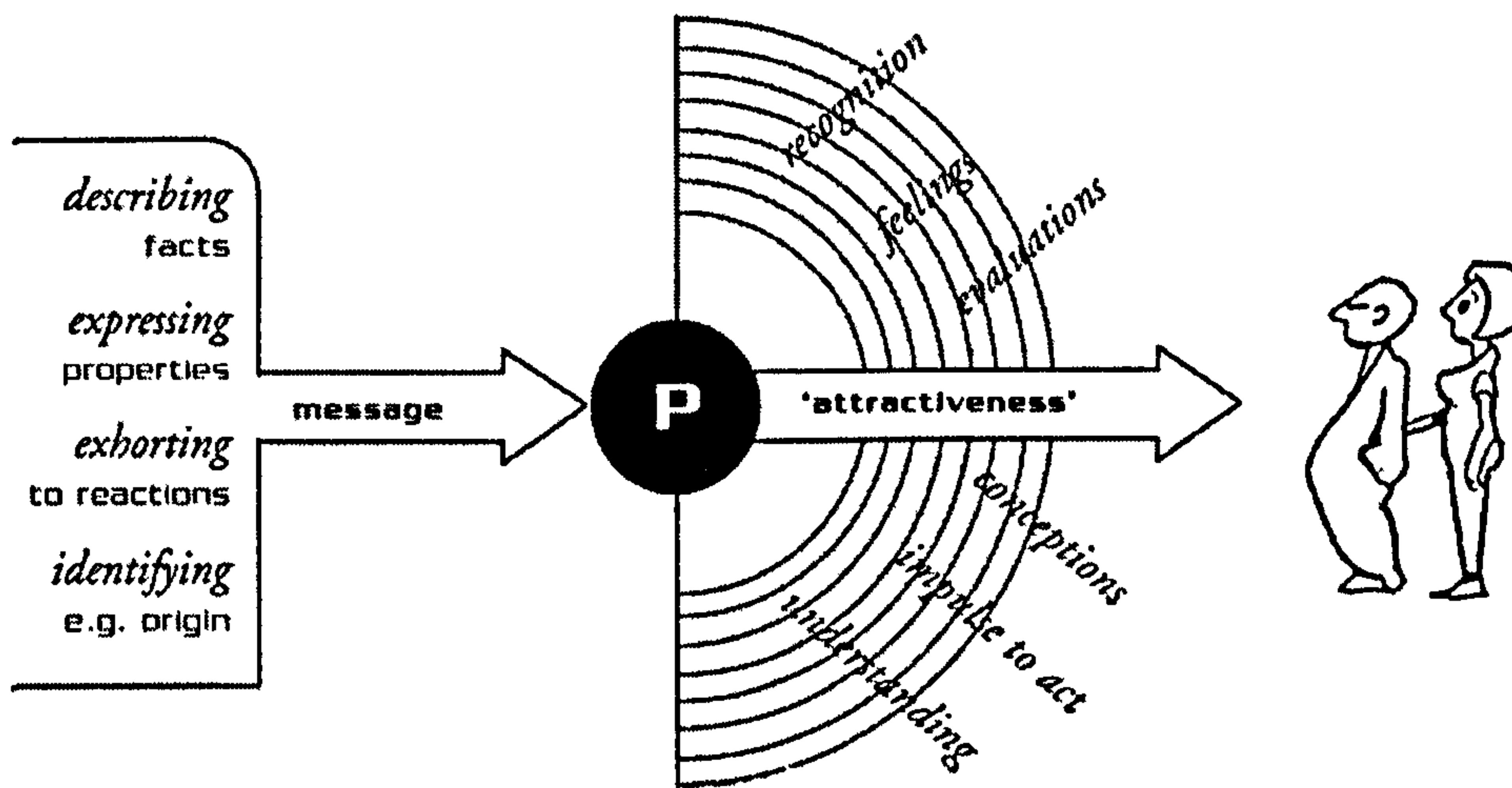


Figure 2.3 Semantic functions (Monö, 1997: 77).

Monö (1997) argues that product developers must be aware of what is to be understood – what the product must 'say' to the customer and market. Similarly, Gotzsch (2004) proposes a model of product's expressions, arguing that the products send out three types of message addressing product, user and company identity.

The understanding of how product can be designed to provide experiences through the embedded quality has evolved in recent years, but in their simplest form all products are felt to create experiences that we perceive through our senses. MacDonald (2000) has described how we as humans have an innate, sometimes subconscious, ability to perceive a wide range of qualities in products which influences our response to them. He continues to describe how this happens through what he calls sensory encounter, illustrated by the following scenario: *'On approaching a car, your initial impression of the object, formed visually, may be attraction, indifference or dislike. Next, you open the door. You judge the weight and quality by feel and sound: does the door-hinge feel secure, and does the door catch make the right sound as it closes? Here tactile and auditory processes have come into play. As you sit in the car, sensing the comfort and support of the seat, there is a smell of the material – of leather, or is it leatherette? Finally as you move away there is a sensation of speed'* (MacDonald, 2000: 1).

The awareness how we perceive products through our senses, and how they should consciously be included when designing products to please and satisfy customers have arisen in recent literature: *'Both design and business communities now talk about design for experience, user experience and customer experience as a conscious element of their offerings'* (Fulton, 2002). In marketing communities, concepts such as emotional branding (Gobé, 2001), and five dimensional branding (branding for all five sense) (Lindstrøm, 2005)

advocate the importance of appealing to customers in ways that create brand experiences. Customer experience is defined by Shaw & Ivens (2002: 21) as: *'A blend of the company's physical performance and the emotion evoked, intuitively measured against customer expectations across all moments of contact.'*

In design communities the concept of 'design for experience' is described by Forlizzi (2002) and Sanders (1999, 2001). Forlizzi describes how people involved in design and product development in recent years have started to develop an understanding of how 'experience' relates to products. She addresses the need for the development of a systematic way by which designers can talk about experience, and understand how to design and support an experience. She states that: *'Designers need to better understand the principles of how people interact with product and how those interactions shape the resulting experience'* (Forlizzi 2002). Sanders adds to the viewpoint by stating that one can not really design experiences, as experiencing is a constructive activity, created by what the product and the user bring to the interaction (Sanders, 1999).

In literature it is evident that the focus on product quality has become less tangible, focussing on the emotional impact of the product. This has moved the focus onto understanding the customers' perception, appreciation and values of these qualities in order to understand and develop product qualities that can facilitate emotional needs rather than functional needs. This in turn leads designers towards facilitating product experiences through embedding qualities that are fit for the user, and fit for the context where the product is used, and has resulted in concepts such as user-centred design (Jordan & Servaes, 1995) and empathic design. The term 'empathic' originates from the word empathy which is defined as the *'recognition and understanding of the states of mind, including beliefs, desires and particularly emotions of others'* (Wikipedia, 2006b). When used in product development, empathic design refers to the ability to design products based on deliberate efforts to empathise with the customer, i.e. to 'walk in their shoes', in order to understand their needs.

As this section illustrates, very little literature has described the product development process for incorporating these less tangible product qualities into the product. Compared with more traditional product qualities such as functionality or safety, one of the aspects of these less tangible product qualities might be that they are difficult to measure in the product.

The language in this field is imprecise, blurred and not established. Often product qualities are for example often mixed up with customer response. What seems to characterise all of the product qualities described here is that they are intangible.

2.4 The product development process

Products are created through the product development process. The design and management of this process is therefore very important when designing product

that will satisfy customers. This section will describe existing models of the product development process and some of the tools used to ensure that satisfactory product qualities are delivered in the product.

2.4.1 What is a product development process?

'A product development process is the sequence of steps or activities that an enterprise employs to conceive, design and commercialise a product' (Ulrich & Eppinger, 1995: 14). Ulrich and Eppinger continue by describing a process as a sequence of steps where a set of inputs are transformed to a set of outputs. This idea of a direct link between input and output is implicit in most models of the product development process; any losses of fidelity in the transformation from input to output are rarely discussed.

It is common for organisations to have a described product development process which they follow. Some organisations have a defined development process which they follow in great detail, others may not even be able to describe their process. Organisations might follow the same structure in their product development process, but the details would be shaped by the individual organisations and therefore be different from others (Ulrich & Eppinger, 1995).

A well-defined product development process is useful, according to Ulrich & Eppinger (1995), as it can help to ensure:

- **Quality assurance:** By specifying the phases a development project will go through and creating checkpoints along the process it is possible to assure the quality of the product, providing that the phases are followed and checkpoints are appropriately chosen
- **Coordination:** A clearly defined and verbalised development process can act as master plan. By defining the roles of the people involved in the product team, the plan can help identify when contributions are needed and with whom information exchange is needed
- **Planning:** A development process consists of milestones corresponding to the completion of individual stages. By timing these milestones a schedule is anchored for the overall development project
- **Management:** A development process can work as a benchmark for assessing performance of an ongoing development effort. Through comparison of actual events to the planned process it is possible to identify problem areas
- **Improvement:** Through documentation of an organisation's development process it is possible to address areas for improvement

2.4.2 Models of the product development process

During the last 30 years many models of the product development process have been developed and described in literature. This section will present some of the most common and the core principles behind their design.

At a generic level most product development processes consist of five to six phases such as: concept development, system-level design, detail design, testing and refinement and production ramp-up (Ulrich & Eppinger, 1995). Pugh (1991) defines the activities, rather than phases, as: user needs, product design specification, conceptual design, detail design, manufacture and sales. Pugh also emphasises the idea of the product development process as 'Total Design'; which he defines as: *'Total design is the systematic activities necessary, from the identification of market/user need, to the selling of the successful product to satisfy that need – an activity that encompasses product, process, people and organisation'* (Pugh, 1991: 5). It is characteristic for literature based in design and engineering (Baxter, 1995; Pugh, 1991), that they emphasise the early phases of product development which are sometimes also defined as design activities. Baxter defines these activities as: business opportunity, design specification, concept design, embodiment design, detail design and design for manufacture. A brief description of phases in the product development process is here given based on models developed by Ulrich & Eppinger (1995), Pugh (1991) and Cooper (1986):

Need, idea and business opportunity

The first phase of the product development process is usually instigated by either a (latent) customer need or a technological possibility matched to market demand (or potential demand). This addresses the business case – the financial reason for proceeding with the product idea. In this phase it is common to develop what is called a 'brief', where the need market/user situation is considered in depth (Pugh, 1991). The brief can vary from a simple statement of requirement – for example; design a car – to a comprehensive document that describes the true user need (Pugh, 1991). Very often the brief is then turned into a specification which describes what the product should do. The specification or product design specification (Pugh, 1991) is based on market research, competitor analysis, patent extracting etc. Ideas about product architecture, technologies and materials can be part of the specification.

Concept design/generation

Based on the brief and/or specification, the goal of the concept design phase is to explore the solution space of product concepts that may be applied to meet customer needs (Ulrich & Eppinger, 1995). Concept generation includes a mix of activities, from external search, creative problem solving within the team, to systematic explorations of alternative solutions or sub-solutions. At the end of this phase it is common to have a set of concepts, presented in sketches (sometimes models) and brief text. On the basis of this documentation managers often select a number of concepts to go into the phase of detail design. The product specification is also revisited, as the project team must commit to

specific values. The fixing of numerical targets is sometimes interrelated and can remain unspecified until the early stages of detail design.

Detail design

Detail design includes a complete specification of geometry, materials and tolerances (Ulrich & Eppinger, 1995) and documentation such as drawings, plans for fabrication and assembly of the product. Pugh (1991) states that the core product development phases are highly iterative and interactive in practice; he continues by saying that that is especially the case for the activities of detail design. This is supported by Baxter (1995) who describes how looping through the design process (from need/idea to detail design) several times is needed before the product is ready for manufacture.

Testing and refinement

In the pre-production phase the product is tested and refined. Prototypes are built and might be tested on customers to see if they satisfy them and match the specification (and brief).

Production

The production phase is initiated by a production ramp-up using the intended production system. During ramp-up the workforce is trained and remaining problems in the production processes solved. The product is produced and launched on the market.

Other models of the product development process emphasise different aspects of the process. Cooper’s (1986) stage-gate process is commonly used (see figure 2.4 below). The gates represent a decision or ‘go/no go’ points which specify a set of criteria against which the project should be assessed in order to proceed to the next stage of development. This means that the gates serve as quality checkpoints, usually controlled by senior managers from different functions who own the resources needed by the project team or leader (Cooper et al., 2005). When the process was first described by Cooper (1986) projects had to wait at each gate until all tasks had been completed, leading to delay in the process. This also meant that there was no overlapping of stages. The deficiencies of the process were addressed leading to Cooper’s (1994) suggested ‘third generation new product development process’. In the revised model the go/no-go decisions are delayed allowing flexibility and speed. This means that the traditional hard ‘gates’ are replaced by ‘fuzzy’ gates (Cooper et al., 2005). This means that conditional gates are passed with a ‘go’ decision made subject to a task being completed in a given time. Situational gates refer to a ‘go’ decision being made when the information from a task is not yet complete, but it is not enough to hold back the project.

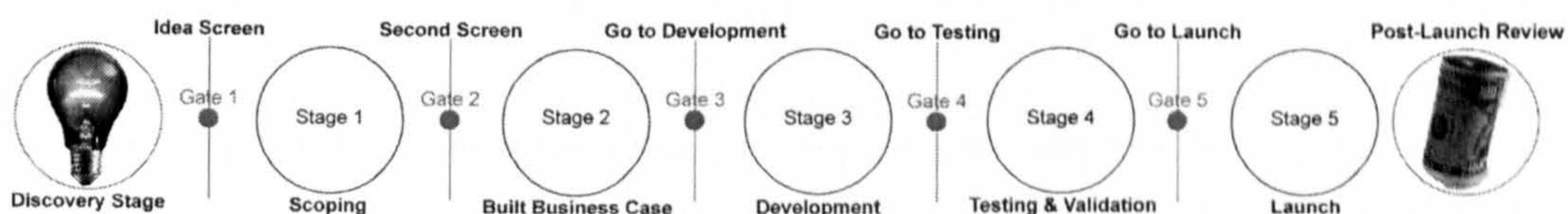


Figure 2.4 Cooper’s stage gate process (Cooper, 2006).

Many organisations have, along with the stage-gate concept, also applied Integrated Product Development (Andreasen & Hein, 2000). Integrated product development builds on the idea of integrating function in multidisciplinary teams throughout the product development stages. In figure 2.5 below the three main streams represent market, product and production.

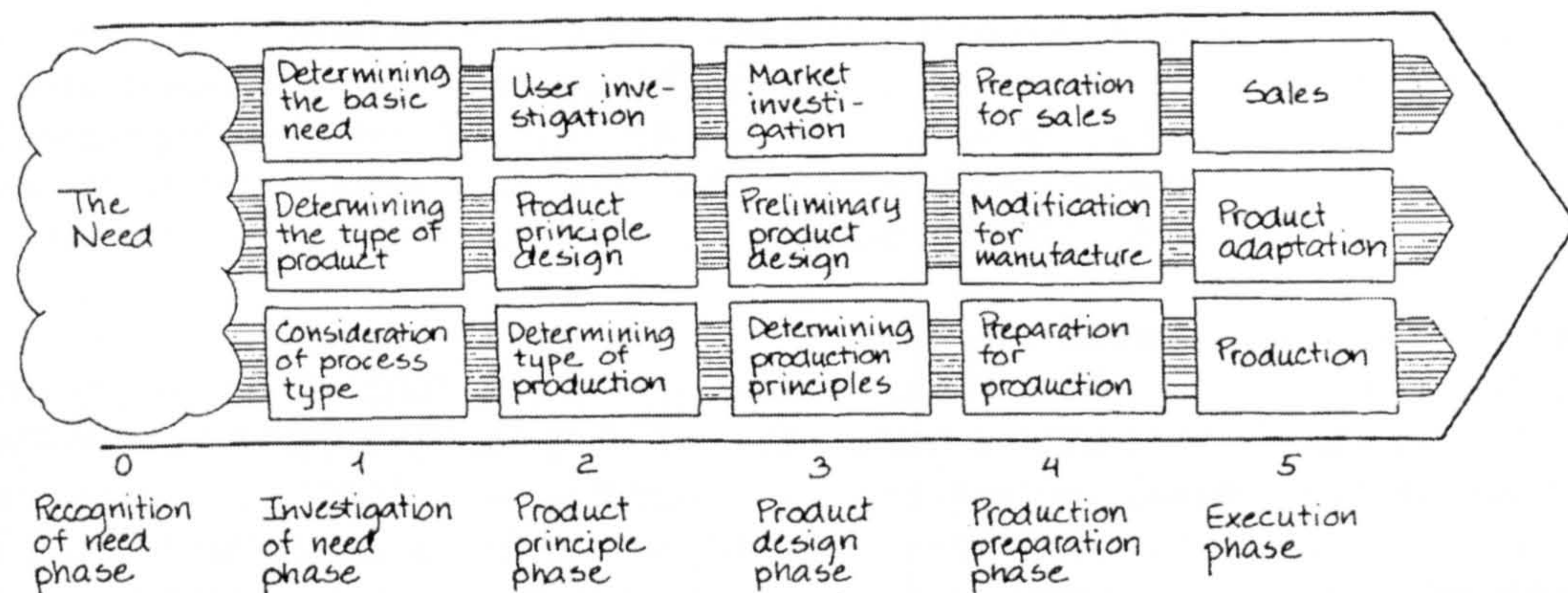


Figure 2.5 *Integrated Product Development (Andreasen & Hein, 2000).*

Wheelwright & Clark (1992) illustrate the process as The Development Funnel, where the funnel illustrates that many ideas are investigated in the top of the funnel, narrowing down to a few ideas being developed and embedded into the final product. Wheelwright & Clark (1992) have divided this process into three phases: The first phase represents the idea generation and concept development. At the end of the first phase is a ‘screen’ – a review is held to find out what additional information is needed or if the idea is ready to move into the next phase, and if so what information is needed at screen 2 to make a go/no-go decision. Phase two is centred on detailing the project bounds and required knowledge in order for senior management to make a go/no-go decision at screen two. If the idea is approved at screen two, the project bounds and knowledge required become the starting point for phase 3 where focussed development happens.

Most product development today can be characterised by concurrent design of the product and its manufacturing (Bruce & Bessant, 2002; Pugh, 1991), also called concurrent engineering. In contrast a serial approach, characterised by distinct phases where functions such as design, engineering and manufacture are involved, prevents integration of product and process design. Serial-, departmental-stage, or over-the-wall are all terms used by authors (Bruce & Bessant, 2002; Trott, 2002) to describe product development models that represent the serial form of product development. It is a common view that these serial model with insular departmental involvement, hinder the product development process (Trott, 2002).

2.4.3 The brief and specification

The brief and the specification are important documents in the product development process as they define the need a product should fulfil and how to design such a product. There seems to be some inconsistency in literature about the differences between the brief and the specification, as they sometimes seem to be the same thing, only representing different degrees of detailing. Pugh (1990: 5) has brought clarity to this by stating: *'From the statement of the need – often called the brief – a product design specification must be formulated – the specification of the product to be designed.'*

Early in the product development process a brief is commonly created as some of the first documentation of a product development project. Phillips (2006: 1) describes a brief as: *'...written documentation that thoroughly explains the problem to be solved'*. Bruce & Bessant (2002: 107) describe a brief as: *'...a statement of the general objectives and requirements of the envisaged project and crystallisation of the views of those commissioning the design.'* They continue by describing the key elements that a 'fairly typical and good brief' consists of as: background of the company; corporate strategy and its relationship to the brief; the design problem; consumer and market information and timescales. In summary the brief represents a written agreement describing the problem (need statement), business objectives and design strategy to achieve those objectives (Phillips, 2006).

Based on the brief the actual specification will be created, defining how the 'need' stated in the brief is going to be fulfilled. This is often done through the conceptual phase, and especially for more technical products the specifications are likely to be developed during the phase of detail design. Turning the brief into a specification is a gradual process as stated by Tovey & Harris (1999: 33): *'The process begins with a brief and with the specification of performance and dimensional hard points to meet legislative, package and operational requirements. Conventionally there is a progression from loosely defined proposals to the creation of a fully detailed, dimensionally accurate representation of the design.'* Pugh (1991) prescribes the product design specification to be based on 32 elements including customers, timescale, product cost, performance, aesthetic, materials, quantity, safety, competition, legal, standard specifications, life in service, manufacturing facility and company constraints, to mention a few. Pugh (1991) also states that it is important to be systematic and thorough, paying strong attention to detail from the beginning to the end of the product development process, to ensure it will be successful. He states that the product design specification provides a core of a control mechanism *'that allows this success to manifest itself'* (Pugh, 1991: 45). Ulrich & Eppinger (1995: 55) use the term product specifications (or product requirements) to mean: *'the precise description of what the product has to do'*. They continue by stating that a specification consists of a metric value.

Pugh (1991) states that the product design specification itself is not a static document. It might change if, during the design of the product, there is good

reason for changing it. On the other side he argues that at the end of the design activity, the design of a product must 'balance' with the product design specification, even if it has changed during the process.

The importance of the brief and the subsequent product design specification is recognised as it steers the design of the product. Cooper & Press (2004) state that studies have shown that the nature of the brief is of great importance to the success of the final product. They continue to emphasise that the brief, as a tool of communication between functions of management and design, needs to represent both perspectives. It is, for example, very important that the design function obtains good information such as market intelligence, both overt and tacit in order to design a successful product. Pugh (1991: 45): *'The absence of a product design specification will result in designs that almost without doubt will fail in the market: Poor product design specifications lead to poor designs; good product design specifications do not necessarily result in the best designs but they do however make that goal at least attainable.'*

The importance of the brief and specification in the product development process is recognised in literature as it informs and steers the design and manufacture of the product, and inherently the embedded product qualities (Baxter, 1995; Ulrich & Eppinger, 1995; Pugh, 1991). The understanding of the brief as a document, communicating an identified need, is the focal point for successful product development. Understanding customer needs is therefore a very important part of a good brief. Walsh et al. (1992) argue that this understanding of the customer is not obtainable from market research, but needs to come directly from the customer. This has led researchers such as Bruce & Cooper (2000) to argue that customers (or end users) should be involved in market research throughout the duration of the product development process (this will be elaborated further in section 2.4.4). The next section will look closer at tools used to turn customer needs into product specifications.

2.4.4 Tools used to ensure product quality

The translation of customer needs into product requirement with utility and fidelity is a difficult task (Baxter, 1995). Several tools have been developed in an attempt to ensure that this translation is systematic, clear and leads to successful requirement fulfilment. This section will describe some of the most common tools used to turn customer needs into product qualities.

Customer needs are often captured through marketing tools such as: interviews, product clinics, focus groups, analysis of sales and repair records etc. (Langford & McDonagh, 2003; Press & Cooper, 2003).

Quality Function Deployment (QFD) is defined by Sullivan (1986) as: *'...an overall concept that provides a means of translating customer requirement into the appropriate technical requirement for each stage of product development and production (i.e. marketing strategies, planning product design and engineering, prototype evaluating, production process development,*

production and sales).' Quality Function Deployment (QFD) is a well-known product planning tool used to relate 'the voice of the customer' to every stage of the design and manufacturing process (Trott, 2002). QFD aims to make an accurate specification of the performance required of a design solution by identifying '*customer requirements in terms of their product attributes*' (Cross, 2000: 108). The method uses a matrix form known as the House of Quality and starts by identifying the customers and their own views of their requirements and desired product attributes. The approach emphasises the involvement of product development teams directly in considering customer needs, as described by Clausing (1994: 107): '*The voice of the customer is brought into the House of Quality, and there we (the multifunctional team) deploy (translate) it into product expectations and extend these expectations into specifications, which will become the design requirements*'. The voice of the customer is represented in the House of Quality matrix by listing customer statements of important (prioritised) product qualities. These statements can be collected through customer clinics, interviews, questionnaires and contextual inquiry (Clausing, 1994). Based on statements such as 'must be easy to open' a translation into design requirements is made (e.g. should be light and have an ergonomic handle). Based on these two inputs an assessment between the customer need and design requirement is made, ranking how well the technical solution will meet the desired product quality (Baxter, 1995). Following the exploration of technical solutions of the product which contribute to satisfying customer needs, the next phase seeks to analyse competitor product. This is done by ranking the performance of competitors' products in terms of both customer satisfaction and technical performance. Based on the benchmarking exercise quantitative targets are set for each of the technical attributes and the targets are prioritised (Baxter, 1995).

A key characteristic of the QFD method is the implication that it is possible to translate customer needs into quantitative targets, and by fulfilling those targets customer satisfaction will be ensured. Sullivan (1986) implies this when he describes the term 'counterpart characteristics' as a core of QFD. Counterpart characteristics he defines as: '*...an expression of the voice of the customer in technical language that specifies customer-required quality; counterpart characteristics are critical final product control characteristics*' (Sullivan, 1986: 40). QFD is rather similar to the relationship between the brief and the product design specification (PDS). The brief can be seen to map on to the QFD customer needs and the PDS map on to the product expectations.

A model for understanding customer perceived quality has been developed by Kano (Walden, 1993). The model illustrates different degrees of customer satisfaction for basic performance and excitement qualities (Baxter, 1995). Kano's idea of three different types of quality is commonly known as the Kano Model (see figure 2.6 below). Performance qualities are qualities where it is believed that the more of this quality that exists in the product, the more the customer will be satisfied. Basic qualities are qualities that are so fundamental that they are expected to be in the product – they are 'must-be' qualities (Walden, 1993) (for example, wheels on a car). Failure to achieve basic qualities will give great dissatisfaction, but achieving them will not raise any positive feelings of

satisfaction. Excitement qualities are qualities that when absent do not cause any dissatisfaction, but when achieved in the product they lead to a great deal of satisfaction. Excitement qualities are often linked to novelty. An example of this was when the Walkman was introduced; customers reacted with delight because they were pleased with the sound quality of a product which they could slip inside their pocket (Baxter, 1995).

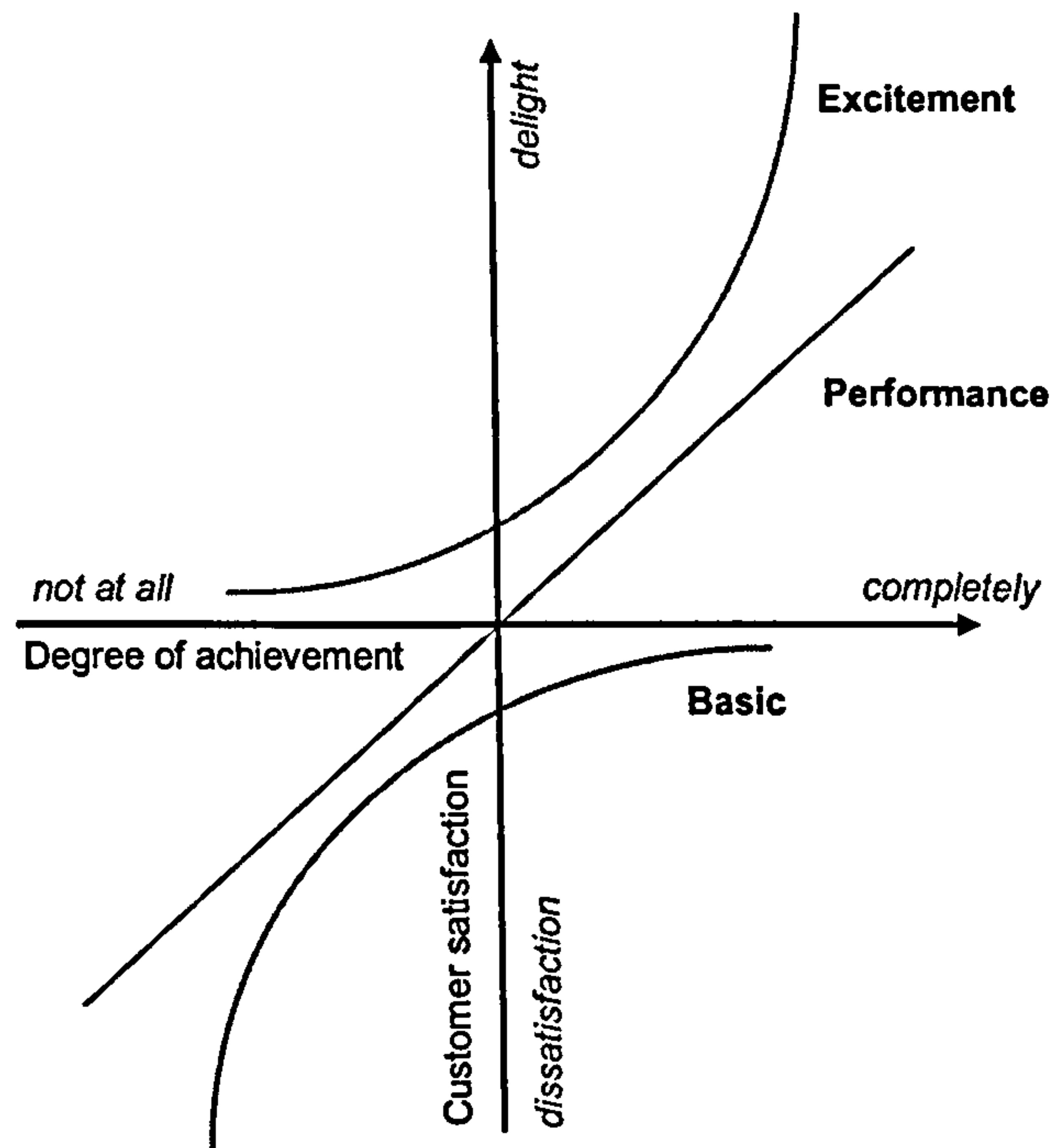


Figure 2.6 *The Kano model of quality (Baxter, 1995)*

Before Kano introduced different types of product qualities, a traditional view was that product quality and customer response were nearly always linear (Shen et al., 2000): if they were achieved (executed) better they would lead to higher customer satisfaction. Kano illustrated that product quality is more complex, as he added to this understanding by characterising basic and excitement qualities and explained their behaviour. Kano also proposed that in a modern world, individual qualities (or product features) are often delighters initially, because of their novelty, but they are likely to migrate to linear and over time even become basic qualities (for example anti breaking systems or cup holders in cars).

Kano operationalised the model, by developing a technique to assess product qualities. Given a set of product qualities or features it is possible to construct a questionnaire which potential customers can complete. The answers will then help to categorise each quality or feature as being basic, linear or an exciter (Walden, 1993). (But it is worth noticing that the Kano questionnaire, as it is known, can not find these qualities; it can only classify previously stated qualities).

Kansei Engineering is a method developed to assess product qualities based on customers' emotional responses to existing product and use this information

when designing a new product. Kansei Engineering is defined as: *'Translating technology of the consumer's image and feeling (kansei in Japanese) into the design specification'* (Nagamachi, 1995). The method has been said to have been applied by Japanese manufacturers over the last 10-20 years. Kansei Engineering aims at implementing customer feelings into product function and design (Nagamachi, 2002). The methods start out by surveying customers' likes and dislikes about existing products in the market, typically by the use of questionnaires. From the analysis of this data, keywords are derived (for instance, the feeling of speed) and these emotional responses are then traced back to their physical origin. This physical part is then broken down to its subconcepts (Nagamachi, 2002). This gives a rough set of characteristics of the subconcept and, based on this, experiments are performed to decide a more detailed specification for design. Statistical analysis has an important role in Kansei Engineering, as it is used to find latent relations between design and feelings (Ishihara et al., 1995). It is through statistical analysis that selection of product qualities is made. This is an excellent example of the desire to translate emotions into stable targets.

2.5 Customers role in the product development process

Companies have an increasing understanding of how vital customer satisfaction is for success (Lagrosen, 2005). As reported in literature this satisfaction is increasingly coming from the less tangible product qualities (Snelder & Schoormans, 2004; Veen et al., 2002; Jensen, 1999; Gilmore, 1998). Customers' emotional response to a product is becoming a product differentiation as well as a satisfaction factor. This has led companies to try to improve the tools by which they can ensure that such product qualities are embedded into the product through their product development process. Some general product development process tools were described in the last section. Although, as Engelbrektsson (2000) states, the need for understanding customer needs and requirements is recognised, it is only vaguely described in product development literature (see Andreasen & Hein, 2000; Baxter, 1995; Ulrich & Eppinger, 1995). It is mostly from marketing and human factor literature that we see an interest in exploring how to get closer to the customers and how to discover 'more latent needs'. This section will look at how customers increasingly are involved in the product development process.

In the past, market research and customer surveys formed the majority of the customer insight brought into the product development process. The research was often feedback from launched products that could improve the next product generation, rather than influencing a product during its development. This has change over recent decades. Customers are today influencing product development in a more direct way. They are not only represented through surveys or quantitative research, but are increasingly being more and more directly involved throughout the product development process, because: *'No-one can know more about the activities and aspirations of design users than themselves'* (Mitchell, 1996: 162).

Designing products that are human focussed and have *'qualitative 'soft' experimental and emotional characteristics'* (Veen et al., 2002: 298) requires a high degree of customer insight – the customer need to be heard and understood. In literature this customer centring has led to concepts such as 'listen to the voice of the customer' and user-centred design, which are becoming more widespread (Tomke & von Hippel, 2002; Leonard & Rayport, 1997). Weightman & McDonagh (2002: 39) argue that: *'Design is too important to leave to designers. User-centred design is important in involving users-as-experts.'* These concepts imply that the user is at the core of product development. Vandemerwe (2000: 28) describes 'true' customer focus as: *'Obtaining value for the customer (whether or not they buy all the items they could of a company's product and services) as well as obtaining value from the customer (who voluntarily choose to stay with a company that obtains value for them).'* This increased focus has led to new ways of including customers in the product development process. Kaulio (1998) has described different types of interaction with customers during the product development process; 'Design for' denotes an approach where products are designed on the behalf of the customer and traditional market research methods are used. 'Design with' includes a display of different concepts or solutions that the customer is asked to react to – this type includes customer clinics where customers assess a product during its development. 'Design by' denotes a product development approach where the customer is actively involved in the design of the product (also referred to as 'co-creation').

Focus groups are one of the more common ways of involving customers. They can have various formats and be influencing the product development at various stages. A focus group is defined by Langford & McDonagh (2003: 2) as: *'A carefully planned discussion, designed to obtain the perception of the group members on a defined area of interest.'* Focus groups typically involve 5-12 participants and a facilitator. They can be used as a self-contained research method or as a part of a collection of research methods. They are commonly conducted in a series of at least three separate sessions to ensure consistency in the trends and patterns observed (Langford & McDonagh, 2003). Focus groups are useful because they can help allow product developers to have direct access to the customer, either through being the facilitator, an observer or video recordings. This provides an insight into customers' perception, needs and values that are difficult to gain through, for example, surveys. The direct interaction allows for the facilitator to encourage participants to elaborate on their feeling on a specific topic, product quality, product etc. Being a group activity, focus groups provide a basis for discussion of participants' individual viewpoints, and it is likely that differences and similarities will be highlighted which can allow the facilitator to dig deeper in trying to understand different participants viewpoints. Focus groups feedback can not only be used at different development stages, but also have different purposes. Langford & McDonagh (2003) have described the following purposes of focus groups:

- Understanding users' tasks and behaviours
- Identifying problems and establishing user and task needs
- Establishing framework for further research

- Evaluating existing or proposed designs
- Generating new design concepts
- Influencing and supporting decision-making

Focus group involvement can stretch from pre project until a prototype is developed, sometimes involving a fixed group of participants. A study by Dahlsten (2004) describes how a group of 24 women were involved in the development of a new Sports Utility Vehicle (SUV) by Volvo over two years.

Focus groups or customer clinics involving a group of customers rather than individuals seem to be favoured on the assumption that group synergies produce more and varied customer needs as customers can build on ideas from each other. This has been questioned by Griffin & Hauser (2001) who suggest that two one-to-one customer interviews can identify the same amount of customer needs as one focus group. By probing the customer about different use situations the interviewer seeks to obtain better and more complete descriptions of the customers' experiences and needs.

Customers are more and more often impacting the product development process although usually through indirect involvement. Techniques such as customers' observations or ethnographic studies are beginning to be used in product development (Cagan & Vogel, 2002; Squires, 2002). Observing customers trying to load their cars outside IKEA or in their home environment are examples of more contextual research. Contextual design can also involve customers more directly, for instance through role-plays, scenarios or events where potential customers are asked to imagine a given context where they use the product (Evans et al., 2002; Squires, 2002; Brandt, 2001). This type of customer involvement is often recorded on video, which enhances the utility of the customer insight as it can be shared with the various groups involved in the product development process.

There seem to be primarily two ways of using customers; firstly they are used in the process of identifying their needs, secondly they are used to assess the actual embedded product qualities during the product development process. Evaluating or assessing products later in the product development process often happens through customer clinics where customers assess product models or prototypes (Black, 2006). If customers are involved from the fuzzy-front end, in order to reveal their latent needs, all the way through the various phases of development, they can be defined as co-producers (Dahlsten, 2004).

Concepts such as 'user-centred design' is becoming a common phrase in product design and product development literature, indicating that the importance of customer involvement is being acknowledged. User centred design is also known as: contextual inquiry, customer-focussed design, empathic design, participatory design, usability, usability engineering, usability testing, user experience design, user-focussed design and user-friendly design (Black, 2006).

Customers' involvement and impact in the product development is growing, as companies continue to find new ways of creating products that will satisfy their customers. There seems to be a move from indirect (market research) to direct involvement (focus groups, observation, customer clinics), the most extreme form of direct involvement being co-creation. User-centred design is becoming more of a topic in popular and academic literature and companies like to say that they are using it and state that it makes for more successful products. New methods and tools, such as qualitative interviews, customer observation and videography, are being developed and applied in the field of product development.

2.6 Communication and understanding

Product development is a social process involving many people from various functions. Working as a team introduces a number of problems compared to developing and designing a product alone (Cross & Cross, 1995). This section will look closer at how product developers communicate throughout the complex process of developing a product.

Bucciarelli (1988) looks at engineering design from the perspective of it being a cognitive process. He argues that while many map the design (or product development) process through diagrams containing phases, interrelations and loops, it is not such a mechanical process. While the diagram might help in planning and organising the design work, it is not a faithful or factual description of designing as it occurs, except at a very superficial level. In his book *Designing Engineers* (1994) Bucciarelli has observed the design process from an ethnographic perspective, which has given new understandings of the social and inter personal side of the design process.

Bucciarelli claims that different participants (in the product development process), with different competences, skills, responsibilities and interests, inhabit different worlds. Although they all work on the same product, they see the object differently. He continues by stating that this does not only influence how they engage with the physical product but throughout the entire process. If asked 'What is the design?' at any time in the process, no one involved in the process will be able to give a complete answer. They will give their individual views, their own images and thoughts, sketches, lists, diagrams, analyses, describe pieces of hardware etc., but a full understanding only exists in a collective sense (Bucciarelli, 1988). Bucciarelli emphasises the importance of the organisational structure behind the design. How we see the product being designed is heavily influenced by how the company is organised formally and informally. He argues that there is a tendency to break down the product into parts often named according to their functional domain. This reduction and naming of parts is not inherent in the product itself, but a classification created by human perception, and it influences the design process significantly. Bucciarelli's studies illustrate how important our collective cognitive comprehension of the product and the development process, is to how it is being constructed, and inherently which qualities are being embedded through this.

Cross & Cross (1995) argue that the ill-defined nature of design makes 'analysing and understanding' a large part of the design process. They state that individual designers can form their own design, while a team has to reach some shared or commonly held understanding of what is being designed or a particular design problem. The concept of 'analysing and understanding' is linked to how people make sense of things and systems. Weick (1995) argues the process of sense making is grounded in individual and social activity, and that sense making is about: '*...authoring as well as interpretation, creation as well as discovery.*' (1995: 8). The emphasis on, for example, team members' ability to communicate easily with each other and the generation of a shared understanding, sometimes referred to as a common language has been described by several authors (for example MacDonald, 1998; Clark & Fujimoto, 1990 and Schön, 1983). They all add to current understanding of design and design practice, but no consistent framework of understanding is present in existing literature.

Schön has also added to a better understanding of the design process from a social perspective. In his book *The Reflective Practitioner* (1983), he describes how this social process often involves individuals' reflection-in-action; Schön argues a designer during the process of design '*...shapes the situation in accordance with his initial appreciation of it, the situation "talks back", and he responds to the situation's back talk*' (Schön, 1983: 79). He defines this as reflection-in-action. Schön's concept of reflection-in-action can help us to understand what happens when designers communicate design solutions verbally or in drawings for instance. The reflection-in-action helps the designer to find solutions in a complex context by having a dialogue and answering the question 'What if...?' Drawings play an important part in designing in particular and product development in general, and they form a fundamental part of the communication process as they often represent something that has not yet come into reality or an idea of how to bring something (in this case the product) into reality. Schön argues that: '*Drawing and talking are parallel ways of designing, and together make up what I will call the language of designing [...] The verbal and non-verbal dimensions are closely connected*' (Schön, 1983: 80-81).

When Schön (1983) describes designing as '*Conversation with the materials of the situation*' it is because drawings and discussions with others about them form an important part of product development and its organisational communication and subsequently sense making.

Sketching and drawing play an important role in design and are used for various purposes (Scrivener et al., 2000; Akin & Lin, 1995). Scrivener et al. (2000) argue that designers often distinguish between freehand drawings produced in the earlier and later stages, seeing the former as private tools for thinking rather than for public communication. Sketches are in general perceived to be more vague, incomplete and ambiguous and might be used by the individual designer as a 'conversation with the paper', or to communicate abstract ideas supported by conversation. Drawings on the other hand seem to be less ambiguous allowing others to comprehend them without necessary verbal guidance.

Goldschmidt (1991) says that sketching can be used as different kinds of 'seeing' ('seeing' is here representing different kinds of design *thinking*). She describes

how designers are 'seeing as' when using what she call 'figural or gestalt argumentation' (perceiving the whole). When 'seeing that' the designer '*advances nonfigural arguments pertaining to the entity that is being designed*' (Goldschmidt, 1991: 131) . She argues that the process of sketching is a systematic dialectic between 'seeing as' and 'seeing that' and that translation between the modes of seeing both develop and stimulate new ideas through reinterpretation. Do et al. (2000: 485) has summed this up by stating that design is '*a triad of interrelated operations – thinking, seeing and drawing.*' Following and in line with ideas by Schön, Weick and Goldschmidt is the understanding of drawings and images as forms of visual sense making (Press & Cooper, 2003). Press & Cooper extend this understanding by stating that it is not just pen and paper that can create visual sense making, but also computers, cameras etc. and by combining these medias create images of 'possible worlds'.

Sketches and drawing can have several purposes, some of which are more related to cognitive processes than the physical media. Ashwin (1989) has characterised drawings according to their communicative function and levels of specification, for example that drawings can be monosemic, meaning that there is only one correct representation, as with for instance engineering drawings, whereas sketches are polysemic, allowing for more than one interpretation.

It is not only sketches and drawings that aid communication and understanding of the product being designed. Various types of product models are also used to create three dimensional images to aid the design process (Rodgers et al., 2000). Product models like mock-ups are used early in the design phases, often representing early conceptual ideas. Later, while designing the product, clay models, plastic models or Computer Aided Manufacturing (CAM) models are used to communicate the design. Finally a prototype is created representing the final product to go into production. In literature, two main categories of product model are described (Brandt, 2005): low-fidelity and high-fidelity. Low fidelity models are often made quickly, typically of cheap materials and such as paper or cardboard, to communicate early ideas about the product. High fidelity models are time consuming and therefore more expensive; they look more like the final product and are made of the same materials as the final product will be. Brandt (2005) argues that introducing users to product models will allow them to better understand the product and give constructive feedback on how it satisfies their needs. She continues to argue that no single type of product model is preferable to another, nor that tangible product models, such as mock-ups are better than drawings, but that tangible product representations influence communication and feedback and in that they can specifically aid the information given by potential customers through focus groups, workshop or clinics. Schrage (1993) has argued that companies with a strong prototyping culture produce 'strong' products He states: '*By quickly and relentlessly converting new product ideas into crude mock-ups and working models, these organisations are turning the innovation cycle inside out. Instead of using the innovation process to come up with finished prototypes, these rougher prototypes are now being used to drive the innovation process*' (Schrage, 1993: 56). What Schrage indicates is that when using product models early on, they becomes medias for communicating and exploring ideas; they are, as Schön (1983) states, 'talking back'. It is through dialogue with various product representations that the product is perpetually

being developed through people's understanding, sense making and illustration of what the product should be, and the processes required to get there.

Sketches, drawings and product models are used in the design process to turn intangible ideas into something more tangible. They form medias which enhance thinking and exploring about the product and the process of how to design it. Very often they form the basis for communication with others and are often supported by verbal conversation. Here they inform the (verbal) language.

As the use of sketches, drawings and physical mock-ups represent the object being designed, they can not stand alone. Verbal communication is crucial in interpreting and understanding these product representations. Verbal communication and the development of a language is crucial for understanding many aspects of product design. Özcan & Van Egmond (2004: 6) argue that *'the multidisciplinary nature of the product design process requires precise, effective and dynamic information flow; therefore, no vague, misspelled, arbitrary communication types can be afforded.'* This can be difficult to achieve even if many product representation such as drawings are indented to communicate the design's context-independent. The recipients' interpretation depends on their understanding of categories of design elements (Eckert & Stacey, 2000). This is why the development of a shared language among product developers is so important. Flemming (1998: 52) suggests that: *'Language must work hard to establish verbally what does not exist materially, and yet at the same time provide enough fluidity so that interested others can manipulate it.'* Flemming continues to state that language permeates the design process as it is used to communicate constraints and requirements; in group problem solving and decision-making; in dialogue between designer and user/customers; in inquiry, research and testing etc., but that such language is easily 'overlooked and undervalued' (Flemming, 1998). Goman (2004) continues by arguing that the words people use in the design process to describe for example materials, ideas and processes can limit or colour their use of them, without their awareness, as language sometimes provides no other word for – and thus alternative ways of thinking about a given idea or object.

Bucciarelli (2002) describes the language used in the design process as being an 'object world language'. He states that participants in design teams share a common language, a specific shared understanding of words meaning. This means that ordinary language is used in such a specialised way it is as if participants were speaking a different language. Eckert & Stacey (2000: 535) do not state that design teams initially *share* a common language, but merely that they create it through reference to past product or experiences; *'Unless accurate and unambiguous communication methods are available, such as precise technical specifications, design ideas are interpreted using contextual knowledge. Therefore it is important to share the sources, which acts as referents'*. Examples of such referents can also come in the format of stories as stated by Lloyd (2000: 370-371): *'Design as a social activity consists in the construction of social agreements. We have observed storytelling to be a mechanism that aids this construction. The consequences of this are that, for any particular product, a language is 'invented' which allows a description of the ongoing experience of that product and design process. In other words the*

product is constructed in words as it is constructed in reality. As the process develops, discourses – in effect meta-conversations – start to emerge surrounding the product and accordingly the product begins to assume some sort of identity. The identity is based on the stories that are told about it, stories that are then condensed into words or phrases: ‘unreliable’, ‘elegant’, ‘smooth’, ‘complicated’, ‘easy to use’, ‘all singing, all dancing’. These are commonly held agreements, some permanent, some only transitory.’

The use of stories to convey meaning, ideas or perspectives has been described by several authors: Lloyd (2000) has observed that storytelling appears to be a central mechanism in the development of a common language in design teams; Weick (1995) describes stories as important in the process of sense making; and Denning (2004) argues that the use of stories in organisations can aid the sharing of knowledge and transmit values. Similarly the use of metaphors aids communication in product development as they can evoke a specific image or meaning through the use of verbal imagery. Dumas (1994) states that metaphors can play a vital role as integrators for a product development team, as they can provide a focus that is otherwise difficult to achieve. Clark & Fujimoto (1990) have described how metaphors have been used in the car industry to communicate product ideas or concepts. Metaphors are used because they convey complex ideas. Lakoff & Johnson (1980) state that metaphors form the basis of language.

Much of the knowledge involved in the product development process is not easily described, it is tacit. Tacit knowledge was first described by Polani (1966) and later linked to product development by Nonaka & Takeuchi (1995). Polani (1996: 4) describes tacit knowledge as: *‘we know more than we can tell’* (i.e. the phenomenon that people may know how to do something, without being able to articulate how they do it). Nonaka & Takeuchi (1995) argue that companies not only process knowledge but also create knowledge. They describe this by adding that companies have tacit as well as explicit knowledge, and through converting and mobilising tacit knowledge, a knowledge creating process is initiated. The idea of converting tacit knowledge into explicit knowledge is that it can be shared with others. They describe tacit knowledge as *‘highly personal and hard to formalise, making it difficult to communicate and share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore tacit knowledge is deeply rooted in an individual’s actions and experiences, as well as in the ideals, values or emotion he or she embraces’* (Nonaka & Takeuchi, 1995: 8). They also describe how tacit knowledge can be segmented into two dimensions. Firstly a technical dimension that encompasses the kind of skills that are difficult to ‘pin down’ often described as ‘know-how’. Secondly, tacit knowledge contains an important cognitive dimension, such as mental models, beliefs and perceptions so ingrained that they are taken for granted. According to Nonaka & Takeuchi (1995) knowledge conversion is possible through socialisation or externalisation, which happens by sharing experiences and articulating knowledge. Their idea of knowledge creation gives insight into how tacit knowledge can be tapped.

2.7 How literature informed the research question

Current understanding of product quality has emerged from decades of optimising product design and manufacturing quality, mainly ensuring product functionality and reliability through a systematic product development process. Quality assessment was primarily based on what was easy to assess in objective well defined measures. Due to product development processes managed through objective, measurable and assessable measures, this has led to well engineered and manufactured products with high technical quality.

A shift in quality focus has been observed. Today product quality is centred on the perceived quality, adding the perspective of the perceiver – the customer. Customers perception of products are based on many aspects of the product, some being well-defined functionalities and some less tangible.

It was found in the literature review that academics have started to research product qualities that are less tangible. These researchers have primarily tried to categorise such qualities by the emotional response they give the perceiver. It was found that current research has focussed on the assessment of such qualities within the product rather than on how to ensure their embedding. This has led the author to conclude that there is a gap in existing knowledge of how these less tangible product qualities are embedded into the product through the product development processes.

One characteristic of many of the less tangible product qualities is that it is difficult to measure their existence in the product, they are non-quantifiable. The author proposes to use this criterion for the product qualities researched in this project. The qualities investigated in this research will therefore be referred to as Non-Quantifiable Product Qualities (or NQPQs). Those product qualities that can be quantified will be referred to as Quantifiable Product Qualities (or QPQs) in this research project. In this research the following definition of NQPQs will be used:

NQPQs are those product qualities that we can not easily put into measures

The literature review addresses current knowledge in the field of product development of less tangible product qualities. It appears that there are several gaps in current knowledge:

- There seems to be a lack of knowledge about how less tangible product qualities that are difficult to specify are embedded into the product through the product development process.
- There seems to be a lack of knowledge into how less tangible product qualities are embedded into products through a stage-gate process

- There seems to be a lack of knowledge about how less tangible product qualities are embedded into the product when many product developers are involved.

This research project is based on these gaps in existing knowledge and seeks to add to current knowledge by answering the research questions:

How do companies embed Non-Quantifiable Product Qualities into their products through their product development process?

Sub-questions are used to help in this research project:

- *How do companies understand their Non-Quantifiable Product Qualities (NQPQs)?*
- *Who is involved in the process of embedding and when?*
- *How does the customer influence the product process of finding, developing and embedding Non-Quantifiable Product Qualities (NQPQs)?*

In order to fully comprehend the research question it is crucial to understand the emphasis on the word *embed*. The word *embed* means 'fix firmly in surrounding mass' (The Concise Oxford English Dictionary, 1985). In Roget's thesaurus (Kirkpatrick, 1998) the word *embed* is associated with: place, support, hold within, and implant. Moreover this understanding of the *embedding* (the activity of 'fixing firmly') inevitably leads on to *how* this is done through the *product development process*.

NQPQ taxonomy

To help the reader to understand better what NQPQs are, here is a brief and non exclusive taxonomy:

Some NQPQs are based on product qualities that appeal to different senses:

Vision: The visual qualities of products are often important to how customers perceive them. The visual qualities are very diverse; it can be the shape, the colours, and the look of different materials etc. Many other NQPQs are initially dependent on their visual property to create interest in the perceiver. A chair can for example look soft and comfortable, and thereby entice the perceiver to touch or sit in the chair to experience if that is the case. Visual properties form the basis for many other less tangible product qualities.

Hearing: Sound qualities can help to identify, for example the type of material as a secondary quality when we touch a surface or product. The slam of a car door can for example inform us about the strength or toughness of the door, by giving us information through its acoustic qualities.

Smell: Olfactory qualities, such as the scent of plastic or leather in a car inform us about its materials.

Touch: Haptic and tactile qualities in a product are perceived through touching. These qualities can inform the perceiver about the type of material its softness, hardness, texture, roughness, etc. which can all add up to a feeling of physical comfort for example a seat.

Taste: Taste is based on our ability to distinguish the tastes such as sweet, sour, salt, bitter, pungent etc. The level of quality in food products are commonly described by their taste qualities.

Kinetic: The quality of movement is called kinetic. For example the dampened and calm move when a CD player opens, a cars handling, or the disrupted motion of old windscreen wipers.

Other NQPQs can be described as being:

Semiotics/Semantic: The study of signs is called semiotics. A product sends out many signals, and the study of the meaning of such signs is called semantics. It is often through visual properties that semantic qualities are communicated (Monö (1997) calls them semantic functions). Monö (1997) has for example described how semantic qualities can help to describe (purpose, mode of operation); to express (properties); to exhort (reaction) and to identify (a product, its origin, nature, category etc.).

Single: A single quality could for example be the colour of a mobile phone, the shape of the buttons on a radio or the material choice of brushed aluminium for a door handle.

Holistic/Gestalt: When multiple product qualities add up to an overall quality then this resulting quality can be described as a holistic quality. What constitutes a sports car is often based on multiple single qualities such as; the low profile, wide tyres, aerodynamic shapes, agile handling, colour and material choices.

Feature: Some quality perceptions are linked to a specific feature of a product. Being able to access GPS through your mobile phone is an example of a feature that can influence our quality perception of a product.

Execution: The execution of a specific feature informs the perceiver about the level of for example craftsmanship, finish, how well parts fit together or the quality of the materials used.

Some NQPQs are linked to cognitive qualities:

Novel: Product qualities can be perceived as new or novel. It can be a new technical innovation that has led to a new feature, a novel material or even a novel feel/touch.

Retro: Some products are produced deliberately using retro qualities. It can be the visual qualities such as shape, material and colour that make a bicycle look like it was made 30 years ago.

Usability: Product qualities such as ease of use can be embedded through the design of handles, openings or more complex usability qualities such as the ease of accessing and navigating the menus in a computer program.

Ideology and ethic: Some products are purchased based on their ideological and ethical qualities. Product qualities embedded through the use of natural materials, for example, can give the product qualities that are also linked to being organic or produced with environmental sustainability issues in mind. Fairtrade products have embedded ethical quality by signalling that it ensures that the small producer gets a fair price.

Social and cultural: Products can have qualities that cater for social or cultural context. Ensuring that a mobile phone has a small hole in the corner where the customer can hang a personal tag is for example important in Asia as it presents the individual with the possibility to customise the product in a way that fits the cultural context. The use of certain materials can give the impression of a product being exclusive, such as a luxury product signalling social affiliation or wealth.

And of course many other qualities are difficult to put into measures which are not collected here. These are the main groupings found during this research, but the author did not set out to define or fully classify NQPQs.

2.8 Chapter conclusion

This chapter has reviewed literature in the fields that were found to be of relevance to the general research topic. It was found that the notion of product quality has moved from being mainly focussed on technical qualities to today where those are mostly taken for granted. Instead more subtle product qualities have become an increasing product differentiator in many markets.

Current research has recently started to inquire into how these more subtle product qualities are linked to customer response. The understanding of positive customer response has evolved from being centred on general customer satisfaction; today the literature has started to discuss the need for a product to be based on empathy with the customer and use situation. This goes as far as

promoting the notion that a product can provide an experience leading to an emotional response in the customer such as pleasure or even delight.

Literature into the product development process and tools used were reviewed to see how the process is managed. It was found that stage-gate processes with defined phases, go/no-go gates (or more fuzzy gates), seem to be the most common way to manage the product development process. Tools commonly mentioned in product development literature to ensure product quality, were also reviewed concluding that the tools presume that a breakdown of overall product quality into quantifiable measures is possible. Methods such as QFD and Kansei Engineering are described in the literature as being able to translate defined customer need into product features, or even to assess the emotional response to parts of a product.

Literature that describes the social side of product development addressed how product developers tend to communicate via drawings, mock-ups or other product representations. Verbal communication would often assist in these representations to ensure understanding.

Based on the literature the research question was validated as it addresses a gap in existing knowledge.

Chapter 3

Research methodology

This chapter presents methodological alternatives and arguments for selection made.

3.0 Chapter structure

Based on the research question this chapter describes the methodological considerations and choices made. Section 3.1 introduces the chapter by stating what it implies to conduct research. The research perspective is discussed in section 3.2, presenting key differences between positivism and phenomenology, and stating what perspective seemed most appropriate for this research project. Sections 3.3, 3.4 and 3.5 address the research purpose, strategy and type. Section 3.6 presents ideas about Grounded Theory and how they are linked to this research project. A figure outlining the overall research methodology is presented in section 3.7. Data collection and analysis methods are presented in section 3.8 including a detailed figure illustrating the process followed and tools used. Section 3.9 elaborates on research validity and section 3.10 concludes.

3.1 Designing a research methodology

The purpose of designing a research methodology is to ensure that the research aims are reached through a conscious, consistent and valid method. The meaning of doing research implies two key aspects; argumentation and validation. A description of the selected research methodology makes it possible for others to comprehend the method behind the research and see that it is followed through in a well documented way. In addition to this aspect of transparency a presentation of the alternatives that were not chosen is given to illustrate that the chosen method is appropriate to the research objectives.

According to Robson (1993) there is a tendency for researchers, when carrying out research, to assume that there is no alternative to their favoured approach.

Although the methods and techniques applied must be determined by the research question, there will still be multiple ways of designing the research. This chapter will present different alternatives and reasoning for the approach chosen.

First some overall research methodology decisions will be presented (research perspective, purpose, strategy and type) and selections argued. Then a model (Figure 3.4) of the overall research design is presented, followed by sections on data collection methods and analysis. A detailed model illustrating the specific selected methods will then be presented (Figure 3.5). The chapter ends with a discussion about how research validity is sought through the use of various methods of triangulation.

Figure 3.1 illustrates different issues of research design that will be considered in this chapter.

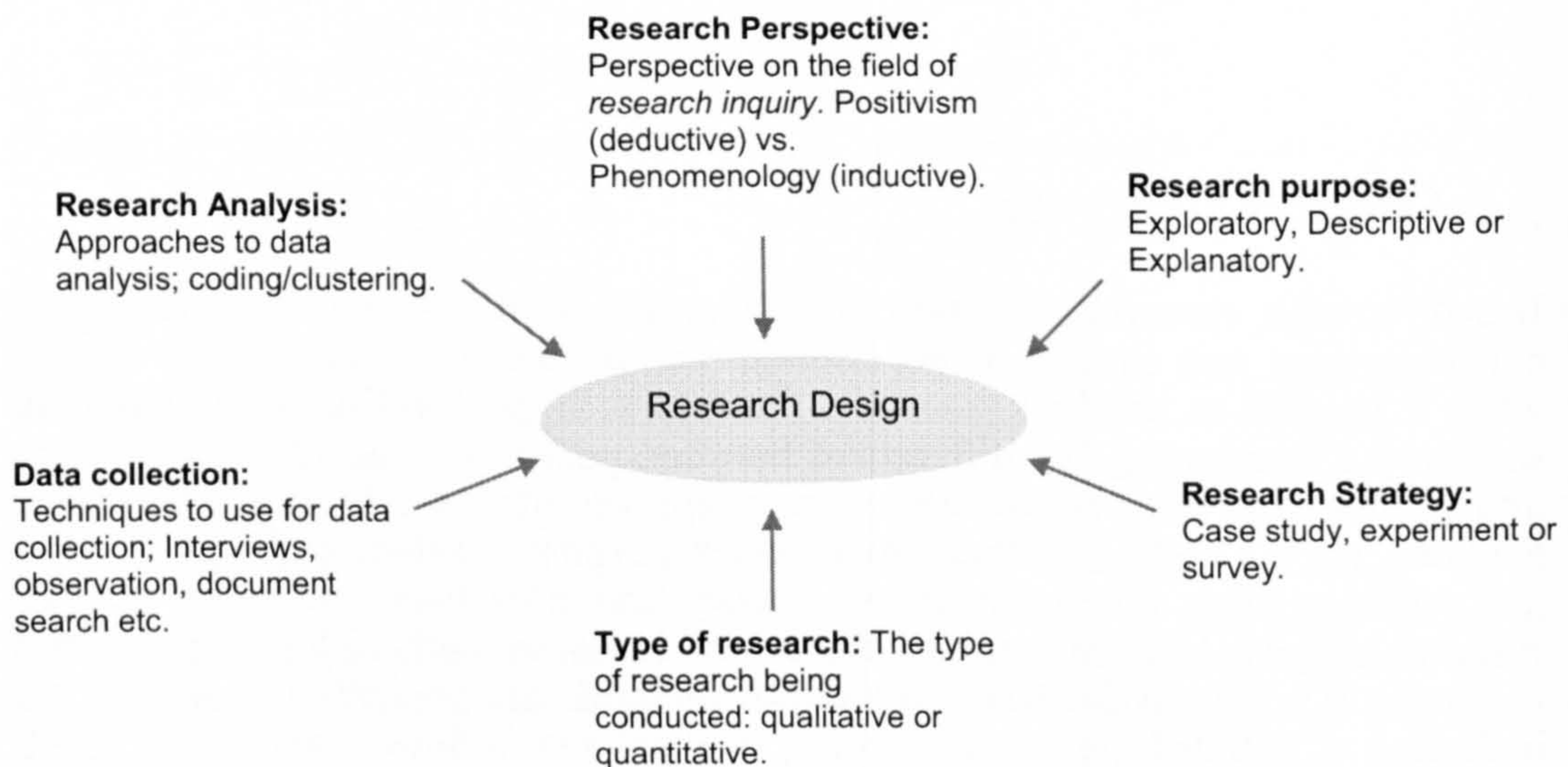


Figure 3.1 The issues taken into account when designing a research strategy. Adapted from Gill & Johnson (2002), Robson (1993) and Blaikie (1993).

3.2 Research Perspective

The underlying research perspective is often defined and differentiated in terms of epistemology, or the '*...theory or science of the method or grounds of knowledge*' (Blaikie, 2000: 8), it adopts. An epistemology consists of ideas about what can count as knowledge and what criteria such knowledge must satisfy in order to be classified as knowledge and not just beliefs. Within social science two opposing traditions exist; positivism and phenomenology. Although opposing in their perspective on what constitutes knowledge most studies will contain elements of both (Easterby-Smith et al., 2002).

Positivism assumes *'That there can be no real knowledge but that which is based on observed facts'* (Comte quoted in Easterby-Smith et al., 2002: 28). Positivism views the social world as existing externally, and that its properties should be measured through the use of objective methods.

The viewpoint that knowledge is only worthwhile if based upon observations of external reality has a number of implications as stated by Easterby-Smith et al. (2002):

- The observer must maintain independence from what is being observed;
- Value-freedom is maintained in the choice of research subject, and how to study it, and must be determined by objective criteria rather than by the researcher's belief or interest;
- The aim of social science should be to identify causal explanations that explain regularities in human social behaviour;
- The hypothetic-deductive approach should be taken to develop fundamental hypothetic laws and deduce tests of falsification or support, by which the theory is based;
- The concepts need to be operationalised in a way which allows facts to be measured quantitatively;
- Reductionism allows whole problems to be better understood if they are reduced into the simplest possible elements;
- Generalisation allows the formulation of universal laws if samples of sufficient size are selected;
- Cross-sectional analysis, making comparisons of variations across samples, ensures that regularities can be easily identified.

These implications have been incorporated into the practice of what constitutes 'scientific method or knowledge' (Gill & Johnson, 2002; Easterby-Smith et al., 2002), and remains the underlying paradigm for traditional inquiry in natural (physical) science.

Critics of positivism find the construction of laws that explain the past and predict the future observation, through causal analysis and hypothesis testing, inappropriate for inquiry into social science (Gill & Johnson, 2002). It has been argued by Laing that *'Human action has an internal logic of its own which must be understood in order to make actions intelligible'*. *It is the aim of social science to understand this internal logic'* (Laing in Gill & Johnson, 2002: 41). The positivistic hypothetic-deductive approach does not explain the actions of human beings, due to a lack of understanding of internal and subjective reasoning. As a result of this critique another (polarised) perspective emerged called phenomenology.

Phenomenology builds on the assumption that reality is determined by people rather than by external and objective factors. A phenomenological viewpoint often seeks to understand and explain why people have different viewpoints, rather than seeking to find external causes and fundamental laws to explain their behaviour. As Easterby-Smith et al. state: *'Human action arises from the sense that people make of different situations, rather than as a direct response to external stimuli'* (2002: 30). Table 3.1 below summaries key aspects of Positivism and Phenomenology.

	Positivism	Phenomenology
Basic beliefs	<ul style="list-style-type: none"> • Explanation via analysis of causal relationships and fundamental laws • Generation and use of quantitative data • World is external and objective • Observer is independent • Science is value free 	<ul style="list-style-type: none"> • Explanation of subjective meaning held by subjects through understanding • Generation and use of qualitative data • World is socially constructed and subjective • Observer is part of what is observed • Human interests drive science
Researcher should	<ul style="list-style-type: none"> • Use various controls, physical or statistical, to allow the testing of hypotheses • Use highly structured research methodology to ensure above • Formulate hypotheses and test them • Reduce phenomena to simplest of elements 	<ul style="list-style-type: none"> • Be committed to research everyday settings, to allow access to, and to minimise reactivity among the research subjects • Use minimum structure in research methodology to ensure above • Develop ideas through induction from data • Look at the totality of each situation

Table 3.1 Comparison of Positivism and Phenomenology. Based on Gill & Johnson (2002) and Easterby-Smith et al. (2002).

A positivistic viewpoint entails deductive research by developing a conceptual or theoretical structure before its testing through empirical observation. This is done through development of hypotheses that form a theory or are generated by one, conclusion about where the hypotheses are expected to hold true, and finally the testing of the conclusions (theory) by gathering appropriate data (Blaikie, 1993). Deduction can be said to start from a general level, and through theory, be applied to a 'unique' (specific) level (Lemon, 2002).

Phenomenology is often associated with inductive research. Inductive research is the reverse of deductive as it involves moving from observation of the empirical world to the construction of explanations and theory on the basis of what has been observed (Gill & Johnson, 2002). The inductive research perspective seeks to understand the phenomena by 'getting inside situations' and understanding them within their real life context. The aim is for the researcher to stay open to the observed without preconceptions, in order to observe and record data without selection or guesses about their relative importance. Then the data are analysed, compared and classified without using hypotheses and on the basis of this analysis generalisations are inductively drawn as to the relation between

them. The generalisations are then subject to further testing (Blaikie, 1993). Inductive research can be classified as going from the ‘unique’ to the general level (Lemon, 2002).

As the research question is seeking to understand the phenomenon of embedding NQPQs in industry a phenomenological viewpoint and inductive research approach seems to be the most appropriate. The lack of prior research in this field means that academic understanding and documentation is absent, which has led the author to reason that it would not be sensible to generate hypotheses and test them, as a deductive research approach would suggest. The hypothetic-deductive viewpoint of positivism that implies that the researcher should reduce the phenomenon to its simplest elements and seek fundamental laws seems to be the opposite of what the research context implies, hence this viewpoint has been rejected.

A phenomenological perspective and inductive research approach has been adopted as it will uncover the process of embedding NQPQs by seeking to understand the subject through the subjective viewpoint of people involved in the process.

3.3 Research Purpose

The phenomenological stance taken implies that one role of the research will be to generate new knowledge and insights through theoretical induction – generating theory based on observations. According to Robson (1993) real world enquiries can be classified in terms of their purpose. He distinguishes between exploratory, descriptive and explanatory purposes which are summarised in Table 3.2 below.

Exploratory	Descriptive	Explanatory
<ul style="list-style-type: none"> • To find out what is happening • To seek new insights • To ask questions • To assess phenomena in a new light • Usually, but not necessarily, qualitative 	<ul style="list-style-type: none"> • To portray an accurate profile of persons, events or situations • Requires extensive knowledge of the situation to be researched • May be qualitative and/or quantitative 	<ul style="list-style-type: none"> • Seeks an explanation of a situation or problem, usually in the form of causal relationships • May be qualitative and/or quantitative

Table 3.2 *The purpose of the research (Robson, 1993).*

Typically, Exploratory research would be conducted when existing theoretical explanation of the phenomena is lacking or inadequate. The new insight might then form the driver of Descriptive research, guiding the collection of the most appropriate data for the accurate modelling of the situation being investigated.

Explanatory research could then be conducted to test the theories generated by the Exploratory and Descriptive research.

The purpose of this research is both Exploratory and Descriptive. It is exploratory because the research question seeks to find out how companies embed non-quantifiable product qualities into their products through their product development process.

- *The overarching purpose of this research can be classified as Exploratory and Descriptive.*
- *The research design will consist of an Exploratory and a Descriptive stage in order to answer the research question in an insightful and elaborate way.*

3.4 Research strategy

According to Robson (1993) there is a commonly suggested relationship between the purpose for carrying out research and the strategy chosen:

- Case studies are appropriate for exploratory work
- Surveys are appropriate for descriptive work
- Experiments are appropriate for explanatory studies

Exploratory research is usually best achieved through the use of case studies. This strategy can be summarised as: *'Development of detailed, intensive knowledge about a single 'case', or a small number of related 'cases'* (Robson, 1993: 40). Case studies are often used to study a situation, an individual's or a group's interest, or concerns in a specific (case) context. This is done through a wide range of techniques including interview, observation and document analysis (Robson, 1993).

Surveys are used to collect information in a standardised form, usually in the format of questionnaires or structured interviews (Robson, 1993). The standardised format of surveys provides data that are easily transformed into quantitative or statistical representations.

Experiments are characterised by: *'Measuring the effects of manipulating one variable on another variable'* (Robson, 1993: 40). Experiments are commonly used to test theories through the support or falsification of hypotheses derived from the theory that is being tested. It is implied that the use of experiments require the variable of interest to be manipulated while other variables are carefully controlled.

Although Robson (1993) states a suggested relationship between the purpose of the research and the strategy chosen, he also states that each strategy can be used

for any of the three purposes shown above. Yin (2002) supports this by stating that, for example case studies have been used in exploratory, descriptive and explanatory research. Mixed or hybrid strategies are commonplace and it is up to the researcher to select the most appropriate strategy based on the research question.

The research methodology applied here will be a Case Study strategy. The research will be conducted through case studies in order to investigate in depth and observe non-quantifiable product qualities in their real context and with a more holistic perspective than surveys and experiments allow. Robson (1993: 52) describes case studies as ‘...a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within real life context using sources of evidence’. In this research a case will be defined as an organisation where the product development process of embedding of NQPQs is being researched. The purpose of the research being both Exploratory and Descriptive.

The research design will reflect this by dividing the research into two stages – an Exploratory and a Descriptive stage. This research design allows the researcher to firstly gain an overview of the phenomenon in general in the Exploratory stage. A divergent and open approach will help provide a broad insight into the embedding of NQPQs. This insight will then guide a Descriptive stage, where a more convergent approach will seek to gain a deeper and detailed understanding of the phenomenon.

In order to gain a more generic insight into this phenomenon four to six cases (case organisations) seems appropriate in the Exploratory stage. The Descriptive stage seeks to gain a deeper and more elaborate insight and will be concentrated on two to three cases.

A Case Study approach has been selected as the most appropriate research strategy for meeting the Exploratory and Descriptive aims of the enquiry.

3.5 Research Type

Case study research is typified by using multiple methods, both quantitative and qualitative (Miles and Huberman, 1994; Robson, 1993).

Easterby-Smith et al. (2002) argue that quantitative research methods have often been focussed on describing, coding and counting events at the expense of understanding why things are happening. By contrast, qualitative methods might concentrate on exploring people’s viewpoint in much deeper detail, or the reasons for, or consequences of, the choice of performance criteria. Andersen (1990) for instance states that qualitative methods are often used to identify problem areas within an organisation. When studying organisational or human cases, qualitative methods such as interviews, observations and document

analysis are commonly used to gain in-depth knowledge about the case(s) (Robson, 1993).

Furthermore, there seems to be a tendency to use quantitative methods in deductive research where the emphasis is on testing theory, whereas qualitative methods seem to be used more frequently when the aim of the research is inductive e.g. focussing on the generation of theory (Bryman, 2001).

The distinction between the two research types are summarised in Table 3.3 below.

Qualitative research	Quantitative research
<ul style="list-style-type: none"> • Deals mainly with the exploration of issues and the generation of theories within new and emerging subject areas • Is used to develop insight and understanding of a subject • Seeks to create gestalt and holistic interpretations 	<ul style="list-style-type: none"> • Is used in research that requires facts and figures in order to answer the research question (through verification of hypothesis) • Seeks to measure, test, and quantify elements in order to explain or describe something

Table 3.3 Qualitative and quantitative types of research (Robson, 1993).

This research can be classified as being qualitative, using methods such as interviews, observation and document analysis to seek in-depth understanding. These methods will be described in further detail later in this chapter.

Interviews, observation and document analysis have been selected as providing suitable qualitative data to uncover the process of embedding NQPQs into products.

3.6 Case studies, inductive research approach and Grounded Theory

In recent years an inductive research approach, known as Grounded Theory, has increased its impact especially in management research. This research will not directly follow a Grounded Theory approach, although there are aspects of the selected research methodology that imply the creation of Grounded Theory. This section will clarify where the research methodology overlaps and differs from a prescribed Grounded Theory approach.

Grounded Theory was first presented by Glaser and Strauss in their book *The Discovery of Grounded Theory* (1967). The book provides a strong intellectual rationale for using qualitative data to develop theoretical analysis (Goulding, 2002). The term Grounded Theory implies that theory is derived directly from empirical data (Partington, 1998) and was at the time presenting a radical view to challenge the general perception that qualitative research was preliminary to the *real* methods of quantitative research (Goulding, 2002).

A systematic approach for building theories from case studies is given by Eisenhardt (1989). Based on the Grounded Theory approach pioneered by Glaser and Strauss (1967), Eisenhardt proposes an eight step process:

1. Definition of research question(s)
2. Selecting cases
3. Crafting data collection instruments
4. Data collection from the case(s)
5. Data analysis
6. Shaping hypotheses
7. Compare the data with conflicting and similar literature
8. Formalise the theory

This research uses an inductive approach to derive new knowledge and understanding of NQPQs. This is done through a selection of cases from where qualitative data will be collected and analysed, which is in line with a Grounded Theory approach. Where this research differs from the Grounded Theory approach as described in the eight steps by Eisenhardt, is in the formulation of hypothesis and theory. According to Strauss and Corbin a theory is a set of relationships that offer a plausible explanation of the phenomenon under study (Goulding, 2002). This interpretation has been extended by Morse (quoted in Goulding, 2002: 45) who proposes that: *'A theory provides the best comprehensive, coherent and simplest model for linking diverse and unrelated facts in a useful and pragmatic way. It is a way of revealing the obvious, the implicit, the unrecognized and the unknown. Theorizing is the process of constructing alternative explanations until a "best fit" that explains the data most simply is obtained.'*

Although the definition of theory seems rather broad, and it is likely that some of the findings from this research can be understood as 'a set of relationships that offer a plausible explanation of the phenomenon under study', it seems to put a constraint on the research by setting out to follow a Grounded Theory approach.

This research sets out to go through two cycles of collecting and analysing data. The first stage is Exploratory and, through the initial data analysis, sets out to inform the data being sought in the Descriptive stage. Due to a lack of previous research in this area, together with the inter-connection of the subject to many other fields, the final outcome will not be a theory in the scientific sense, but a meaningful framework that contributes to both practitioner concerns and to improved understanding (Yin, 2003).

The chosen research methodology is similar to that of Grounded Theory although the objective is not to create a final theory of the phenomenon of embedding of NQPQs, but create the first building blocks of a conceptual understanding based in empirical data.

3.7 Research methodology model

On the basis of the methodological considerations and choices made the following figure illustrates the research methodology at a general level. The next sections will describe more detailed choices when it comes to data analysis and synthesis.

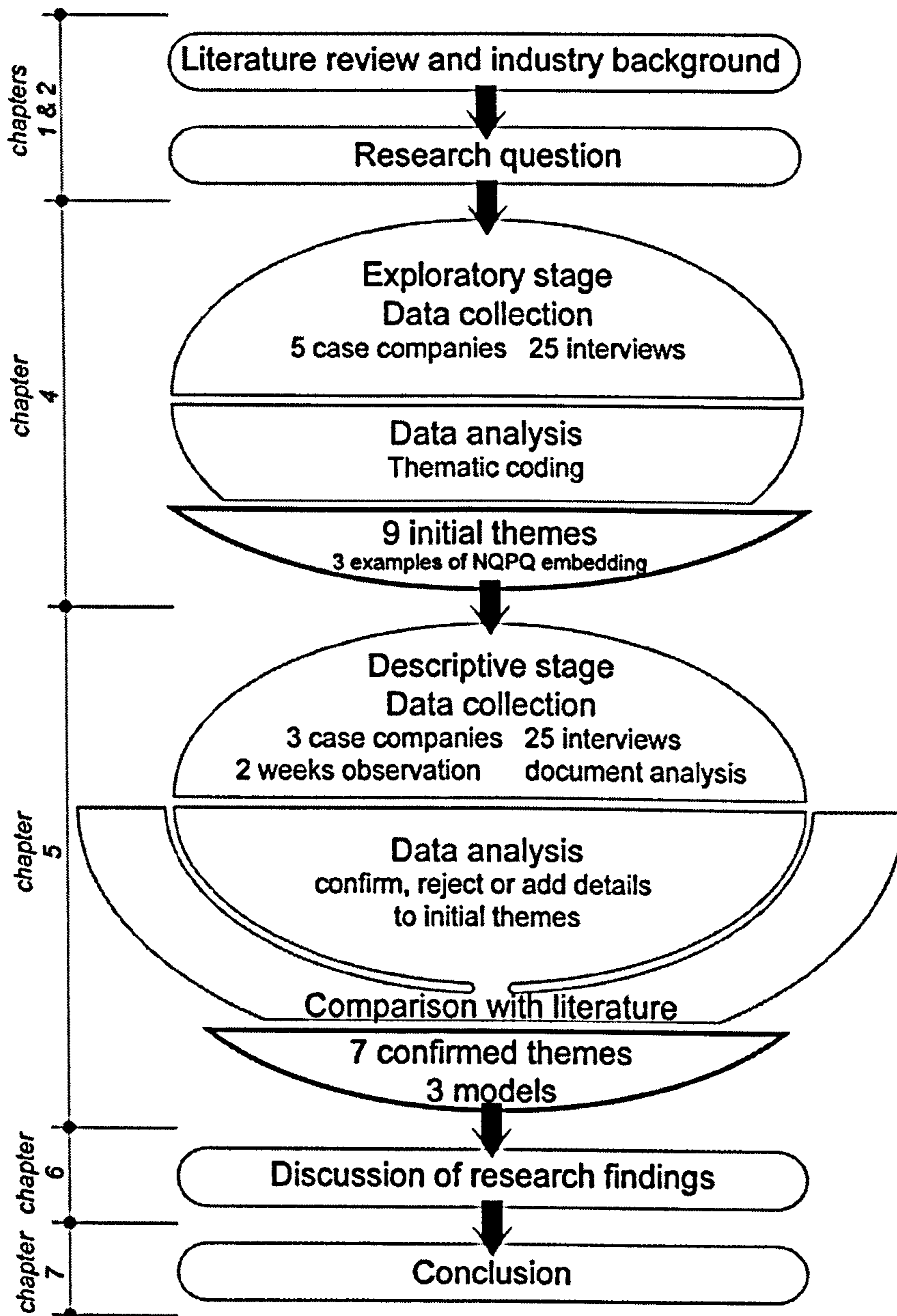


Figure 3.4 Model of the chosen research methodology.

The Literature Review presented in chapter 2 and Industry Background presented in chapter 1, formed the basis for the chosen research design. The research is conducted in two stage: Exploratory and Descriptive.

In the Exploratory stage interview data are collected in five case-companies. The interview transcript is analysed through thematic coding (see section 3.8.1). The outcome of the analysis is grouped into themes. These themes are then handed over as the starting points for the Descriptive stage.

In the Descriptive stage the author seeks more detailed information in three of the initial five case-companies. Based on the analysis and themes from the Exploratory stage, new data are collected to confirm, reject and add detail to the themes. In this stage triangulation is sought, through the use of new data sources such as observation and document analysis. A series of in-depth interviews is also conducted in one case-company. The data is analysed on the basis of the existing themes, although the new data are likely to alter the grouping of themes as new details are added. Individual theme findings are then discussed in the light of literature and conceptual models developed.

In the discussion chapter findings from the Descriptive and Exploratory stages are discussed together, through juxtaposing and enfolding of literature from fields that have not previously been directly related to the field of NQPQs.

The concluding chapter sums up the findings of the research. Contribution to knowledge is argued, strengths and weaknesses of the research discussed and suggestions for further research proposed.

3.8 Data collection and analysis methods

On the basis of the overall research design the following sections will describe chosen data collection and analysis methods.

Qualitative data commonly means words based on interview, observation or documents (Miles and Huberman, 1994). In this research, interviews, observation and documents are used as empirical data. In the Exploratory stage, semi-structured interviews formed the basis for thematic coding and the emergence of themes through grouping of data. In the Descriptive stage, interviews, observations and documents formed the basis for data analysis and validation of the themes from the Exploratory stage.

3.8.1 Interviews

Interviews give the researcher the opportunity to probe deeply and uncover new clues, understanding new dimensions of a problem, through the acquisition of data based on an individual's personal experience (Easterby-Smith, 2002).

Using a semi-structured qualitative interview technique means that the researcher guides rather than steers the conversation with the interviewee (Daymon & Holloway, 2002). Semi-structured interviews sit between the two extremes: unstructured/non-standardised and structured/standardised interviews. In unstructured interviews there are no predetermined questions except at the very beginning where the researcher sets out with a general question in the broad area of study. Standardised interviews resemble written survey questionnaires, ensuring that every interviewee is asked the same questions in the same order. They direct the response of the interviewee, prohibiting the researcher and the interviewee from exploring together the meaning of the object of inquiry (Daymon & Holloway, 2002).

In semi-structured interviews the questions are used as a guide with the focus on issues that are sought covered during the interview (Robson, 1993; Daymon & Holloway, 2002). The sequencing of the questions is not the same for every interviewee as this depends on the flow of each interview and the response of the individual. A semi-structured interview technique has been chosen for this research, because it gives the needed guidance to ensure a sufficient coverage of the topic as well as allowing the interviewee to take the conversation in a direction where the topic of investigation made sense to the individual. In an ill-defined field like the phenomenon of understanding and embedding NQPQs it is very important not to let specific preconceptions, terminologies or perceptions influence the data gathering situation. This was sought through a semi-structured interview format.

It could be argued that people being interviewed might not give the real motives or reason behind their behaviour, because they might not wish to give out sensitive information or describe situations that do not follow conventional beliefs or procedures in the organisation (Easterby-Smith, 2002). There is always a risk that people describe their motives or actions arising from a logical and rational reasoning, where in reality they are somewhat different. It is common that the interviewee starts to see and connect things in a new way when starting to talk about it – this is often to the advantage of the researcher as well as the interviewee. By asking about situations, processes and decisions in a way that is not normally discussed in the organisation, the interviewee often starts to learn about tacit processes and understanding.

Using interviews gives the researcher an opportunity to juxtapose different viewpoints, finding similarities or differences, and thereby getting a view of how people involved in the embedding of NQPQs view the process and their role within that process.

The guiding interview questions were designed to be open-ended, asking questions based on *how*, *who*, *when* and *where* in order to allow the interviewee to elaborate on what he had already said (Yin, 2003). Examples of where they thought embedding of NQPQs in their products had been successful or unsuccessful were also prompted to uncover what constitutes a success or failure. The guiding questions can be found in appendix A. Kvale (1994) argues that one of the quality criteria is the shorter the interview question and the longer the

interviewee's answers, the better. Although this might seem slightly simplistic, it remained a guideline in order allow the interviewees to address their viewpoints in ways where the researcher's question did not seem to dominate and be intrusive. Questions by the researcher mainly emerged as a response to the interviewee's stories and viewpoints, seeking to clarify, elaborate and validate their interpretations (Kvale, 1994).

Interview Analysis

Interviews are used in both the Exploratory and the Descriptive stages although analysed in different ways. In the Exploratory stage the interviews were analysed through a thematic coding of transcripts aimed at understanding the phenomenon of how companies understand and embed NQPs. In the Descriptive stage the interviews were used to confirm, reject or add new details to the findings from the Exploratory stage.

All interviews were recorded on tape in both the Exploratory and the Descriptive stages. Sixteen interviews out of 25 collected in the Exploratory stage were transcribed, resulting in 350 pages of transcript (see appendix B, presenting a transcript). Each interview lasted approximately 1½ hours. The records of the remaining interviews were thoroughly listened through and notes taken. In the Descriptive stage all recorded interviews were listened through, filling in a pre-designed document when new data either confirmed, contradicted (rejected) or added new detail to findings from the Exploratory stage. The interviews in the Descriptive stage lasted from ½ - 2 hours depending on the interviewees and their involvement in the process of embedding NQPs.

Transcriptions of interviews makes them easier to analyse, but the transcript can lose important non-verbal information like pauses, intonations and emotional aspects like irony or humour that is implied through the use of the voice. The transcript is a hybrid between an oral conversation that develops over time, face to face in an actual situation and a written text, created for a generic, non-present audience (Kvale, 1994). This is why it is important to keep coming back to the recorded interview and listen to what led up to a specific quote, which has been found of interest to the researcher in the quest for answers to the research objectives.

Thematic coding

When analysing data from the Exploratory stage it seemed important that the data guided the analysis so that a code emerged out of the data. An alternative could be to start analysis with a provisional 'start list' of codes developed prior to the fieldwork (Miles & Huberman, 1994), but this approach was dismissed in favour of not imposing preconception to the data analysis. Instead an inductive approach was chosen, where data are moulded into themes that represent them. This process is known as Inductive Thematic Coding (Boyatzis, 1998).

As the researcher prefers working methods that are visual and tactile, coding data by hand was chosen (Miles & Huberman, 1994), rather than using computer software such as for example NVivo. NVivo allows the researcher to go through the data, like the interview transcript, code that data, then group it electronically

and present it in groups, or a hierarchy of groups and sub-groups. First the researcher read through the interview transcript, highlighting anything that seemed of interest in answering the research question or the more general research objectives, to gain an insight into how companies understand and embed NQPQs into their product. During the process of highlighting, notes would also be made in the margin, saying why or what seemed of interest to the research inquiry. Codes like 'design process', 'lack of communication', 'example of an NQPQ', 'decision-making issues' etc. emerged out of the data. When this process was completed with the 16 interviews, all highlighted quotes and their respective notes/codes were physically cut out of the A4 sheets of transcript, leaving hundreds of paper strips. These strips were then spread out on a big table, so they were all visible. By going through all the quotes again they were grouped into piles with other quotes that seemed to have some commonality – they represented a theme in the data. Some quotes would be given more than one descriptive code, and would therefore be photocopied so it could go into more than one group. Initially about 20 thematic codes were established. Some were later dismissed if the theme was only represented by very few quotes, resulting in 12 different themes based on the inductive coding. The title of the theme emerged out of the grouped quotes. The 12 themes are presented in Chapter 4 – The Exploratory phase.

3.8.2 Observation

In the Descriptive Stage the researcher sought to gain a deeper insight into the design and development process of NQPQs. This was done through various data collection methods including observation. Observational evidence is often useful in providing additional information about the researched topic (Yin, 2002).

The researcher spent two weeks in the Design Department of one of the case-companies. The researcher was placed at a desk in an open office landscape introduced as doing research into the subject of NQPQs. During the following weeks, the researcher listened in on day to day conversations, presentations and discussions. In between these informal observations, the researcher arranged interviews with several people in the organisation, including people working in the Design Department.

Observed situations were noted down discreetly while the researcher was working at her desk. The researcher's reflections were also noted in the fieldnotes. The observational notes were analysed like the interviews in the Descriptive stage, looking for confirmation, rejection of the themes from the Exploratory stage or looking for details or new information that would help in answering the research objectives.

3.8.3 Written documents as source of data

Documents such as reports and minutes from meetings are not without significance, even though retrospective (Gill & Johnson, 2002). When studying

the process of embedding NQPQs it is important to understand how the case-companies communicate them in writing. This was done through document analysis during the Descriptive stage. Documents like briefs and specifications were sought, but were very difficult to get hold of due to confidentiality – even for launched or old products. It was possible to obtain a series of stage-gate documents, process Gantt-charts, reports on NQPQ assessment improvements and reflective reports on internal design collaborations.

The documents were analysed like other data in the Descriptive stage, through the lenses of the themes developed in the Exploratory stage for confirmation, rejection or new information.

The documents and observational data were seen as a supplement to the large amount of interview data from the two research stages. The observations and document analysis provided the researcher with data that were not influenced by the research inquiry or the researcher – it was unprompted communication and interaction that informed the research with a insightful supplement to the interviews.

3.8.4 Detailed figure of data source, collection and analysis methods

Figure 3.5 below summarises the process followed and tools used for data collection and analysis in the two research stages.

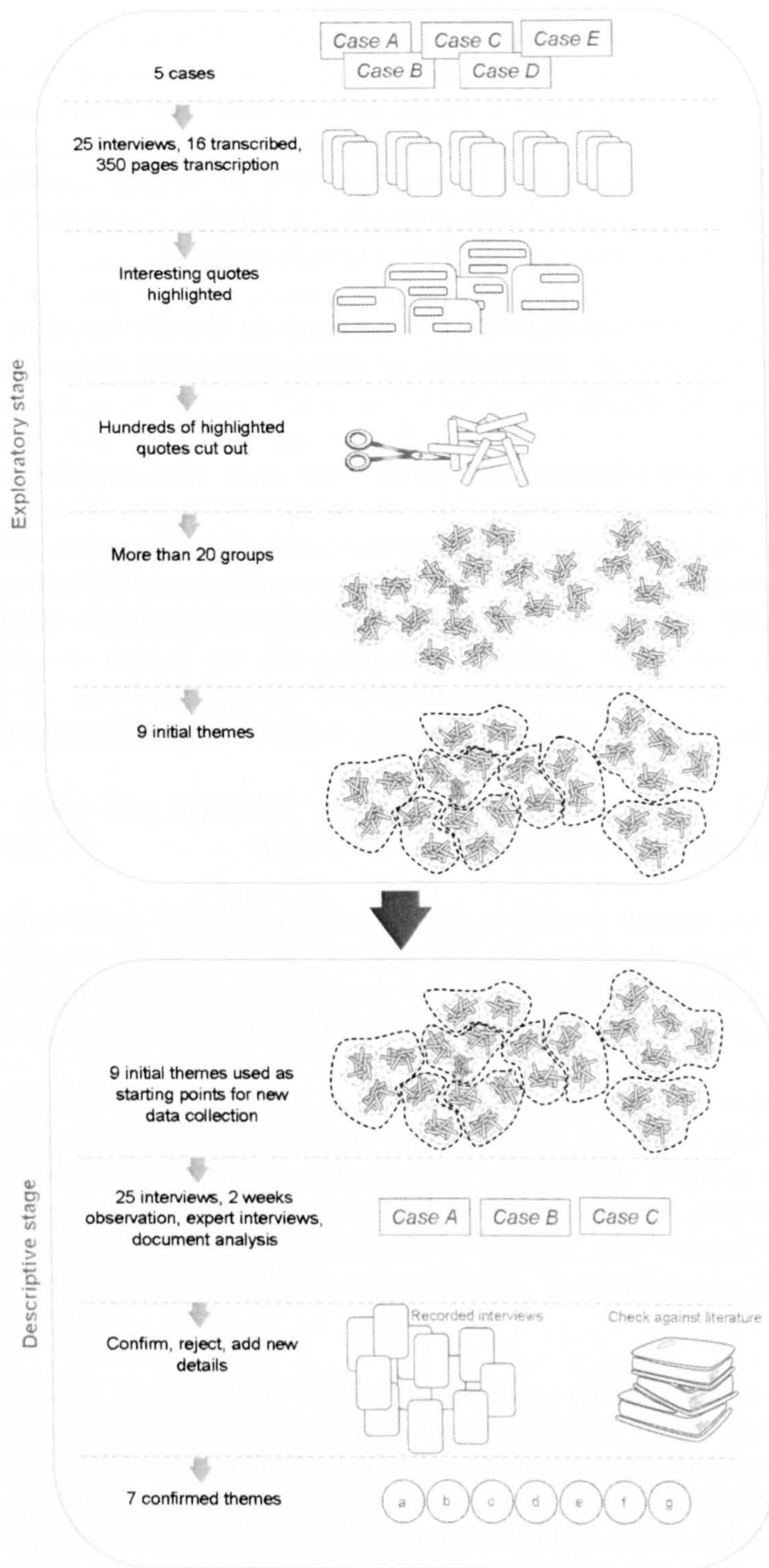


Figure 3.5 Data collection methods and data analysis process.

3.9 Ensuring research quality.

When designing a research method, conducting the research and presenting the findings it is of fundamental importance to ensure that the research is of good quality. Research quality implies the need for ensuring validity, reliability and generalisation (Yin, 2002; Easterby-Smith et al., 2000). The meaning of these terms varies considerably with the research perspective taken. Table 3.5 summarises some of the differences between a positivist and phenomenological perspective.

Test	Positivist	Phenomenology
Construct validity	<ul style="list-style-type: none"> Do the measures correspond closely to reality? 	<ul style="list-style-type: none"> Does the study clearly gain access to the experience of those in the research setting?
External validity (generalisability)	<ul style="list-style-type: none"> To what extent does the study confirm or contradict existing findings in the same field? 	<ul style="list-style-type: none"> Do the concepts and constructs derived from this study have any relevance to other settings?
Reliability	<ul style="list-style-type: none"> Will the measures yield the same results on other occasions? 	<ul style="list-style-type: none"> Is there transparency in how sense was made from the raw data?

Table 3.4 Perspectives on validity, reliability and generalisability. Adapted from Easterby-Smith et al., 2002 and Yin, 2002.

A phenomenological viewpoint is elaborated further by Yin (2002), who describes the three forms of validity relevant to exploratory research – construct validity, external validity (generalisation) and reliability. Construct validity is described as the certainty one has that the phenomenon has been measured and studied appropriately. External validity is often also referred to as generalisation – the degree to which one has confidence that the findings can be generalised beyond the immediate study. Reliability concerns the confidence by which it is believed that the research and its findings are repeatable. Reliability in case study research can be enhanced by ensuring the transparency of methods and analysis so that they can be operationalised and repeated (Yin, 2002).

Table 3.5 summarises the requirements for research design quality and how they have been sought in this research through research design, data collection and analysis, and representation of the findings.

Requirement for research design quality	Method utilised
<p>Construct validity</p> <ul style="list-style-type: none"> Establishing correct operational measures for the concept being studied Enhanced by using multiple sources of evidence, establishing a chain of evidence and using key informants to review draft of case study report 	<ul style="list-style-type: none"> Used another researcher to analyse data, to check coding Used multiple data sources: interviews, literature, observations and documents Perspective of different organisations (5 case-companies) and employees from different functional groups
<p>External validity (generalisation)</p> <ul style="list-style-type: none"> Establish the domain to which the study's findings can be generalised Enhanced by using replication logic in multiple case studies 	<ul style="list-style-type: none"> Replication of interview questions in the Exploratory stage – all interviewees were asked the same questions The case organisations represented three different industries, suggesting validity for larger manufacturing companies
<p>Reliability</p> <ul style="list-style-type: none"> Document the procedure followed in the research, to ensure that others can replicate the case study research Enhanced by creating a case study protocol that documents the research design and application 	<ul style="list-style-type: none"> Semi-structured interviews followed guideline questioning structure and were recorded and transcribed Consistent data analysis through coding, grouping and labelling Researcher documented all methods used and made notes on use

Table 3.5 Methods for achieving research design quality in general and their utilisation in this research (Based on Yin, 2002; Easterby-Smith et al., 2002 and Bryman, 2004).

As stated by Boyatzis (1998: 144) 'Reliability is critical in using thematic analysis. Reliability is consistency of observation, labelling or interpretation. It is not verification, which is a pure positivistic notion'. He goes on to say 'Validity of findings can not conceptually exceed the reliability of the judgments made in coding or processing raw information' (ibid). It is important to understand the emphasis Boyatzis puts on how overall validity of the research should be sought through *reliability of judgment during* the data collection, coding and analysis. Boyatzis (1998) argues that reliability as consistency of judgement appears in qualitative information in two basic forms: (a) consistency of judgement among various viewers; and (b) consistency of judgement over time, events and settings.

Consistency among various viewers is attained through letting different people code the data to see if they see the same themes in the same data. Another approach is to present the observations, interpretations and findings back to the case-companies. This was done after both the Descriptive and the Exploratory stage, to check that the judgement of the researcher was reasonable. Consistency over time and events is attained when a person makes the same observation at

two different times or in two or more different settings. This was, for instance, done when different interviewees expressed the same understanding, notion or reasoning when describing the process of embedding NQPs.

Generalisation was sought by researching in three different industries in the Exploratory stage, and three different companies in the Descriptive stage. The technique used remained the same, so only the organisations/individuals remained the variables.

Triangulation was designed into the research from the start. Triangulation by method was achieved by using interviews, observations and documents to study the phenomenon of interest in the same setting. Finally theoretical triangulation was achieved through looking at the data collected with different lenses. In the Exploratory stage the lens used is to look for patterns in data, to create themes, - in the Descriptive stage these themes formed the lenses for looking for new data that confirm, reject or add detail to the theme findings.

3.10 Chapter conclusion

This chapter has described the research methodology chosen to fit the research inquiry and alternative methods. A phenomenological research perspective was found to fit the objectives of the research and has been chosen, and a case study approach has been argued to fit the research objectives.

Chapter 4

Exploratory stage

This chapter presents the first stage of the research. Data are presented in the format of themes that emerged through analysis and the implications for NQPQs are briefly discussed.

4.0 Chapter structure

This chapter presents data from the exploratory stage of the research. In this stage 25 interviews were collected from five companies. Section 4.1 elaborates on the objectives for the exploratory stage and briefly summaries the methodological approach designed in chapter 3. Section 4.2 describes the reasoning behind the sampling of data sources. A brief argument on the existence of NQPQs is given in section 4.3. Section 4.4 describes how data were analysed leading to the emergence of 12 themes. Section 4.5 presents 9 themes which emerged from the data and 3 more themes which were answers to specific questions. Section 4.6 concludes this first stage of the research. Section 4.7 summarises the findings from this stage that is then handed over to the descriptive stage.

4.1 Objectives and methods for the exploratory stage

The objective for this stage of the research is to get a general insight into how the case-companies are embedding NQPQs through their product development process. This stage seeks to understand the phenomena from a broad perspective. Having a broad and multiple perspective is crucial in ensuring the quality and validity of the findings at this stage. As described in chapter 3 an interview technique has been chosen, to get an insight into various people's perspectives on the phenomena. The objectives were for the researcher to look *at* NQPQ embedding; and *for* factors that affect it. This was done through capturing people's understanding and actions in the product development process.

The interviews were semi-structured, supported by 21 questions (see appendix A) to ensure coverage of areas of interest to the researcher. The questions were

centred on product qualities that are perceived to be of importance to customer satisfaction but difficult to define or measure.

4.2 Multiple Perspectives

This section will describe the reasons for selecting the case-companies, and the reasoning behind sampling within each case.

4.2.1 Selection of case-companies

In research the sampling of data is crucial for later analysis (Miles & Huberman, 1994). Selecting what kind of case-companies to approach and in the event of a positive response, to gain access to, has inevitable consequences for the conclusions that can be drawn from the data. Based on the research objective it was decided to approach companies that developed and manufactured everyday consumer products. In order to gain insight into NQPQs in a normal market situation, industries where competition is a key driver in product development and where (western) markets are near saturated were chosen. This choice was made on the assumption that embedding of NQPQs would be of higher importance in these industries as they are likely to influence competitive advantage. This assumption is supported by Hekkert et al. (2003: 111) who state: *'When consumer products are on the market for a long period of time, their technical specifications tend to become less and less varied and the importance of product design as an opportunity for differential advantage in the marketplace increases'* (see also Kotler, 2000; Urban & Hauser, 1993). It was also important that the case-companies had an in-house design and engineering function to understand how current decisions about NQPQs would be approached by the organisations that are to manufacture the product. This avoids data collection in cases where outsourcing of all or parts of the design and engineering process occurs, as it would not give the fundamental data of how companies are embedding NQPQs through their (entire) product development process, as sought to establish initial research into this field.

Companies that manufacture functional consumer products such as vehicles, mobile phones and electronic goods such as kitchenware and Hi-Fi were targeted, as it was important to see the embedding of NQPQs in the products where well defined and measurable product qualities (QPQs) are also being embedded. It was also important that the product was likely to be chosen because of its functionality, which means that some of the QPQs would be influencing the choice, and not just a lifestyle product selected primarily because of the NQPQs.

Companies with 100+ employees were approached, to see how bigger organisations, that are split into many functional groups, embed NQPQs. This also meant that the product development process was likely to be managed with care and probably with a standard process.

In the exploratory stage data were collected from five manufacturing case-companies; three vehicle, one mobile phone and one Hi-Fi. All organisations are well-known and their identity remains confidential. All organisations are present globally, although the research data were collected in Europe. In each organisation 4-8 interviews were conducted, leading to 25 interviews in total. The next section will briefly introduce the five companies.

Company A

Case-company A is a large international vehicle manufacturer, producing passenger and commercial vehicles, such as minivans, trucks, SUVs (Sport Utility Vehicles). The company has a long history and has evolved their product over many decades. The company was one of the earliest to conduct market research and adapt its design and development according to particular markets.

Company B

This case-company is an international vehicle manufacturer, producing passenger and commercial vehicles such as SUVs, trucks, coaches and construction equipment. Case-company B has a tradition for research and development in the area of vehicle safety.

Company C

Case-company C is a large international vehicle manufacturer, producing passenger and commercial vehicles, such as SUVs, pick-ups and small trucks. The company has in recent years opened a design centre in Europe, to ensure product development is tailored to the global customer.

Company D

This case-company is a large mobile phone manufacturer, producing to a global market. Company D has been involved in the development of the mobile phone for decades and is known for focussing on usability and product differentiation.

Company E

Case-company E is a Hi-Fi manufacturer making televisions, stereos, MP3-players and phones. The company has a long tradition for focussing on design as a key market differentiator. This has given the company an up-market profile where sound, materials and execution are the core product qualities.

4.2.2 Sampling within each case-company

In each of the five case-companies people from different functional groups (design, engineering, marketing, product planning, quality management, product innovation) and with different responsibilities (designers, engineers, managers, chief programme managers, chief product engineers, marketing and quality specialists) were interviewed, in order to gain insight into how these individuals understand NQPQs and the process of embedding them into the product. As well as sampling data from different functional groups, data were collected from people involved at various development stages, from initial product idea to manufacturing. All interviewees had a minimum of 2 years experience in that

company, the majority had 10+ years' experience in that company, and the average industry experience was 12 years. Each interview lasted approximately 1½ hours.

4.3 Do NQPQs exist?

This research assumes the existence of product qualities that are not quantifiable. While the thesis focuses on the process of embedding of these NQPQs, it does not set out to prove the existence of these qualities in products. But these qualities are difficult to articulate and define (which is why they are so difficult to achieve in practice), and their existence may be seen as conjecture. This section briefly brings evidence from literature and the data to support the existence of product qualities that are difficult to measure.

In the literature Monö (1997) says that products sends out signs and that designers much be aware of what the product 'says' to the customer. Product semantics is a rich subject, discussing the signals that products send to users, as argued by, for example, Krippendorff (1995). Lindstrøm (2005) describes how products need to appeal to all five senses; while MacDonald (1998) has described the importance of product developers developing a 'qualitative sense' and the importance of 'ergonomic fit', as well as products aesthetic qualities. Dittmar (1992) has addressed products symbolic qualities in society, including the ability for the embedded qualities of a product to communicate about identity and social class. Crozier (1994) has similarly described products as symbols of the self.

While these authors give us a language, they do not convey the urgency or importance of these product qualities as well as real-life examples of products. Most people will have purchased or used products and been influenced by such qualities, but rather than draw on the readers own experience, here are some examples of NQPQs drawn from the interviews:

'like this feel of the material the colour and the technique' (TB77).

'we want something uplifting' (JK031).

'it should look contemporary' (Adoc2).

'finally it will be this blue plastic, the right plastic with the right grain' (TB77).

'because we have a certain style ... the shape of the speaker holes, it is actually really, really important that we have that. But it is not exactly...it is not written down anywhere (smiles), but it is something we have to have, because it is our identity' (PT23).

'you need to continue to sell the car and in that way you must make it more attractive emotionally. I mean you put it in a show room and somebody must go in "aha, something new has happened"' (SR 198).

*'we wanted the car to look like it was **'planted on the road'** and would have good road holding' (RU_{p3}).*

*'although they might be very **subjective measurements**, but it says that in the area of ergonomics or forward visibility, we will make sure that ... are going to be amongst the leaders in vision. Which might include even the thickness of the pillars, or the colours so that it **does not appear dark**, you know, you use light colours and it **does not look like it intrudes'** (GB81).*

*'I think we do measure a lot. The only difference is that ... it is this internal measurement system, which the sceptics outside can say "but that's **only your opinion**"' (PG_{p8}).*

*'and we know that (competitor brand) sampled 70 different types of leather just to **get the smell right** in the showroom... They will put a bag of scraps of leather underneath the seat in their car, that will smell quite nice, so as soon as you open up the car in the showroom, you get hit with this **beautiful smell** and it makes a big difference' (PG_{p24}).*

*'And that will be the design parameters within which they will develop the various steering characteristics, so it has a (brand name) **feel to it'** (PJ36).*

These bold extracts are just a few of the many examples of reference to specific product qualities. No attempt has been made here to create a catalogue or categorisation of such qualities, but their existence is demonstrated through literature, data and our own everyday experience of interacting with the products we buy and use.

4.4 Data analysis and presentation format

The transcribed interviews were analysed using thematic coding, then grouping quotes and letting themes emerge out of the data. This process is described in detail in Research Methodology, section 3.8.1. When analysing quotes within a theme the researcher looked for quotes that seemed to support the same viewpoint as other interviewees, observations or ideas, as well as quotes that were contradictory; activities that helped embedding and situations where embedding was difficult. Finally the researcher looked for patterns within the data to see if conclusions could be made at a more generic level. The theme was eventually given a concluding name, depending on what it was illustrating. The following nine themes were identified through the inductive analysis, and three themes were initiated by direct questioning:

List of themes identified

1. The product development process of embedding NQPQs
2. Specification of NQPQs
3. Translation of NQPQs into QPQs
4. Organisational awareness of NQPQs

5. Forum for discussing NQPQs
6. Influence of perception and experience of NQPQs
7. Customer insight
8. Cost reduction
9. Decision making and responsibility

All the interviewees were asked some specific questions, and the answers to those are presented in themes 10-12.

Examples of embedding NQPQs

10. NQPQs in updates versus new products
11. Examples of where the interviewees think they got the NQPQs right
12. Examples of where the interviewees they think they got the NQPQs wrong

The themes are presented using this format:

Theme heading

- A bullet points list is used to summarise brief findings from the theme

Data:

Here quotes are presented as they appear in the transcript (all quotations in *italics*) with comments added.

Implications for NQPQs:

The theme finishes with a section about what implications the findings have for NQPQ embedding.

4.5 Findings from the exploratory stage

This section presents the emergent themes from the 25 interviews. In the comments to the data the interviewees are commonly referred to as 'product developers', unless their status as for instance 'manager' was judged to be of importance to interpretation of the quote. The term 'product developer' has been selected to avoid any misconception of the title 'designer', as someone mainly styling the product, and 'engineer', as someone that mainly constructs the product.

4.5.1 Theme 1 – The product development process of embedding NQPQs

This theme falls into three sections: ‘The whole product development process’, ‘Design within the product development process’ and ‘Judgement throughout the product development process’.

The whole product development process

The whole product development process is the entire process from when the initial product idea emerges to when the product is launched.

It was observed that:

- Stage-gate process is used in all the researched companies
- Integrated product development forms the basis of the product development process
- Embedding of NQPQs is happening throughout every part of the stage-gate process
- Assessment of NQPQs is often subjective and based on selection among alternatives

Data

The stage-gate system is usually enforced on the product development process to give it structure. Interviewees from all the case-companies have said something similar to this interviewee: ‘...*Each week we have these reviews, and all the time it goes up and down - sometimes a material or a function is out and it could be back a month later. And then we have a gate system*’. He continues by describing their use of Integrated Product Development: ‘*We have group meetings every week, where we have people from the commercial side, we have a technical project leader, we have overall project leaders, then we have design project leaders and designers, I will be there as well and our design manager*’ (TB67). Interviewees from all the case-companies mentioned that their process is based on the idea of Integrated Product Development, defined by Andreasen & Hein as follows; *Integrated Product Development is an idealised model for product development, which is integrated in terms of creation of market, product and production, and which clarifies integration between project and management, including the need for continual product planning*’ (2000: 21). As mentioned by the interviewee above this means that marketing, product design/engineering and production are involved simultaneously throughout the development.

To the question on how they know when a product is good enough to pass one gate and go into the next phase an interviewee answered: ‘...*this basically comes from the expert's skill. We have to rely on subjective ability here. So these people that I mentioned will say “Yes that is what we asked for in the product definition, this is what we think we have got. Is it adequate - is it not?” If it is it will go ahead, if it's not it will be stopped*’ (PGp13). This was a common answer across the case-

companies, i.e. that it is down to experienced people within the organisation who continuously assess the product and decide if the NQPQs are there or not. The assessment of NQPQs at gate-reviews appears to be subjective, based on experienced people's judgement. These are in all of the case-companies commonly based on a selection between alternatives as this quote illustrates: '*... so basically we do a lot of different prototypes and then we present them to the industrial designers, marketing and managers. And they find what they like. And then when they have found what they like it starts... it goes into the process, the design process ...but the actual concept is soft*' (PT44).

Implications for NQPQs

The product development process is managed through the use of a stage-gate procedure, where definitions, target setting and target fulfilment is key to assessing progress. This implies that NQPQs are handled by a process where quantifiable goal setting and goal fulfilment support much of the product development process. Such a system is good at using numbers, and product developers have become used to setting targets, using numbers and monitoring regularly against those numbers, as they provide a clear pass/fail criteria. But NQPQs are also being handled in this system using numbers. This means that NQPQs are less able to be embedded in a reliable and consistent way, as subjective assessment is impacting the embedding.

The design within the product development process

The design process is in this research defined as the process from when a brief is received by the design function or engineering function to when they have developed the final prototype. This section will look closer at what happens to NQPQs during this period.

It was observed that:

- The design of NQPQs is usually initiated by a brief or product specification
- All the case-companies use a set of comparative benchmark products to form the primary basis for the product quality
- Sketching and models are often used to communicate NQPQs that are difficult to describe verbally
- NQPQs are designed through an iterative process of selection and development

Data

Initially a product brief is commonly developed by Product Planning and Marketing in the researched case-companies. The brief describes the overall product intent, and is in some cases supported by a target customer profile or a user situation like SK8 describes: '*We try to make small user stories about the user and what situation he is in.*'

The perception of what the brief is varies considerably among people involved in the design process. Here a marketer describes what happens in design after the

brief is passed on: *'The way the car is actually designed within the design division is actually by listening to the quantifiable and perhaps denoting a package and the engineering data relating to that. But after that is very un-quantifiable emotive design'* (DGp4). The marketer feels that designers have freedom to introduce 'emotive' content. But when asking a design manager to describe how most product qualities in the brief are defined in quantifiable terms: *'90% is measurables and the rest is more about the feeling. And then you have to interpret what do they mean with that, so you have to look at the competitors and then start by writing the prerequisites for all attributes'* (TB55). Even the 10% non-measurables are commonly manipulated into 'attributes'. The brief or product specification initiates the design of NQPQs although it might not be specified in a clear and consistent way.

A set of benchmark competitor products called 'the comparative set' forms the basis for setting targets for NQPQs and QPQs in all the case-companies, as this interviewee describes: *'All the time we are benchmarking, it is probably 50% or more of our job'* (DC79). Another interviewee describes how benchmarking often starts out with a discussion of what is the right benchmark, e.g. what should form the 'comparative set': *'It is discussing in our team and writing it down in our specification, that is more on the benchmark area. So we do it with benchmarks, but we also discuss what is the right benchmarks in the group prior to that'* (JEB40).

NQPQs are commonly developed through an iterative process of selection and development. By providing alternatives, a reference point for communication is given: *'...the industrial designers give us three possible solutions'* (PT309). Although detailing and refinement is sought through this process, it is not always what is embedded in the final product: *'Because they did not notice it until it was made and you do not see that on the model. So you do not get things like that, which comes up in real life, that is slightly different because when you make it ...you can not make it as perfect as the model'* (PT309). Sketching is often used to communicate NQPQs in the early stages of development. Later models and prototypes are used too. Sketching and models are often needed to communicate NQPQs that are difficult to describe verbally. But some NQPQs can be difficult to perceive during development or even in the prototype. This means that the product developers will not be able to react until they have the final product, and then it is maybe too late to change the NQPQ.

Implications for NQPQs

The product qualities that are embedded into the final design are normally a result of many trade offs. The use of the comparative set has a strong influence on NQPQs being designed into the new product. In the car industry this is more prominent for both NQPQs and QPQs, whereas the mobile phone industry seems to push NQPQs so their product stands out from competitors.

The design process of NQPQs is based on suggesting many alternative solutions, then selecting a few that are believed to be the best and developing those in more detail. Then another selection round will be made, and this process continues

until one solution is chosen. This iterative process is used from concept design to detail design.

Sketches and models are used to help describe and define NQPQs throughout the product development process. And although they help communication and selection between alternative solutions, they are not carried through the product development process in a format where they can directly ensure the desired embedding.

Judgement throughout the product development process

It was observed that:

- It is common that NQPQs are discretionary – there is no system to ensure that they are in the product
- Estimated revenue influences the embedding of NQPQs in vehicles
- Managers' judgement can have a substantial influence on the NQPQs
- Benchmarking informs judgement of product qualities
- Customers are sometimes invited to judge NQPQs at various design stages
- In one case-company a separate group had specific responsibility to monitor and judge NQPQs embedded throughout the product development process

Data

In the design and product development process there seem to be many different factors that influence the judgement of NQPQs. One of them is the fundamental assumption in products with many functional qualities (in this case a vehicle), that *'The discretionary items are basically anything that could be taken out that is not absolutely required which would include non-quantifiables as well as quantifiables'* (GB16). The judgement of 'what is required' is not always well defined for NQPQs, leading to discretionary NQPQs, because there is no system to ensure that they are in the product. The interviewee continues to describe why it is so: *'And then it is a matter of assigning a dollar value to what we think in terms of revenue we can get for a particular item. And so we will literally do it almost by feature as well'* (GB16). Estimated revenue influences the embedding of NQPQs in vehicles.

Because NQPQs are looked at at feature level when judgements are made, it can be difficult to understand how much it will affect the overall product quality to take out one feature: *'The marketing guys saying "we have to have it", and the engineers are saying "but why? – it's costing me all this money and I get nothing back for it, so why would I keep that in my programme?... give me a revenue for it", was his answer – "give me a price – you need to make money otherwise do not do it"'* (GB20).

When people involved in the design and development feedback reach a conclusion about an NQPQ they will often seek the judgement of the project manager: *'And at the end of the day it needed those...it needed that person and the chief programme engineer we call him – the guy who ultimately runs the programme – to actually have the agreement and discussion to be convinced that “yes we do” or “we do not” do it' (GB20)*. Managers' judgement can have a big influence on the NQPQs. In the mobile phone case the judgement of global marketing managers seems to form the final check that the visual NQPQs are suited for his or her market, by judging a non-functional prototype: *'It just shows what it looks like and then marketing do a sort of a world tour and they go around in the different regions, say Africa, Asia, Japan and they go around and you have these sort of marketing managers in each region, who control it, and there is a board and they... you actually have to sell that design idea – that design to them, before the phone goes to production. So if they say: “we don't like that - it won't sell here”, it might not go into production' (PT289)*.

Benchmarking is widely used to inform judgement of NQPQs, as in this case where a designer is describing how they define the product quality that they are seeking to embed: *'Yah, okay generally we have the experience, saying this is the key mat and it is a tactile feel, but quite often we have a benchmark product. And this could be a competitor it could be another (brand name) phone, and they generally say: “we like the feel of this” and then we try to match it' (PT58)*.

Customers are sometime invited to judge NQPQs at various design stages. Customer judgement of NQPQs is influencing the process of embedding in many different ways especially in car companies. Surveys or customer clinics are commonly used as these two quotes illustrate:

'...and then just to check it we go and survey often all of the customers in these three markets against the same product as we have benchmarked. We just make sure that they're quite well in alignment' (PGp6);

'...they would come to a clinic they will look at the car and they will follow the questions, it takes an hour to answer all these questions' (TB6).

Yet again benchmarking is used to inform judgement, this time made by customers. The mobile phone company does not use customers in the judgement of NQPQs during the development of a product but tends to assess customers' reaction to launched products: *'...it could be such as how to assemble the phones... we are used to it, we know how to use it, do it now: “oh, this works fine”, but then you see someone who...but the trouble with these customers, they will not see the phone until after we have developed it, so we can not get them in at the beginning we can just learn from past mistakes' (PT135)*.

In one of the case-companies a separate group, called 'Perceived Quality', has the specific responsibility to monitor and judge the embedding of NQPQs throughout the product development process. *'So for example, the exterior design, it is very much a matter of opinion. So we will have people who will go from the Perceived Quality Team and say “okay, for an exterior design this is what we think is good and this is bad”. Then we define what is good and bad about it. Sometimes it is*

quite difficult in terms of an exterior design because you are basically looking at the overall product and saying whether or not you think it is good' (PGp8).

Implications for NQPQs

Often decisions about NQPQs appear discretionary – even if there is customer data that support them – whereas QPQs often are embedded on the basis that they are non-discretionary, and are seen as not negotiable, simply because they are defined in a tangible objective format in the brief/specification.

Perceived revenue seems to impact on the judgement of NQPQs in vehicles during the design and development of them. This makes it very difficult for new NQPQs to be embedded into the product, because the cost has to be held against the potential sales, but of course that would be a prediction and can not be guaranteed.

The process of embedding NQPQs in vehicles, involves more reactions by potential customers at various stages. These reactions inform the decisions about NQPQs, but the decisions are not necessarily steered by them.

The product development process used by the mobile phone company differs from the automotive companies by letting global marketing managers evaluate the NQPQs in a prototype before the phone goes into production. If the prototype is not well received across markets it will not go into production. Customer judgement of NQPQs only happens in launched products and informs the product development process at a more generic than product specific level.

Interestingly one of the vehicle manufacturers had constituted a functional group with sole responsibility to judge and ensure 'perceived quality' – the quality perceived by the end customer. They have no design/creative role to propose designs. The Perceived Quality group is set outside the normal organisation and reports directly to the board of directors. They are involved throughout the product development process, judging product quality including NQPQs on behalf of potential customers. If they find the quality to be insufficient they have the right of veto in stage-gate reviews.

4.5.2 Theme 2 – Specification of NQPQs

It was observed that:

- NQPQs are commonly not clearly translated from design intent (the brief) to product specification (plan for fulfilment of intent)
- NQPQs are often described in terms of an emotional response in the customer, and remain at this level throughout the product development process without reliable translation into product characteristics
- Lack of objective specification of NQPQs can lead individuals to interpret the product objectives

- NQPQs are often developed as part of a QPQ, being the additional and discretionary qualities of a well-defined non-discretionary QPQ.

Data

The early phase of product development, within the case-companies, starts with a rough brief that would capture the main features, i.e. target customers and an overall description of the product appeal/offering. It is not regarded as a specification with well defined product qualities, so often product developers have to seek verbal explanation about what is meant in the brief: *'...I mean the more chain the information goes through the less rich data you get so in the end you can get a one-liner saying we need a 'wallpaper'. And then it is up to you to try to track names if you want to understand'* (SK58). The interviewee continues to elaborate on the lack of understanding of the NQPQ that is sought through discussion: *'...I think the strategy is to put the non-quantifiable issues on the agenda and into the discussions as early as possible in software development. I mean in the beginning we get a request about something that no-one understands. We have not heard about it – there may be some other people that have researched it for two years, but we try to understand that is the feature and that is the moment to put the soft issues on the agenda, because then it becomes a part of the discussion'* (SK78). (Underlining illustrates the interviewee's emphasis).

In all the case-companies NQPQs are commonly not clearly translated from design intent (the brief) to product specification (plan for fulfilment of intent), resulting in generic product characteristics informing the development of NQPQs: *'...Yah, but when we for example two pages about product, this is what the product will be – this is the new features, and it will look roughly like this and this is what we should be careful about these are the risks... it is a little bit of marketing language: "This is roughly the promise we will sell"'* (SK88). NQPQs are often described in terms of an emotional response in the customer, and remain at this level throughout the product development process without reliable translation into product characteristics. But they remain a small part of all the product qualities as most are turned into measurables: *'...90% is measurables and the rest is more about the feeling. And then you have to interpret what do they mean with that, so you have to look at the competitors and then start by writing the prerequisites for all attributes'* (55TB).

It appears that NQPQs are not always present in the specification, but arise from individuals who are involved in the design phases. Asked how the interviewee believed that NQPQs get embedded into the product, two interviewees illustrated that they are not necessarily in the brief or later specification. One said: *'...I guess we (engineering) have our opinions and they listen to it, quite a lot. We seem to have quite a lot of influence on the industrial designers for instance. Generally it is linked to a quantifiable because it could be dimensions, it could be how it is made so that changes the shape...'* (PT67). The other interviewee simply answers: *'By putting the right people in the team...you make sure that people within the team fit the profile plus or minus your normal distribution of the target customer'* (DGp7). Lack of objective specifications of NQPQs can lead

individuals to interpret the product objectives. The first quote also illustrates a common observation that NQPQs are often developed as part of a QPQ, being the additional and discretionary qualities of a well-defined non-discretionary QPQ.

Based on the brief, NQPQs are commonly specified by the team/product developer through interpretation of what the customer is believed to value. This process is characterised by developing different ideas (divergence) selecting one or two (convergence) and then developing these in more detail before another selection helps to close in on a solution. This process is iterative.

In the early stage a great deal of exploration and proposing of alternative NQPQs will lead to a 'knowledge pool' from where the selection and combination exercises can take place: *'...at the beginning of the process we have ...the industrial designers usually have three different types of concepts or phones, what they look like, and then we basically then have to figure out if they can be made. And that can be a little (laughs)... sometimes, so we have to research as much as we can. But you also...you look at it and give your opinion, what you think, and then it goes around lots of engineers and they take on your opinion'* (PT39). But as is evident in this quote, NQPQs are often seen as secondary to what are already well defined objectives like QPQs. The development and selection is often steered by the benchmark measure, so by breaking down NQPQs of competitors a 'measurable' specification is sought.

Sometimes NQPQs are defined later in the design stages on the basis of a physical sample called a 'master' from where a quantifiable specification can be made: *'We are working with master specimens so we have what we call an A-master and an A-master could be a piece of anything – it could be this pen – it could be an A-master. We will like this feel of the material the colour and the technique. The engineers and the people from laboratory, plastic specialists, they will then develop the master plaque, called the CD master specimen, it's a plastic part that is made of that material, it is not the right colour from the start, it is black and a ABS-colour, but then finally it will be this blue plastic, the right plastic with right grain and all the technical specifications and in the end you have the production part that could be handled, made in that plastic and in that colour and its surface'* (TB77).

Implications for NQPQs

NQPQs seem to be a part of the overall product/design intent and this is rarely translated into a specification from the start. Instead NQPQs are often described indirectly either by the emotive or cognitive reaction it seeks to evoke in the customer, for example 'looks contemporary', 'easy to handle' or 'feels uplifting' or by giving the product developer a profile of the customer or use situation, for example 'a van for a small/one-man business'.

The lack of a clear NQPQ specification means that individual interpretation of the product brief is often what steers the development of different product concepts; with NQPQs being embedded as secondary qualities to specified product features. Selection among alternatives then defines and specifies the

NQPQ indirectly. This means that NQPQs are not always specified in the brief or specification, but appear as a consequence of concept selection.

4.5.3 Theme 3 – Translation of NQPQs into QPQs

It was observed that:

- NQPQs are commonly transferred into more quantifiable measures wherever possible
- Turning NQPQs into measurables is often done by: 1) quantifying the physical product quality/characteristic, or 2) measuring response in a potential customer or expert
- The transformation of NQPQs (into more quantifiable measures) occurs through the use of benchmarks, tests, index systems and numerical targets
- Some NQPQs are kept consistent across products through the use of rules or guidelines – these are often enforced to ensure consistent product identity (brand) and usability
- Perceived product quality (by customers) is sought by product developers to aid the justification of NQPQs, such as specific features, material choice or product appearance

Data

The process of embedding NQPQs can occur by transferring them into measurables. This means that, for example, the sound of the door slam will be measured in competitors' cars and a sound profile will be conceptualised and designers will seek to embed this in the new product: *'...I think sound is a very good example; the engineers have now developed...well they have got the ability to actually test from within the car what the sound patterns are exactly, using, you know, simulated with microphones in the ears and what have you. And they have also learned what the things that sound good or not so good, and they look at...they do the sound mapping patterns looking at the second, third, fourth, fifth order sound frequencies. And they know that if they have got a particular area on that sound map that it is predominantly...that is not associated with...maybe that is a harsh sound quality or something. And they know now by tuning inlet ducts and the shape and the length of those and the resonating chambers, they can actually tune in to whatever sound they want to'* (JP65). As this quote indicates, the emotional response to an NQPQ can lead to an investigation that will break down this particular NQPQ into aspects of it that can be measured and quantified.

Asked how much of the NQPQs are translated into measurables, one interviewee answers: *'...I think we do measure a lot. The only difference is that in terms of the measurements it is this internal measurement system, which the sceptics outside can say "but that's only your opinion". Okay it might be opinion that is*

collated between members of the Perceived Quality Team or it might even be collated to market opinion in some respects. But it is still only subjective. So, you know, for the people who want to shoot it down, they can always do so' (PGp8). Turning NQPQs into measurables is often done by: 1) quantifying the physical product quality/characteristic, or 2) measuring responses in a potential customer or expert.

The importance of turning the NQPQs into QPQs is evident in the two following quotes. These quotes refer to a design review process: '...Unfortunately the business climate means if it does not have a number or a positive number to support the cost, which is a negative then it does not ...it is very difficult for people to keep it there and not consider deletion' (GB14). It appears to be difficult to defend a non-quantifiable attribute against challenge from the well-quantified cost: '...And I can guarantee when I go and make this presentation to the people who hold the purse strings for the new project, they will say "We can't afford this, go back and quantify how much value this has to the market. How many cars will we sell more..." And that is where the problem starts because it is almost impossible' (PGp3).

Asked about how they handle design features or aspects of the product that they can not necessarily measure: '...Well we do measure them. Whether or not it is a robust measurement system is another argument...we would call the things that we can measure the objective qualities. And these generally end up in technical specifications. And again with market feedback it will be...as objective as you can make it. It will be based on survey results' (PGp6).

The reason why it is important to translate some of the NQPQs into more quantifiable measures is because they are embedded through the physical construct of the product, like for instance visibility in a vehicle: '...In effect they are all made into...although they might be very subjective measurements, but it says that in the area of ergonomics or forward visibility, we will make sure that we have got vision angles of this, and we are going to be amongst the leaders in vision. Which might include even the thickness of the pillars, or the colours so that it does not appear dark, you know, you use light colours and it does not look like it intrudes...And therefore the engineers have got targets that they can work to, even in some of those relatively non-quantifiable areas...Then the rest of it is going to be down to the intuition and the, if you like, the drive of the team to influence the other areas of the vehicle that would impact on the vision' (GB81).

Often NQPQs that seem to be very complex are being turned into a QPQ, in this case vehicle handling: '...If you want an engineer to design something, if you are well aware, you have got to give them something to design to. So it does have to be quantified. And we have...on things that, you know, perhaps the layman might think that something like steering is not quantifiable. The engineers will know how much friction there should be in the system, what the torque should be and the rates of response and the effect under...they will have all of that quantified' (JP36).

This designer believes that certain product characteristics drive the customers' recognition of what makes a particular type of product. For example, sports cars are sports cars because of these: wide tyres, low body profile, aerodynamic shape, agile steering dynamic etc., but they also have other characteristics. Even the 'sports carness' of a sports car is turned into a measure by making direct benchmark comparisons to existing sports cars: *'...There is very much a platform quantifiable statistic which is around what constitutes a small car, what constitutes a classical affirmation of a B car, C car, D car luxury segment, MPV, SUV and proportions related to product design... And whilst design is measured in the main by the designer's eye, those quantifiable statistics are either supporting or driving, depending on the priorities being attached to a product design'* (DGp2). By referring to existing established product qualities, the non-quantifiable qualities are referenced back to 'benchmark-measures' that have evolved from past product executions. This works well for mature products (as with vehicles), but it can also hinder the development of novel NQPQs. Products such as mobile phones which have evolved significantly in technical terms over the last decade seem to be more likely to add new NQPQs to signal technological innovation (for example to have not only the number of ring tones expanded, but also the complexity, leading to melodies rather than 'tones').

Benchmarking is commonly used to help in defining the NQPQs. The product quality that is used as a benchmark works as a fix point or reference point for the quality that is being designed/developed. It is common to use three to five reference qualities when benchmarking NQPQs, as they would each represent different solutions to the same quality and help to enlighten what differentiates them from one another.

Benchmarking today's products commonly gives the product developer a base for developing NQPQs that will satisfy customers in the future: *'So we have to define a position trying to objectively measure how each of these benchmark competitors – what level they have achieved and then what we can do to compete. Add up to that the complexity of trying to look forward because it's no good benchmarking against today's product, we have to look forward into three to five years ahead. And so to be competitive at the point of sale, and up to a minor change, we have to achieve this'* (PGp3).

Here another example of using benchmarks to turn NQPQs into measures: *'...much more down to objects or measures. Obviously we will start at the very macro level. So for example I will make the material definition – they will say for example we will kick off a new project and it will be for example a "C segment competitor" and we need to know what C segment is, C segment is up against these competitors. So we will know what we're up against. So we have to define a position trying to objectively measure how each of these benchmark competitors – what level they have achieved and then what we can do to compete'* (PGp3).

And yet more attempts to turn them into hard numbers: *'...Well I would say that we try to either measure things directly, sort of dimensions, torques, whatever it features or whatever it might be. And the things we feedback measure directly*

we try to measure using customer ratings or engineering expert rating evaluations in some cases. Because there are some elements of cars that when you ask the customer you get a different reaction, different response to the ones that the experts will give you' (PJ23).

Where NQPQs feedback easily be translated into physical product attributes or quality, subjective responses can be sought and assessed via an index system:

'We have our own index internally. We have the perceived quality – the global standard that we apply where we judge things. And we have basically skilled people around the globe and we frequently re-visit our product – also our standard and we survey the market just to make sure that we are continually correlated to public opinion' (PGp6);

*'I...Yah, but also...I will tell a target figure. We have a 1-10 digit scale at (company name), so I would put a target figure for each complete car. Like 8.0 could be one target figure but then I have divided it down...into exterior quality, interior quality, so I could say that the instrument panel must reach 8.5 or 8.6... ordinary customers or internal customers, they would come to a clinic - they will look at the car and they will follow the questions...You would ask the questions three at a time and you click in a box from 1-10 what you think about the different items' (TB7). Methods that translate subjective evaluation into numerical measures, like index systems are used to assess both potential customers' and experts' assessment of the product: *'...The internal system that we have is deployed by the experts that we have around the globe. The difficulty with that is that you'll get a different opinion, sometimes between Japan, US and Europe. But actually it's fairly well aligned anyway – and then just to check it we go and survey often all of the customers in these three markets against the same product as we've bench marked. We just make sure that they're quite well in alignment' (PGp6). These three statements illustrate that non-quantifiable product quality is often measured through an internal measurement system – an index system. Index systems can be said to create a point of reference for evaluating product quality. The quotes also illustrate that the non-quantifiables may be assessed by experts, so that they can become pseudo-quantified and that surveys are used to try to find out the general perception in the market. It seems to be important to have many different types of people to assess the product qualities, although the data show that 'skilled' people have a high influence on the assessment.**

As these examples illustrate, we have to ask if the transformation of NQPQs (into more quantifiable measures) occurs through the use of benchmarks, tests, index systems and numerical targets.

Characteristic NQPQs are sometimes the result of a great effort to turn certain complex NQPQs into QPQs as the following quote illustrates: *'...And that will be the design parameters within which they will develop the various steering characteristics, so it has a (brand name) feel to it' (PJ36). This quote also illustrates the link between quantifiable parameters and how they add up to a certain 'feel' – the non-quantifiable quality, i.e. that the product should deliver a certain brand-specific feel to the users. The statement also illustrates the belief that repeated use of these specific quantifiable parameters will send out a signal*

of consistency in product characteristics and enforce the notion of a brand-specific quality.

Some NQPQs are kept consistent across products through the use of guidelines or rules – these are often enforced to ensure consistent product identity (brand) and usability. Here is an example from the mobile phone case: *'...and also a long list of user interface style guidelines that we have. We have defined styles, for example, what should soft key labels be and how do menus look. So we have a lot of, actually, documented rules about what is the (brand name) user interface styles for the phone we make, so they have this product identity'* (SK105).

Perceived product quality (by customers) is sought by product developers to aid the justification of NQPQs, for example with specific features, material choice or product appearance. But there are also examples of NQPQs not being incorporated into the product because they can not be turned into a QPQ or the potential customer reaction is difficult to assess. Here the interviewee has been asked if the company design olfactory qualities into their products: *'We have not yet, no. We have discussed it many times but it is just too difficult to quantify...We tried to make an internal index that would appeal to all senses including smell'*. (PGp24). The same interviewee continues by illustrating how a competitor uses this type of NQPQ consciously in their products: *'...and we know that (competitor brand) sampled 70 different types of leather just to get the smell right in the showroom... They will put a bag of scraps of leather underneath the seat in their car, that will smell quite nice, so as soon as you open up the car in the showroom, you get hit with this beautiful smell and it makes a big difference'* (PGp24).

Implications for NQPQs

This theme illustrates that NQPQs are often being turned into or linked with quantifiables (i.e. measures) in order to make them more tangible and thereby easier to embed and assess throughout the development process. It can also mean that if it is impossible to make this translation, the NQPQs might struggle to get embedded into the product.

There appear to be various levels of understanding on how to turn non-quantifiables into quantifiables. At the very basic level, it seems important to measure things in figures because the numbers system creates a base that can not be argued about and gives the assessment a point of reference that everyone in the design process will understand. Sometimes the actual performance of the NQPQ itself is not interesting to designers, but only the value it gives to the end customer. It can be seen that the direct impact of the perceived product value is sought by designers to help in the justification of a specific feature. This value is very difficult to present at the feature level.

Benchmarking is commonly used to help define or translate the NQPQs into quantifiable measures. This can be done in two ways; firstly and most commonly by benchmarking the product quality that is sought to that of competitors, and thereby turning the NQPQ into a QPQ. Another method used is to assess the human reactions in assessment systems like index systems. Index systems are

used to create numerical representations of emotional response to product qualities. This pseudo-quantification is used to represent an overall score of the product and the reference point would be given on the scale. Index systems are especially useful for NQPQs because they provide a numeric representation that can be used when assessing them in relation to QPQs.

Through description and quantification, some NPQPs are being embedded across products through guidelines or rules. Guidelines enhance NQPQs' consistency and make it less likely that they are altered or not embedded.

4.5.4 Theme 4 – Organisational awareness of NQPQs

It was observed that:

- Companies are conscious that NQPQs exist in the product and that they have the responsibility to embed them in the product
- Companies focus on NQPQs from a customer point of view as well as how they as an organisation can manage to embed NQPQs
- Companies understand NQPQs in many different ways. For example, how time changes NQPQs, NQPQs from a customer viewpoint, how NQPQs link to the brand etc.
- Many interviewees commented that trying new techniques (such as using customer profiles, product clinics or building scenarios) has helped them understand what NQPQs mean to customers, how they can justify them financially and embed them
- All the interviewees had an elaborate awareness of NQPQs and their importance in the product. They could also give examples of people within their organisation that they feel did not have such an awareness

Data

All of the case-companies have a high awareness of the importance of NQPQs: *'...design and emotion are very important, and I think they are becoming more and more important, because people take for granted that you have good reliability in your car, and then it is something else that is standing out from the crowd and that is design, emotion and wellbeing' (SR41); '...I think we should focus more on what the customer sees and feels' (TB143); '...I think the strategy is to put the non-quantifiable issues on the agenda and into the discussion as early as possible' (SK58).*

Awareness of NQPQs is very diverse. It includes awareness of how important it is to send out a constant message by the use of one NQPQ: *'We have been trying for many years of having soft leather in the car to have a 'not fake strategy' (TB177); to be aware of the difference between NQPQs that reveal themselves visually and only when the product is in use: 'most people purchase by style... they are*

buying by style or price. So you need someone to get into the vehicle to realise actually this car is a lot easier to drive, and a lot better, and more rewarding to drive than whatever another competitor of the same price point and size' (GB8).

Awareness of visual NQPQs in mobile phones is high, both on the outside of the product and on the inside, which is only seen when the customer accesses the SIM card or changes the phone cover. The first quote illustrates an awareness of how the speaker and microphone holes are shaped, as they aesthetically send signals about style and brand origin: *'...when it comes to the size of the (microphone and speaker) holes, believe it or not, that is such a big issue all the time...it is ridiculous really, when you are too worried about a couple of holes... but industrial designers are frightened because the speaker holes are actually one of the main parts, features that you can see. So they always fight to keep it (PT83).* If the customer should happen to take the phone covers off and look at the technical parts these have also been considered: *'Yah, the inside is considered now as well (PT83).* Similar comments were made by two of the vehicle case-companies, where awareness of the impression the customer gets when opening the bonnet have lead to a particular styling of some characteristic parts.

Awareness of where NQPQ consistency is lacking: *'And frankly speaking we do not think we have this with (brand name), because there is not so much cross-car line (meaning cross-model) consistency. So we are trying to develop (brand name) "touch"' (PGp5).*

Companies will seek confirmation of NQPQs during embedding by asking experts as well as potential customers to ensure alignment of perception: *'The internal system that we have is deployed by the experts that we have around the globe...then just to check it, we go and survey often all of the customers in these markets against the same product as we have benchmarked. We just make sure that they are quite well in alignment' (PGp6).* This illustrates that they are aware of the difference between a trained expert and the customer when assessing NQPQs.

Awareness towards NQPQs is present at different levels. This quote (below) illustrates an awareness towards a coherent product experience by using a language that mentions individual features/attributes but at the same time uses a collective notion 'the driving experience' to ensure that the pieces are brought together coherently: In other words they use two languages in parallel, since you can not ensure that the 'whole' experience will happen just because you deliver all of the pieces: *'...But we have actually made the car also a better car in terms of it's driving quality i.e. ease of use, the features, the functions, the ergonomics are much better and more intuitive. And that is something we are deliberately trying to build upon by trying to change the emphasis from driving dynamics to driving quality, because quality is all around those other attributes as much as anything else' (GB9).*

Awareness of extended product quality – context of use: *'I mean are you doing system design or are you designing behaviours? Being able to see that*

link...uhm, that is education, personality, and it is experience (of the designer)' (SK191;) '*...I think it goes beyond human computer interaction that... I mean... it is not the interaction with the product itself that is interesting – it is what it is used for in a context*' (SK193). This designer is aware that the same product in different environments can generate different reactions. Many interviewees commented that trying new techniques, in this case where and how a product is used (the context), by building scenarios, using customer profiles or customer clinics, helped them understand what NQPQs mean to customers and how they can justify them financially and embed them.

Here an example of awareness towards how the customers are pre-influenced, as well as the fact that some products sell purely on their NQPQs: '*...So if you wanted to sell a door that flipped from the top edge you would never make any money because, not that it's a bad idea or it doesn't work, but people are conditioned because that's how it has always been. So in fact sports cars will probably go on for a long, long time whether people like them or not because there is a conditioning out there. You know, there are some people that say 'well that suits my image'. Whether it actually meets any needs is irrelevant in terms of functional needs. In fact most sports cars don't deliver any functional needs at all, but what they do is deliver on the emotion*' (36GB). Companies understand NQPQs in many different ways. For example; how time changes NQPQs, NQPQs from a customer viewpoint, how NQPQs link to the brand etc.

Although it is evident in the data that companies have a diverse understanding and awareness towards NQPQs in their products, there are also examples of people who do not seem to be aware of the importance of NQPQs. Here is an example from the development team: '*...I have got a manufacturing guy in my team and a marketing person in my team. And I can converse with the marketing person and the manufacturing guy is saying lots of expletives "I do not know what you are talking about – I do not believe the customers buy cars for emotional reasons, they just buy a car don't they? They just buy the car they want and they pay the price that they can afford – what is all this emotional bollocks?"*' (GB129). And here a similar example: '*...it really depends on the person. There are a lot of people I can easily go and talk to... and they respond... I mean we talk about the softer values of using a mobile phone and it makes instantly sense to them and they can reply. And some people obviously don't get it*' (SK53). But there is also example where awareness is lacking at managerial level: '*...without wanting to get into the politics of it there is, and again because I guess it's non-quantifiable, there are issues with convincing certain people that we should do it. Even my direct management structure do not really believe in and see the value in innovation, yet they are charged with it*' (GB103).

Implications for NQPQs

The diverse awareness of NQPQs in products in all of the companies does not always translate into ways of handling and embedding the NQPQs into that product. The awareness spans from being mental models of the nature of NQPQs, to specific product examples, or quotes that illustrate the perceived importance of NQPQs by product developers.

Most product developers are aware that users have more than a checklist of measurable product qualities and that the customer values these qualities such as drive quality, user behaviours etc. One designer sees his job as needing to maintain two languages and to maintain a translation service between the two languages. The first language is at the feature level while the second language is concerned more with the holistic qualities of the product.

An awareness of the importance that NQPQs have on customers makes companies go to new lengths to embed the NQPQs, whether it is by designing a brand-specific 'touch' to the material used in vehicles, being more aware of the context in which the product is going to be used, or simply by illuminating 'fake materials'.

4.5.5 Theme 5 – Forum for discussing NQPQs

It was observed that:

- The understanding and embedding of NQPQs are becoming more prominent in the discussions between people involved in product development
- NQPQs are discussed formally and informally in the case-companies
- Discussions about NQPQs happen in direct relation to the product under development and in more abstract conversations.

Data

NQPQs seem to be increasingly referenced in day to day conversation, whether it is on the agenda or through a more informal setting: *'I think it is being discussed everywhere right now, because it is something we know as a whole organisation, that we need to improve in this area' (228SR); '...I would actually claim that it is everywhere, at least in my department of 200 (people)... I don't know how the other people work (SK185).*

Conversation about NQPQs occurs naturally during the design phases and is often centred around a physical model. Here the interviewee has been asked if they use a benchmark product, a product model or other tactile material when communication NQPQs: *'It is actually quite important to have this with marketing and managers... because they do not have the knowledge of how things are made so you need to have the physical parts to talk about and we do...as soon as we get the part it is usually straight over to see if they like it or not' (PT256); '...trying to describe something between two teams (marketing and mechanics) and the only way you can describe things that you can not go and measure is to try to have something that you can compare it to' (JEB20).*

NQPQs are discussed at many different levels within the organisations. People seem to be steered by their individual intuitive understanding of NQPQs and seek others that share their view: *'...so I think it is part of daily discussion'...I do*

believe they (NQPQs) are a part of everyday language, the hard thing is what are these discussions based on? Are they based on knowledge – are they based on gut feeling... So we try to work with people whose gut feelings match (ours) and are happy to see them advance in the organisation, because they can put awareness to issues that are important' (SK185). It seems like NQPQs are discussed in different functional groups, but that these can fail to align their views with (top) management: '...A lot of it, this discussion goes on basically at all levels and everywhere. And some of it is structured and a lot of it is unstructured, and the hardest part is at line one. Because the people upstairs will talk about it, but then by the time it has come down and we have got five vice-presidents who are staffing five divisions. You have got people down here who do not agree with people they are interfacing' (RUp20).

Implication for NQPQs

People in the case-companies discussed NQPQs at a formal and informal level and this was observed to have a high impact on NQPQ understanding. Through sharing and elaboration of various perspectives people involved in product development can reach a sense of a shared language and common understanding. The NQPQs are commonly linked into the companies' more strategic decisions, such as company vision or brand strategy. Embedded product qualities are the result of such considerations and decisions, and it is important that this is discussed to reach a common understanding across all functional groups.

It is evident that companies use physical models to communicate and assess NQPQs throughout the product development process.

When NQPQs are discussed in the organisation it seems to be mostly at a horizontal level (within or amongst functional groups) or in top management. There appears to be a lack of vertical communication (between top management and the rest of the organisation), or that top management send out mixed signals such as the need to embed high quality NQPQs, but also a need to reduce cost.

4.5.6 Theme 6 – Influence of perception and experience of NQPQs

It was observed that:

- There is a learned consciousness of what people understand as good quality in NQPQs based on their experiences
- Customised NQPQs exist for different global markets

Data

Product developers are aware that by giving a product such as a car a stronger engine, the associations are likely to influence the perception and assessment of other design qualities. This is due to the user's previous experiences rather than the actual added product quality: *'...Only by putting a stronger engine, by replacing a six cylinder engine with a V8 engine, could mean that you get higher*

scores on some area within design quality' (SR212). Another example relates to the use of genuine materials, i.e. plastic vs. wood. Although plastic can look as good as real wood one company has made it their strategy only to use real wood instead of look-a-like versions, because they are aware of customers' general perception and past experiences: *'...Before when we had wooden décor, we were so good at making substitutes, so we could make a photographic copy wood, put paint it on so that the customer could not see if it was real wood or fake... so now we have a strategy that says that if we would like to have wood it should be real wood, if it should be plastic it should be a good plastic. If something looks like aluminium it should not be painted plastic, because if you look at this...and it looks like aluminium but it is moulded in plastic. Should it be aluminium or steel? – it should be real material'* (TB161).

The product developers acknowledge that different customers are pre-influenced by the product qualities related to a specific brand: *'...we are going to sit down and discuss how we can make a study in order to see what the customer is expecting ...'cause you have different customers; You have (brand name – top luxury brand) customers, that could be one group of customers and you have (brand name – another luxury brand, but generally perceived as 'average' luxury) which probably is another group and they have different values'* (SR62). Also cultural differences influence the pre-perception experiences and thereby the assessment of the product: *'...The internal system that we have deployed by the experts that we have around the globe. The difficulty with that is that you will get a different opinion, sometimes between Japan, US and Europe'* (PGp6).

Implications for NQPQs

There seems to be a good understanding and awareness of pre-perception and that users are conditioned to have a certain association with specific design qualities, depending on past experiences with similar as well as other product types.

The awareness towards how customers are pre-conditioned is something that is very important when trying to embed NQPQs. It can be used in a conscious manner to enhance the NQPQ experience by enhancing already existing pre-conditioning or it can be used to break the traditional view by coming up with novel NQPQs.

4.5.7 Theme 7 – Customer insight

It was observed that:

- Companies show increasing interest in understanding customers' needs and desires in products. Companies try to understand what NQPQs customers value
- All the researched companies have extensive market and customer research

- NQPQs are difficult to judge and assess. A common strategy is to go to customers to get an assessment of NQPQs
- The customer is sometimes represented by in-house people. External field experts and dealers are also included to better understand customers' relationships with product
- Companies are aware that customers can not articulate latent needs or give a projection of what they would like in the future

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Customers impact the embedding of NQPQs in various ways, some directly and some in a much more subtle way. Asked how much of the embedded product qualities are based on customer insight, this interviewee answered: *'We actually work to a rule of 80/20. 80% is us – 80% is design driven directions, 20% is looking at customers' responses, insight and commentary'* (DGp11). An interviewee from another case-company explains the depth of customer research: *'...so they have done a lot of research on this because it is a new (market) area as well for (case-company name). So they have actually gone out to try and find where the market is ...and...let us say Africa or South America and I think they (marketing dept.) spend three to four months doing this...and then they came back and presented us...showed us what they found, which I thought was very good'* (PT9). Although the statement is given in relation to customer insight, it seems as if the research is conducted at a higher, more market oriented level. The market insight can ensure that overall understanding of desired product qualities related to specific culture is achieved. This broad insight can help to illuminate potential danger areas when embedding NQPQs, but it is unlikely to influence the product design specifically since the product is marketed globally: *'...So it is the same product that goes to every single market, so they basically have to drag a bit of each area into this (product)'* (PT19).

An example where customers influence the product development in a more subtle way: *'...we saw the power of innovation was being consumer focussed and generating interesting things from that. Not necessarily just being innovative. So it was much more of a consumer focussed approach than an innovation approach'* (GB6); *'...what we can really learn from is when we have users invited and if we allow them to think aloud, I usually do that ...uhm, this is when they say something that we definitely did not expect'* (SK139).

Although customer insight is used continuously throughout the product development, and seen as very important in the embedding of NQPQs, there also appears to be elaborate understanding of the limitation of this approach: *'No, we will use them (past or potential customers) very often, but we will not limit ourselves to what they have said is good. We always have to try to build on top of that'* (PGp15); *'...but ultimately the problem that you have got, even if you get very precise feedback from our customers you have got to recognise their limitations, because they will say what is nice to them. And our job is to think well that is nice today but in three years' time you might not like it any more and they have moved on'* (PGp15). The interviewee is aware of the time factor when

asking customers' opinions today knowing that a product will be launched in one to five years' time and that the context and perception is likely to have moved on. Companies are aware the customers can not articulate latent needs or give a projection of what they would like in the future.

Using customers to inform the product development process goes beyond their interaction with the product, to also include more abstract understanding of customers lives, values and emotions: *'...and understanding what their attitudes/values are and looking then at their transportation needs and wants. And then what we did was to develop several vehicle concepts so, full vehicle concepts to suit their needs. And more importantly, attitudes and emotional aspirations, so obviously that is a lot of style' (GB6); '...You know, in that sense we felt we understood a little bit about the customers but we went out and verified that with the range of people. You know the people that just drive it, the people that own it and drive it, and the people that just own it – and get all those different perspectives' (GB40); '...We had a clinic like that, with qualitative research, where we actually had people going into the homes of our customers and talking about the product for several hours and also the environment they are living in and so on' (SR144); '...Well we do a huge amount of customer research and if we are developing a new vehicle, that will go through... well we go through various phases, Very early on in the programme or even before the programme we do what we call a consumer immersion. So the engineers and the marketing brand people and the programme teams and so on will basically find out as much as they can about the customer...Decided lifestyles, method and values and so on. So they'll kick off the process potentially by spending a day or two with customers, observing how they use their vehicles, interacting with them, discussing various things with them. So that goes on in the early stage, and then we also, as we go through the actual design development process, and by that I mean the styling and appearance of the car, we hold regular clinics' (PJ28-32).*

The 'customer' is not always involved directly, as in this case where a dealer represents them: *'...Only last week I was out in Düsseldorf talking to some of the dealers. Because a good dealer can represent many, many customers, but with each one you have to understand the limitations, you have to be careful because everybody wants everything and they all want them for free. So we just have to try to balance it' (PGp5).* And sometime the customer is represented by in-house people: *'...there are some areas or occasions where we will use in-house respondents. ...if we want to do something very quickly, a small thing, we will actually run an in-house 'customer group' we call them or a virtual interaction team. Or we have got a group of...there is a database of individuals who we have measured and checked their sort of customer profiles and what have you. So if we want a particular type of consumer we can say well actually we have got 20 people on the database. We can get them to check how...an example of that was we were debating on the (product name) about the rear light design, and we had gone for a high amount of rear light for all sorts of reasons, styling reasons, improved rear light visibility reasons and so on. But there was a concern about whether that was making the rear pillar too thick and so we got our in-house*

team to do reverse parking tests and so on against competition and then we could convince ourselves that we were actually okay' (PJ100).

In two of the researched companies they are using virtual customer profiles to frame the development of the product qualities. Here it is a technical feature: '...we had a highly technical feature and we tried to create... this time it was purely ... and totally stereotyped with a lot of issues: female, very young, advanced user, male, privately employed... totally stereotyped... everyone understood them. And their names became part of the discussion we could really use them because that is not what you say but what would 'Fiona' say?' (SK58).

In all the researched car companies, customers are used in car clinics to give their viewpoint on different conceptual models. This input helps the manufacturer to understand what appeals to a potential customer: '...Maybe we'll start off with four or five initial themes. They will be taken through a research process, at the end of which we will probably narrow it down to two things. We'll know which bits of the car customers liked, which bits they don't like, what they...what they...specifically what it is that they like or dislike. We'll get into things like proportions, harmony and those kinds of aspects' (PJ32). Because NQPQs are difficult to judge and assess, a common strategy is to go to customers to get an assessment of NQPQs.

The mobile phone company does not use customers to evaluate the product during development, which has implications as are here illustrated here: '...but the trouble with these customers, they will not see the phone until after we have developed it, so we can't get them in at the beginning we can just learn from past mistakes, past things, things that they recommend we should change' (135PT). This means that the assessment of NQPQs are made by in-house people: '...But generally we have design reviews all the time, so as soon as we get the concept we bring in other designers, they have all worked in the same area and then you all just sit down and go through your design and then they tell you what they think, if they think it works...So you do get this input, because they have also heard... their product are generally out in the market ...so they have heard now what people think of them. And they can then say: "Well we have heard that this is a problem" (PT137). The customer is sometimes represented by in-house people. External field experts and dealers are also included to understand customers' relationship with product better.

Implications for NQPQs

It is clear that customers have a great influence in the embedding of NQPQs. In the early stages of product development customers are used to inform the product developers about direct desires as well as latent needs. In this way, they help the product developers to come up with NQPQs that are likely to satisfy the customer. During various stages of vehicle design, customers are used in the assessment of NQPQs.

When elaborating on the influence of customers during the design of NQPQs it becomes apparent that the customer might not always be represented in the form of an actual potential customer. It can be a car dealer or phone/network provider,

an in-house person who fits the target customer or it can be a 'virtual' customer in the shape of a hypothetical customer profile, a 'persona'. All of these representations have great strength, but also potential weaknesses. What seems to be the reasoning for selection is either to seek inspiration material, or to add a kind of outside perspective on the product, whether that is an actual potential customer or some pseudo-representative of one.

4.5.8 Theme 8 – Cost reduction

It was observed that:

- NQPQs are often degraded during cost reduction exercises
- The reported difficulty in protecting NQPQs is that the case-companies can not estimate their impact on customer satisfaction and revenue
- It is difficult to protect NQPQs during cost reduction because functional and technical QPQs are perceived as essential and NQPQs are not

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It is difficult to argue the cost of NQPQs: *'...And I can guarantee when I go and make this presentation to the people who hold the purse strings for the new project, they will say "we can not afford this, go back and quantify how much value this has to the market. How many cars will we sell more by providing this material to providing this material?" And this is where the problem starts because it is almost impossible'* (PGp3). (Underlining illustrates the interviewee's emphasis). The pressure on cost reduction is profound and it leads to the degrading of NQPQs, because it is difficult to evaluate the perceived customer value relative to their cost: *'...If you are looking to the engineers that are doing the design and so on, they are so much pressured by the cost cuttings today, and I think that if you looked within the company there is a lot people that want to achieve something by doing something, but it is not allowed to cost anything. And I think that everything does not (need to cost extra) when you talk about design and design quality, but I think if you want to do the complete picture you have to spend the money in this area...making designs that do not have too many split lines and things like that – you can do that, but that is 50% and the other 50% is more like now we got to see what surface material we are going to have. What is the jewel effect of this area ... And then you come to the tricky point; what is it allowed to cost? How do you get the balance right?' (74SR)*. These statements were common in the case-companies making vehicles, the mobile phone company do not directly state that NQPQs are under cost reduction pressures.

Cost reduction affects NQPQs harder than QPQs because QPQs are seen as fundamental and non-discretionary to the product, whereas NQPQs are seen as more discretionary: *'...I can see when we balance the cost in project now, we tend to say: "okay we can not take anything away here" and then maybe you can*

not do so much in this area (meaning technical qualities), take away things and then you come down to this area (meaning driving experience and convenience) where you can...as we call it in the spec, reduce content...or reduce materials...and things like that' (74SR).

The costs of NQPQs are often held against the added revenue value. This seems to be a logical approach, but it is assuming that the product would be purchased by the customer even if this quality were not embedded: *'...We add up all the costs and investments and we trade that off against all the revenue and the volumes and then it is basically down to discussion and negotiation as to what we can afford, what's discretionary and how discretionary is it?... the marketing guy's saying "we have to have it", and the engineer's saying "but why? – it's costing me all this money and I get nothing back for it, so why would I keep that in my programme? "' (GB20).*

NQPQs are often well understood and discussed early in the product development process, but lack financial anchoring: *'...we are sitting in a group to at least from the start be ...agree upon a certain level...that we can approach the project with, to say this is our mutual agreement that this is what we want to do ...but then of course you come into the situation when you are faced with the project, they will not know what it cost...and that of course is the tricky part, because it is not allowed to cost anything' (SR88).*

The financial backing of NQPQs is often lacking because it is difficult to argue how important it is to embed the proposed solution. Arguing that it is necessary in order to achieve an appropriate degree of product quality and as a consequence the desired customer satisfaction, seems to be difficult to prove. Numerical facts, for example lost revenue, seem to be the best way to ensure that money is allocated for NQPQs: *'...I think the project (team) as such knows it is important and as they have a limit in cost to reach, they have to do some kind of balance and that balancing is not up here (pointing at the paper), so it will be a tricky part in order to try to go to the management in order to achieve more money in order to do this. Because you need to state how important it is and when it is not measurable then you have a little problem...so I think that we have to become better in trying to communicate the consequences of not doing the right thing ...and then of course you need to know what is the right thing...and then you need to quantify that and then you communicate that and you need to have people to understand it' (SR90); *'...Yah, that is the biggest problem since we have 26 attribute areas and most of them have measurable ...areas...because you can always tell if an engine gives 200 horsepower or if braking is functioning... but what the customer sees and touches is very difficult, and a very sad thing is that, we can not preserve all this good quality surface material all the way from model start to production start, because we have cost cuttings, budgets that we do not meet and somebody has to take a decision: "okay, we have to take down the cost" and then the easiest way is to take away the material' (TB23).**

The cost cutting is such a significant issue that scheduled negotiations at a different location are necessary. And decisions about NQPQs are often taken to

the level of management who then judge their importance and cost: *'...and the biggest problem is that all the time we have these cost saving issues going on in all projects, and we also have what we call a 'war-room', it is a meeting held each four weeks in a old shelter where people who are having a task of saving cost are finding out: "oh, what if I am taking away that colour of that speaker, or make it from metal into plastic, then we could save 50 pence", and then they ask me and I say: "No you can not change the colour, because this is part of the design, and it is a feature, and you can not change it into plastic because then you will have this, and the customer will see that it is plastic and looks cheap." And if I say no they could raise this to the 'war room' and then management will come and see the balance between what we have today and what we will get and the savings. And if I am unlucky they will go for this decision for saving. And the customer will then see that next time they buy the car, there is a downgrade of the quality. It is like if you have a Swiss cheese then you take away the cheese between the holes – in the long run the customer will see the depreciation of the car' (TB105).*

A good way to embed NQPQs seems to be to embed them in a QPQ, so that you do not have to argue their existence as a QPQ: *'...But if you would like to upgrade the quality, you have to think more about rational ways to the technical side, the functional side, to preserve this quality issue' (SP250).*

At the moment NQPQs are affected by cost cutting to the same or a higher degree than QPQs, but as this interviewee pointed out they are often involved in the customer experience, and cost reduction should be designated to areas that are not as important for the customer: *'...So what I would like to do, if you have the cost of a part is this (makes a drawing), and this is 100%....maybe this 4% is what the customer sees and touches, and then let us say this is \$100 total, so instead of doing what they do now that is reduce the costs and then they say that that is only what you havebecause now we have to deliver it for \$80... so this is the surface. I would like to do the opposite that you preserve this all the time and then you have to do cost cutting here. But here they have to be more innovative, the engineers and the suppliers, and the toolmakers. So what we are discussing now with the quality staff is to have special...how do you say...earmarked areas we call them 'appearance items' so that all the parts that the customer will see' (TB100).*

Implication for NQPQs

The cost cutting of NQPQs is a big issue in the car manufacturing companies. There is no cost allocated directly to NQPQs at the beginning of a project, they are often allocated late in the project and allocated on discretionary terms. Personal belief and persuasion power is often what leads the argument because numerical evidence is difficult to produce. Management is often involved in decisions about NQPQs based on cost constraints. It is then up to individuals from the project team to argue why a certain material or manufacturing process will provide a higher degree of customer satisfaction than a cheaper alternative or even deletion of a feature. This can be difficult because degrading or deletion of one NQPQ might not have a big influence seen in isolation, but when the customer perceives the product as a whole the degrading of several NQPQs will sum up and influence customer satisfaction in a negative direction.

4.5.9 Theme 9 – Decision making and responsibility

It was observed that:

- Decisions to do with NQPQs are made during gate reviews on the basis of whether or not people feel that the NQPQs are embedded in the intended way
- The decision making process to do with NQPQs is often very dependent on the individuals involved in the team, and on the leader. Personal opinion and the ability to convince other people are important factors when making decisions about NQPQs
- It is not clear who has the responsibility for the NQPQs. In the vehicle case-companies the project manager (financial responsibility) and the Chief Project Engineer (product responsibility) are both involved in the overall responsibility, but there is no clear delegation
- The higher you are in the organisational hierarchy the less data you need to support your decision about an NQPQ
- Marketing has a big impact in the decision making process on NQPQs
- Design (department) and advanced activities groups (innovation) are often involved in the early development stages of NQPQs, but some are not represented all the way through to the manufactured product
- The Design department is in charge of designing most of the visual NQPQs, but they do not necessarily have a strong say in the decision making process
- Consensus decisions are commonly sought, but they are also believed to give bland designs/NQPQs, so the opposite is now more commonly sought across the case-companies
- One company emphasises the importance of creating a product team with the people who understand which NQPQs are important by mirroring the target customer in the choice of team.

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The stage-gate reviews represent no formal check or decision point when it comes to NQPQs. This is grounded in the lack of a well defined or measurable checklist by which they can be assessed: *'...so each week we have these reviews, and all the time it goes up and down – sometimes a material or a function is out and it could be back a month later' (TB76); '...there is a lot of different opinions, and therefore of course it could be good to have a quantifiable measurement in order to say this is facts. Let's face it now – do we make a decision or not – but when we do not have that, there is a lot of different opinions...it is tricky' (SR228).*

In the beginning NQPQs are on a list of features that are likely to go into the product, but although this might seem as if a decision is made to embed them into the product this is not the case: *'...how do you get them into the, if you like, the programme assumptions and keep them there, is a matter of convincing the people. So just following on from the previous discussion is you have got to convince the people why you need it and get the right people to be convinced to keep it in to that list of assumptions'* (GB34).

Some of the interviews show that there is ongoing process development in order to improve the process of embedding of NQPQs. Although at present the NQPQs are mainly embedded through individuals' involvement and their ability to ensure that the NQPQs are embedded in the product: *'...But it's basically down to me convincing those people and convincing them what I've done is there for good reason, why all the good reasons and to keep them in there. And then beyond the few months later it's out of my control'* (GB58). When asked about returning to check if the NQPQ is still being embedded into the product, the interviewee answers: *'...No there's no formal check. There's no formal... if you like 'role' to do that... We will individually, because personally we are interested, we will probably check back. But the formal system, the system would not necessarily create that...We put forward a proposal saying "actually, because some of these are not quantifiable", and we didn't use those words but in effect the same, there needs to be a mechanism whereby they do not get deleted without a good reason, and a good cross-functional group of people agreeing to it'* (GB60). This suggests that even NQPQs that are selected and in the process of being embedded into the product have a high risk of being deleted because some of the people involved in the early development stages are not present all the way through the product development process.

When questioned on how they know when a product is good enough to pass one gate and go into the next phase from an NQPQ point of view, one interviewee answered: *'...this basically comes from the expert's skill. We have to rely on subjective ability here. So these people that I mentioned will say "yes that is what we asked for in the product definition, this is what we think we've got. Is it adequate - is it not?" If it is it will go ahead, if it is not it will be stopped'* (PGp13). In other words some experienced people within the organisation continuously assess the product and decide if the NQPQs are there or not.

The decision-making involved in the embedding of NQPQs appears to be in the power of an individual's personal belief: *'...It is totally down to the people that are going through those discussions and trade-offs, buying into the value and the benefit of what you have developed and your idea if you like and keeping it in there. So if the top man says "No, no, I really know why that's important, I understand the customer needs, that's going to generate huge appeal and impact. I'm prepared to live with the cost" - then it will stay there. But unless you have got either some good champions or conviction within the whole project team it's going to be a subject'* (GB26).

Marketing will fight to get NQPQs into the product and will try to support this through research and other customer data: *'...The marketing community would*

be typically a community that would defend something that's something more emotional than rational that you can not get a price for or get some revenue for. And it's a matter of them being able to prove and justify based on whatever voice of the customer information they have – be it research or what have you (GB34). Marketing has a big impact on the decision making process.

In principle everyone has a right to influence the decisions towards NQPQs, but formally it helps the higher you are in the organisation: ...Formally and I think also in practice because that is the only way we can manage it - it is by reviews. And the first review... the first of these reviews there is no really formal requirement what the document is going to contain exactly and how should it be structured, but every time we have such a review in principle everyone can veto or everyone in my department can veto at least' (SK101).

Although many people have their say in the decision making process, there seems to be a belief that you need to let someone take the lead: '...we trust those people and we empower them to act and we listen to them. And we give them forums on a regular basis to discuss what it is they are trying to achieve and how they feel. And by virtue of a decision-making process and a project management process we get to the place we want to be. It is not fair to say it is designed by committee or designed by consensus because you would never get it right. You have to give somebody the lead and you have to empower them to act, you have to let them make decisions and you have to trust those decisions' (DGp6). Consensus decisions are commonly sought, but they are also believed to give bland design/NQPQs, so the opposite is now commonly sought across the case-companies.

The problems with the NQPQs in the decision making process is often the lack of 'measures' that illustrates (or better 'proves') the need for a certain feature as this quote shows: '...Yes, so when I come to a decision meeting, a balancing meeting or a cost reduction meeting, I will fight against people. I will say that: "Oh, no we can't change the weight of that because if we lose 1 kg this performance will go down" – and what I will say is: "No we can't change the material because the customer will feel the difference and they won't accept it or they will feel a down grade of the quality" and they ask how can you prove it? I can't weigh it, I can't measure it exactly – it is a subjective feeling and that is why I have to fight against everybody else' (TB133). And because the impact is difficult to measure it is not allowed to be added to the cost: '...Then you have a line organisation, with design, design quality and you have the line organisation performing the engineering side, and we are sitting in a group to at least from the start ...agree upon a certain level...that we can approach the project with, to say this is our mutual agreement that this is what we want to do ...but then of course you come into the situation when you are faced with the project, they want to know what it costs...and that of course is the tricky part, because it is not allowed to cost anything' (SR88).

Direction and decisions can be based on intuition by managers, whereas people in lower positions would have to base their viewpoint on data, even if they are specialists: '...It's totally down to the people that are going through those

discussions and trade-offs buying into the value and the benefit of what you've developed and your idea if you like and keeping it in there. So if the top man says "No, no I really know why that is important, I understand the customer needs, that is going to generate huge appeal and impact. I am prepared to live with the cost" – then it will stay there' (GB26); '...If you have a very high status you can say it does not feel right and then it gets cancelled, but the situation we are in we have to come with good arguments. We had to analyse it backwards; "what was right here and what went wrong?" – and trying to find argument for the solution we believed in. That is where the User Interface design community are good at discussing things and using ... yah, partly intelligence and partly gut feeling and if you have good collaboration with people it is no problem to have this ... but when you have to sell the solution and convince people that this is the right solution you have to have a lot of strict arguments' (SK64); '...This basically comes from the expert's skill. We have to rely on subjective ability here. So these people that I mentioned will say "Yes, that is what we asked for in the project definition, this is what we think we have got. Is it adequate – is it not?" If it is it will go ahead, if it is not it will be stopped' (PGp13).

Implications for NQPQs

Data suggest that NQPQs are embedded through the design process and checked/verified at each gate. Data also suggest the process of embedding is heavily dependent on individuals' personal perception and beliefs. Your hierarchical position influences the strength of the research you need to influence the NQPQ. If you have high position you can reject or keep in on the basis of 'gut feeling', whereas if you are lower in the organisation, you need more data to back up your argument.

It is evident from the data that senior managers are likely to be the gatekeepers when deciding on the NQPQs, but that their role may have one of two contradicting aims:

- That the senior manager judges all the viewpoints he/she gets from the product development team, and seeks to reach some sort of agreement that leads to a consensus among everyone
- That the senior manager does not represent and gather viewpoints, but steers the decisions in a specific direction in order to get a product that has a distinct set of qualities instead of a mixture of many, because it is believed that a consensus approach leads to bland design/quality

It is also evident from both the data above and other data, that the embedding of NQPQs is a matter of trial and error – that you embed them in prototypes and then assess the prototypes against one another and take the best from each. Sometimes designers have to try something in order to understand the reality of what they had previously imagined. Sometimes this works, often it does not work fully, but the designers can learn from it and hopefully get it right.

4.5.10 Theme 10 – NQPQs in updates versus new product

It was observed that:

- Visual NQPQs are important in product updates. The manufacturer wants to signal to the customer that the product has been refreshed
- The focus on NQPQs in updates only involves a small part of the product compared to when a whole new product is developed

Data

The interviewees were asked if they deal differently with the NQPQs when they do minor updates compared to when they develop a brand new product; the following answers exemplify the common replies: *'...I think with updates you probably have a bit more freedom...so you can change it a little bit how you would like it to be...you also got more time' (PT141); '...Emotionally...yah, because I mean you need to continue to sell the car and in that way you must make it more attractive emotionally. I mean you put it in a show room and somebody must go in "aha, something new has happened". And it is something new, but it is not so new' (SR198).*

The following statement gives an example of a NQPQ-focus in updates – a lighting solution, which is basically down to shape and look – the technical feature does not change: *'...Usually you are turning or you are re-balancing or you are updating. I mean the most classical facelift, if you like, a minor change to an existing vehicle will be a lighting solution...within the parameter you can do something quite dramatic and make something up to date' (DGp13).* It is common that the NQPQs focus in updates only involves a small part of the product compared to when a whole new product is developed.

The NQPQs are used to communicate renewal: *'...When we were doing a minor change (update), in my history with (brand name) we have never done a minor change without making some exterior communication, just to tell people that it's a different product (PGp16).* Visual NQPQs are important in product updates. The manufacturer wants to signal to the customer that the product has been refreshed.

Here is an example where the NQPQs are driving the overall change of product ambience through a minor update (from a hatch to a sport version of the same hatch): *'...Just to come back to the (brand name - sport version) for example. That was a minor programme by definition. But because we had a different customer group in mind, we did set the engineers different parameters. For instance we wanted the car to have a much sportier handling feel, sharper steering response and so on, so it actually has more of a warm hatch feeling to it.so there are examples for minor programmes where we can change and affect those things' (PJ87).* The understanding is that they can change the QPQs in minor updates, but what is interesting is that they do it because they want to send out a signal of being a new version (a sports car) and that is embedded in

transforming the NQPQs (for example sportier handling) into QPQs (set the engineers parameters).

Implications for NQPQs

Compared with the NQPQs embedded in new products, there seems to be a greater need to communicate change in an up-dated product and therefore a focus on visual NQPQs occurs. The embedding or redesigning of NQPQs is often concentrated on a designated area, for instance the lighting of the vehicle.

4.5.11 Theme 11 – Where interviewees think they got the NQPQs right

It was observed that:

- Successful NQPQs are often related to embedding of novel features or materials or having reached superiority in an NQPQ area compared to competitors
- An NQPQ success could also be a product feature or quality that was picked out by the media

Data

In this case a successful NQPQ is seen as a novel NQPQ feature, designed by the interviewee, that went into the product: *'...I guess the last project, we just did a mobile phone with a rubber front face...which is a very expensive way of making this and all these kind of wacky ideas... anyway we came up with this idea where you just pushed it on the front and then it clicks in. And they all went for that in the end'* (PT203). Asked to clarify if this related to the manufacturing process or what the end customer would see, the interviewee elaborated: *'...What the end customer would see and also the manufacturing process. Actually, it made it very simple, it is just a standard part. You could not say... there wasn't sort of stages we went through... it was sort of; "I think this would work, idea" and then sketched some concepts and then "yah, let us go for that"'* (PT205). It appears that the NQPQs – the tactile feel of rubber, went into the product because it was embedded into a necessary functional part, the keypad. This meant that there was no need to fight to get the NQPQ embedded into the product, it came as a sub-quality of a part that was seen as a fundamental part. This example is similar to what other interviewees from other case-companies have answered. Successful NQPQs do often have an aspect of novelty, either a novel feature, choice of material or embedding an NQPQ as an extra quality to a QPQ, which is often what leads to (an NQPQ) superiority compared to competitors.

An example of a whole product that is seen as successful in terms of NQPQs: *'...I think the one product you can look at today which is new and succeeding violently is (model name). And (model name) as a product is almost in a (model name) brand, is actually almost suppressing the (case-company) brand. So as a product – (product name) and there is a whole series of features within (product*

name) that actually are non-quantifiable successes' (PGp14). And two examples of a successful NQPQs at the feature level: '...Historically we have had a few successes around things such as the (model name) – the original (brand name) had a pen holder in it, and it was one of the first European cars that had a pen holder. But that was obvious. It was not a pen holder stuck in the back of somewhere else but it was right in front of you. Okay, most pens did not fit in it, you had to have a slim pen rather than a fat pen, but you know, we got a lot of media review from it and a lot of customer feedback. And then other things on a similar sort of smallish scale, I would say that's something that, again, it's something you need to have lived with a (model name) to realise the benefit is the heated front screen. And that is actually innovation – that is taking a technology from a different industry, aviation and aerospace, applying it to a car – because why would it...in fact it is probably as important in a car. And we have had it patented for a long time so other people could not actually do it' (GB107).

Often what has been received well in the media is what the companies refer to when describing successful embedding of an NQPQ: *'...I think the whole area of driving dynamics we have got right. I mean you pick up any magazine, read any road test of pretty well any car that we have built and you will find comments about the excellence of the driving dynamics' (JP102); ...The Press wrote: "The most highly rated characteristic is the car's interior, with its centre console...the console expresses exclusivity, simplicity and space... Very neat, very futuristic"* (WBp55). Data from all the case-companies suggest that what the media highlight as good and bad quality in the product, has a profound effect on what the interviewee/company perceive as a success. This is much more significant for NQPQs, as QPQs would have been numerically benchmarked against competitors and a media reaction easier to foresee.

Implications for NQPQs

The data show that the researched companies find it difficult to predict what will be a successful NQPQ. The variety of how they judge an NQPQ's success explains a great deal about what they are striving for and how. Their understanding of success is related to innovation (trying something new), high sales figures, what customers have commented positively on in past products or NQPQs that enforced the brand. Reactions by the media are also very important in judging if a product has succeeded in terms of NQPQs.

4.5.12 Theme 12 – Where the interviewees think they got the NQPQs wrong

It was observed that:

- NQPQs have led to dissatisfaction where the product in use has failed to support cultural application
- NQPQs have led to dissatisfaction where price has not cognitively resonated with the qualities embedded in the product. Often NQPQs are misrepresenting or are not matching the QPQs.

Data

One interviewee describes how the protective tape that covers the screen of a mobile phone when you buy it, remains a part of the product for some customers. In Asia there is a tendency to leave this protective transparent tape on the screen, but because the tape is just designed to protect the screen until the customer gets the phone, it is not especially customised to fit the curvy screen in this example, leaving the protective tape to go over the edges of the phone and leaving air bobble between the screen and the tape: *'...but you have this protective tape. Actually, when you buy a phone you just take that off and you got a phone. But in Japan they keep it on, so with this shape it would come up slightly on the side and ...so you feedback have any bubbles and you can not have anything...so we wanted to keep it smooth so we could put this down and there would be no bubbles so they could use it'* (PT317). In this case the customised use in one market meant that the design of an NQPQ had to be seen in the light of regional use. Luckily this was detected at an early stage, when the product was still being designed.

Here is an example of where an NQPQ has been embedded through QPQs, but failed to deliver what the customer expected. The NQPQ is 'the freedom to access the internet from your pocket', but in reality this access is limited. The translation from NQPQ into a QPQ has failed to capture customers' expectations about what 'access to the internet' means. Customers' understanding of the internet is based on experiences with a PC and when a smaller device fails to give the same degree of access they are left dissatisfied: *'...I guess WAP (Wireless Application Protocol) is the ultimate example – mobile Internet in your pocket. It was heavily marketed and got a lot of media attention and everyone thought it was the future... and then... technologically it was not that advanced, but that was not really... the use cases and what people could really use it for were very different from what was expected'* (SK41).

The link between perceived quality by the user and product price is often mismatched: *'...Where the economics of design's aspiration and the economics of actually building a car at set volumes at agreed price, does not meet the customer market price expectation. And that price, volume, margin mix is usually where it goes wrong'* (PGp15); *'...Generally it is where we have been limited on cost, so it is maybe not something that we have said "yes that will be brilliant" and it has turned out rubbish. It is normally because we have said okay that will be adequate and actually it is not'* (PGp22).

An example of where the product quality was acceptable in numerical terms, but failed to satisfy the customers because the appearance (an NQPQ) did not satisfy the customer: *'...Since it was launched it became apparent that the door mirrors were too small. People found that they were not actually very big...and one of the things they have done is changed the mirrors to be bigger. And that is an interesting example because the original mirror design must have met our vision requirements and our other design requirements because otherwise we would not have done it... so there is a non-quantifiable on a very rational functional component... Whether they could see any more with a bigger mirror or not is*

probably not actually what they are complaining about – there is a perception – big car needs big mirrors’ (GB115-117).

Sometimes good NQPQs fail because they are not suited for all global markets: *‘...It is on most of the electrical equipment, where we had earlier on all buttons we had a soft feeling, it was a soft paint that made it good to touch, almost like this rubberised ...but there was some technical problems with that paint so in warm and humid area it felt like chewing gum, so now that is taken away and that give more plastic feeling of the all the buttons and rotary knobs’ (TB179).* In this case inadequate execution of an NQPQ resulted in its being taken out of future products because it was not engineered to be sustained in a hot climate.

Implications for NQPQs

Interviewees were asked to give examples of when they thought they had got the NQPQs wrong. The question was kept open, leaving it up to the interviewees to define ‘wrong’. All the interviewees answered with examples where NQPQs have failed to meet customers’ cultural or personal expectations to a satisfactory level. Some of these insights became apparent during the product development process, while testing products before production, others were learned through customers’ complaints.

A more general problem seems to be where the customer expects a higher level of NQPQ compared to the price. Often the product development team will have to compromise on the execution of an NQPQ due to cost constraints, knowing that it might merely satisfy the customer, but in fact the customer is dissatisfied.

4.6 Chapter conclusion

This chapter has presented the analysis and findings from the exploratory stage of the research. The analysis is based on data collected from five case-companies, through 25 semi-structured interviews covering a range of actors involved in product development inside large companies making consumer products.

This created a rich data set which was analysed thematically, with the resulting twelve themes contain 56 initial findings. These themes and findings are used to guide the second stage of the research, which is described in Chapter 5.

Some of the interesting findings include the observations:

- that the standard stage-gate process is used in all case-companies, but the process is ill-suited to handling NQPQs;
- that many NQPQs are regularly transformed into QPQs;
- that people involved in product development are aware of the importance of NQPQs to a successful product;
- that there is a lack of clarity of process and responsibility for ensuring that these important qualities are brought into the product;

- that customers are purposefully used to inspire the creation of NQPQs, and then as assessors of product qualities;
- that NQPQs are particularly prone to being deleted, especially during cost-reduction exercises.

4.7 Summary of findings from the exploratory stage

Theme 1 – The product development process of embedding NQPQs

- Stage-gate process is used in all the researched companies
- Integrated product development forms the basis of the product development process
- Embedding of NQPQs is happening throughout every part of the stage-gate process
- Assessment of NQPQs is often subjective and based on selection among alternatives
- The design of NQPQs is usually initiated by a brief or product specification
- All the case-companies use a set of comparative benchmark products to form the primary basis for the product quality
- Sketching and models are often used to communicate NQPQs that are difficult to describe verbally
- NQPQs are designed through an iterative process of selection and development
- It is common that NQPQs are discretionary – there is no system to ensure that they are in the product
- Estimated revenue influences the embedding of NQPQs in vehicles
- Managers' judgement can have a big influence on the NQPQs
- Benchmarking informs judgement of product qualities
- Customers are sometimes invited to judge NQPQs at various design stages
- In one case-company a separate group had specific responsibility to monitor and judge NQPQs embedded throughout the product development process

Theme 2 – Specification of NQPQs

- NQPQs are commonly not clearly translated from design intent (the brief) to product specification (plan for fulfilment of intent)

- NQPQs are often described in terms of an emotional response in the customer, and remain at this level throughout the product development process without reliable translation into product characteristics
- Lack of objective specification of NQPQs can lead individuals to interpret the product objectives
- NQPQs are often developed as a part of a QPQ, being the additional and discretionary qualities of a well-defined non-discretionary QPQ

Theme 3 – Translation of NQPQs into QPQs

- NQPQs are commonly transferred into more quantifiable measures wherever possible
- Turning NQPQs into measurables is often done by: 1) quantifying the physical product quality/characteristic, or 2) measuring response in a potential customer or expert
- Transformation of NQPQs (into more quantifiable measures) occurs through the use of benchmarks, tests, index systems and numerical targets
- Some NQPQs are kept consistent across products through the use of rules or guidelines – these are often enforced to ensure consistent product identity (brand) and usability
- Perceived product quality (by customers) is sought by product developers to aid the justification of NQPQs, such as specific features, material choice or product appearance

Theme 4 – Organisational awareness of NQPQs

- Companies are conscious that NQPQs exist in the product and that they have the responsibility to embed them in the product
- Companies focus on NQPQs from a customer point of view as well as how they as an organisation can manage to embed NQPQs
- Companies understand NQPQs in many different ways. For example, how time changes NQPQs, NQPQs from a customer viewpoint, how NQPQs link to the brand etc.
- Many interviewees commented that trying new techniques (such as using customer profiles, product clinics or building scenarios) has helped them understand what NQPQs mean to customers, how they can justify them financially and embed them
- All the interviewees had an elaborate awareness of NQPQs and their importance in the product. They could also give examples of people within the organisation that they felt did not have such an awareness

Theme 5 – Forum for discussing NQPQs

- The understanding and embedding of NQPQs are becoming more prominent in the discussions between people involved in the product development
- NQPQs are discussed formally and informally in the case-companies
- Discussions about NQPQs happen in direct relation to the product under development and in more abstract conversations

Theme 6 – Influence of perception and experiences of NQPQs

- There is a learned consciousness of what people understand as good quality in NQPQs based on their experiences
- Customised NQPQs exist for different global markets

Theme 7 – Customer insight

- Companies show increasing interest in understanding customers' needs and desires in products. Companies try to understand what NQPQs customers value
- All the researched companies have extensive market and customer research
- NQPQs are difficult to judge and assess. A common strategy is to go to customers to get an assessment of NQPQs
- The customer is sometimes represented by in-house people. External field experts and dealers are also included to better understand customers' relationships with product
- Companies are aware that customers can not articulate latent needs or give a projection of what they would like in the future

Theme 8 – Cost reduction

- NQPQs are often degraded during cost reduction exercises
- The reported difficulty in protecting NQPQs is that the case-companies can not estimate their impact on customer satisfaction and revenue
- It is difficult to protect NQPQs during cost reduction because functional and technical QPQs are perceived as essential and NQPQs are not

Theme 9 – Decision making and responsibility

- Decisions to do with NQPQs are made during gate reviews on the basis of whether or not people feel that the NQPQs are embedded in the intended way

- The decision making process to do with NQPQs is often very dependent on the individuals involved in the team, and on the leader. Personal opinion and the ability to convince other people are important factors when making decisions about NQPQs
- It is not clear who has the responsibility for NQPQs. In the vehicle case-companies the project manager (financial responsibility) and the Chief Project Engineer (product responsibility) are both involved in the overall responsibility, but there is no clear delegation
- The higher you are in the organisational hierarchy the less data you need to support your decision about an NQPQ
- Marketing has a big impact in the decision making process on NQPQs
- Design (department) and advanced activities groups (innovation) are often involved in the early development stages of NQPQs, but some are not represented all the way through to the manufactured product
- The Design department is in charge of designing most of the visual NQPQs, but they do not necessarily have a strong say in the decision making process
- Consensus decisions are commonly sought, but they are also believed to give bland design/NQPQs, so the opposite is now commonly sought across the case-companies
- One company emphasises the importance of creating a product team with the people who understand which NQPQs are important by mirroring the target customer in the choice of team

Theme 10 – NQPQs in updates versus new product

- Visual NQPQs are important in product updates. The manufacturer wants to signal to the customer that the product has been refreshed
- The focus on NQPQs in updates only involves a small part of the product compared to when a whole new product is developed

Theme 11 – Where the interviewees think they got the NQPQs right

- Successful NQPQs are often related to the embedding of novel features or materials or having reached superiority in an NQPQ area compared to competitors
- A NQPQ success could also be a product feature or quality that was picked out by the media

Theme 12 – Where the interviewees think they got the NQPQs wrong

- NQPQs have led to dissatisfaction where the product in use has failed to support cultural application

- NQPQs have led to dissatisfaction where price has not cognitively resonated with the qualities embedded in the product. Often NQPQs are misrepresenting or are not matching the QPQs

Chapter 5

Descriptive stage

This chapter presents the second stage of the research. Based on the themes found in chapter 4 new data are added and literature enfolded in the discussion under each theme.

5.0 Chapter structure

This chapter presents data from the descriptive stage of the research. In this stage further interviews, observation and documents were collected in three of the case-companies that had already participated in the exploratory stage. Section 5.1 elaborates on the objectives for the descriptive stage and briefly summarises the methodological approach designed in chapter 3. Section 5.2 describes the aims and reasoning behind sampling of data sources and how data were analysed. Section 5.3 describes how some of the themes from the exploratory stage are merged and broadened as a result of the new data, leading to 7 themes being presented in this chapter. Section 5.4 presents new data for the 7 themes and discusses how these findings compare with existing literature. Section 5.5 summarises and concludes what the findings from this stage tell us about the process of embedding Non-Quantifiable Product Qualities (NQPQs) in consumer products.

5.1 Objectives and methodological consideration for the descriptive stage

The objective of this stage was to gather new data in order to elaborate on the findings from the exploratory stage and to ensure that they are valid. In the exploratory stage the themes were derived out of the data – using an inductive process i.e. going from specific observations to more generic patterns or findings. This descriptive stage of the research takes the findings from the exploratory stage and seeks new data to confirm, reject or add new details to them. This stage will also look for data that fall outside any of the existing themes to see if something of importance to the process of embedding NQPQs has been missed in the first stage of the research. Whereas the objective in the first stage of the

research was to be open and explore the potential avenues in answering the research question, this stage is, in comparison, more descriptive, seeking to elaborate and expand on previous findings and thereby ensuring that they remain valid or if not, find out what new data can add towards answering the research question.

5.2 Data collection and analysis in the descriptive stage

Interviews, observations and document analysis were used in the descriptive stage. These different types of data were sought in order to allow triangulation and thereby enhance research quality. The following data were collected in the three case-companies. The naming refers to the same companies that participated in the first stage of the research, as described in section 4.2.1.

5.2.1 Data collection in case-company A

The aim was to gain in-depth insight into the process of embedding NQPQs in one organisation. This was sought through 20 interviews with employees from company A who were interviewed one-to-one lasting 1-1 ½ hours. The reason for doing so many interviews in one company was to gain a broad insight into one organisation's understanding and process of embedding NQPQs. The selection of employees that were interviewed came from marketing, product planning, pre-programme activities, R&D, quality assurance, Chief Project Engineers (CPE), programme leaders, industrial designers and engineers. In some instances the people had worked on the same development project, but most commonly they would not refer to specific cases, but answering in a more generic manner from their experiences.

A series of documents and a generic process chart that follows the product through the different stages were also collected and analysed (approximately 150 pages). In a few instances the researcher referred to these documents during interviews to seek further insight or clarification of their role in the product development process and links to NQPQs in particular.

Since the researcher spent a considerable amount of time in case-company A, a desk and PC were made available in an R&D section. Here time was spent between interviews going through documents, intranet sites etc. Spending time in the working environment gave the researcher the opportunity to observe the company culture and to have more informal conversations with various employees. On occasion more informal conversations would be recorded afterwards and be incorporated in the data set.

5.2.2 Data collection in case-company B

The researcher spent two weeks observing and interviewing in case-company B. The design department was approached because it plays a big part in the development of NQPQs that the customers are meant to perceive. The researcher had a desk centrally in the open-plan design department throughout the two weeks spent in the organisation. Here the researcher could observe and listen to daily conversation between employees concerning design including NQPQs. Because the researcher was based in the design department informal conversation about NQPQs and their embedding occurred naturally. The researcher would often approach or be approached by employees in the design department. When that happened a brief introduction to the research topic and the reasoning behind the placement was given before any further conversation was instigated. This ensured that the employee would understand the role of the researcher and make them aware that confidentiality concerns were cleared. During the time spent in case-company B more formal interviews were conducted with eight people outside the design department. The criteria for selection were people that had an impact on NQPQ development, selection and quality assurance, hence people from the Engineering department, Quality department, CAD/3-D designers, Chief Project Engineers and Chief Programme leaders were interviewed.

One document reporting on product development progress meetings, where different functional groups coordinate their activities, were added to the data from this case-company.

5.2.3 Data collection in case-company C

The aim of this data collection was to gain insight into the processes and functions of one specialist group on the embedding of NQPQs in case-company C. This group solely focusses on what they define as Perceived Quality by the customer. The purpose of this functional group is to follow and ensure appropriate embedding of product qualities that the customer will be likely to perceive. The group follows the product from concept stage all the way through to launch and the 6 month post-launch evaluation from the perspective of perceived quality. Perceived quality is the result of customers' reactions to all the product qualities, including NQPQs.

The researcher mapped and questioned the various roles, responsibilities and reasoning behind decisions made by this group throughout the product development process in case-company C, centred on their stage-gate process and NQPQs. This group plays a big role in how case-company C understands, breaks down, communicates and polices NQPQs, and the objective was to gain deeper insight into this process based on the first interview with the leader of this group from the exploratory stage. This was done through four recorded conversations with the group leader of Perceived Quality over five months resulting in more than eight hours of recorded interview data.

5.2.4 Data analysis

All interviews were centred around NQPQs, but the format remained more like a conversation than a semi-structured interview. Based on a brief introduction to the research project and why they had been selected for an interview, the interviewees were prompted by a few questions based on the findings from the exploratory stage to seek their reaction, and to gain insight into their understanding of NQPQs and how they perceived the process of getting them embedded into the product. Additional prompts were often centred on who-, why-, when-, what- and how-questions.

Although this descriptive stage sought to confirm or reject the theme findings from the exploratory stage, in practice, it mainly acted to confirm the findings by adding much more elaborate detail about the process of embedding NQPQs.

The data analysis was done by the researcher listening through the new interviews while having a document open on the computer to note down quotes that confirmed, rejected or added details to a theme from the exploratory stage. A table with the existing findings in rows and columns to confirm, reject or add detail made it easier to ensure transparency and structure during data analysis. Often a quote would be placed in more than one theme. New and interesting quotes would be grouped as 'wildcards' in a separate group. This group would later be analysed in order to see if they constituted patterns or the emergence of a new theme. Similarly the researcher's notes, taken during the observational periods, were analysed to see if they added detail, confirmed or rejected previous findings or if there seemed to be new themes emerging when compared to the interviews.

The document analysis was centred on the format by which NQPQs are communicated in the case-companies, and to see if this stayed consistent throughout the series of documents that followed the stage-gate process. These documents also confirmed and added new details to existing themes by illustrating how their embedding is documented (or not) in a tangible format, rather than how the embedding is described by the interviewees when prompted by the researcher.

5.3 Presenting new findings

For each theme new data are discussed and to conclude if they confirm/reject previous findings. New details will be illustrated and discussed. The findings based on data will then be held against existing literature to check if other authors have previously said something similar or different and what that means for conclusions of the theme findings.

During the data analysis it became clear that some of the themes carried over from the exploratory stage would benefit from being merged, as the new data

confirmed interconnection to a degree where analysis could not be done with the themes remaining separate.

As a consequence of the new data four themes from the exploratory stage were merged into two: theme 1 – ‘The product development process of embedding NQPQs’ was merged with theme 2 – ‘Specification of NQPQs’ and theme 4 – ‘Organisational awareness of NQPQ’ was merged with theme 5 – ‘Forum for discussing NQPQs’. Theme 6 – ‘Influence of perception and experience of NQPQs’ was left out in this stage because it was seen as too generic. During the data analysis of the ‘wildcards’ it became clear that a new theme was emerging. This led to a theme about how NQPQs are communicated, which will be presented last in this chapter.

Figure 5.1 illustrates how the nine themes from the exploratory stage were merged into seven themes during the descriptive stage.

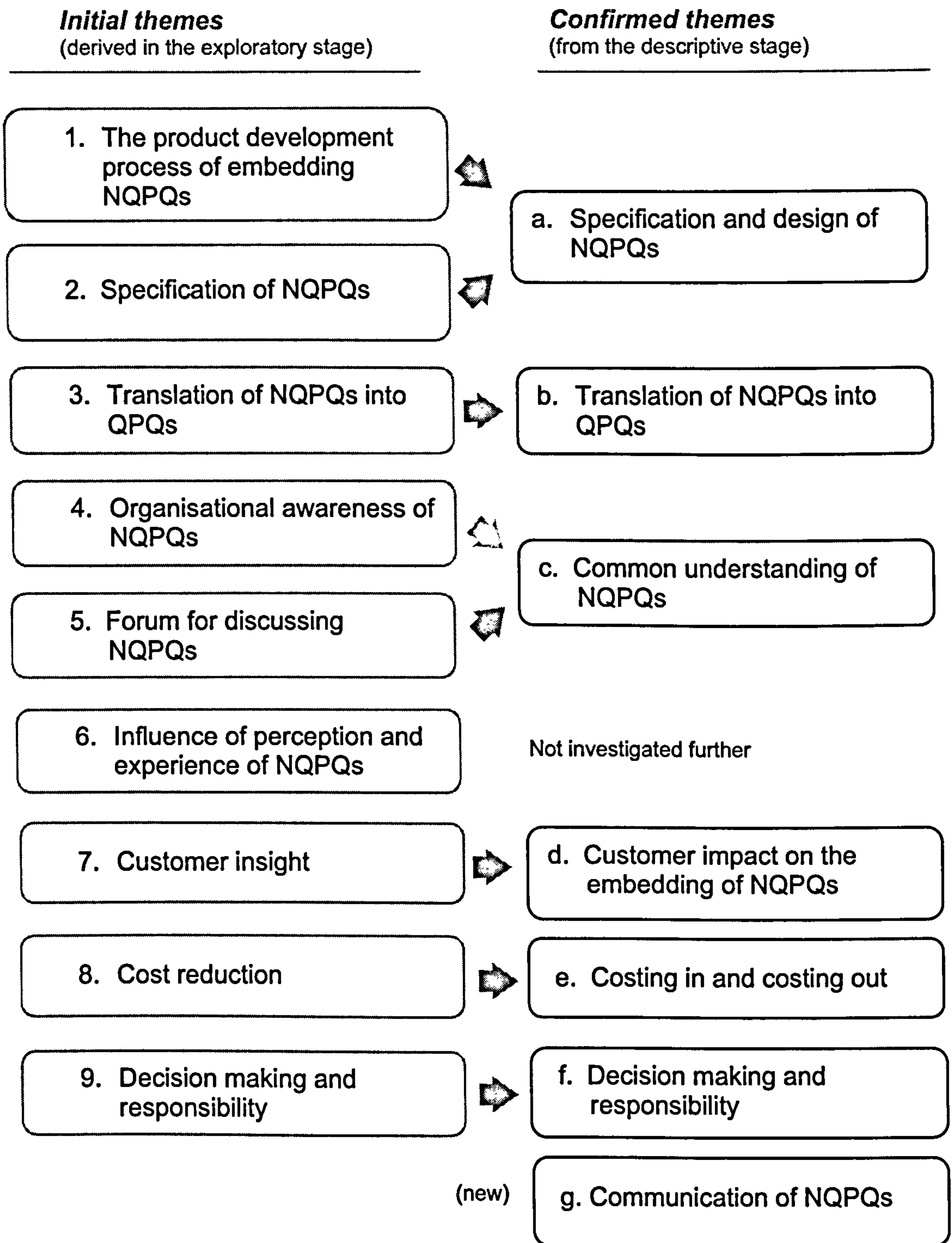


Figure 5.1 Regrouping of themes from the exploratory stage to the descriptive stage.

5.4 Findings from the descriptive stage

This section presents new data for the seven themes and discusses how these findings compare with existing literature.

List of confirmed themes after descriptive data analysis:

- a. Specification and design of NQPQs
- b. Translation of NQPQs into QPQs
- c. Common understanding of NQPQs
- d. Customer impact in the embedding of NQPQs
- e. Costing in and costing out
- f. Decision making and responsibility
- g. Communication of NQPQs

5.4.1 Theme a – Specification and design of NQPQs

This section will elaborate on two closely related themes that emerged from the exploratory data findings, presented in chapter 4; the product development process of embedding NQPQs (theme 1) and specification of NQPQs (theme 2), which will be presented here under the heading called Specification and Design of NQPQs. They are presented together as one theme, because through the descriptive stage they became more intertwined.

This theme is broken down into four parts. The first part elaborates on how the embedding NQPQs fits into the stage-gate process. The second part elaborates on the briefing and specification process of NQPQs. The third part presents a model of the development phases NQPQs go through and the fourth part discusses the risk of losing NQPQs at handovers. In each part new data from the descriptive stage will be added and literature enfolded.

The stage-gate process

In the exploratory stage it was found that all the case-companies used traditional stage-gate methods to manage the product development process and that NQPQs follow this process in the main. In the descriptive stage this was investigated further as to how NQPQs are affected by being managed through the stage-gate process.

The stage-gate process is commonly used because it is an effective and efficient way to manage the product development process. The stage-gate process provides a sequential process consisting of several stages of development. The 'gates' are quality reviews, where progress is assessed against defined targets. The gate reviews will only allow through products that meet the necessary targets (Baxter, 1995). This process ensures that the product does not go from one development phase to the next before they have reached a targeted level of

development. This provides a high probability of quality assurance in the final product. In the (theoretical) stage-gate process everything seems to follow a linear and logical evolution with no risk of losing any information, design intent or product understanding.

A crucial element of the stage-gate process is to define the product quality target in objectives terms, so that it can be checked at the end of a stage to ensure the target has been fulfilled as intended. This is, for example, what happens when product qualities are broken down to sub-qualities and are specified in numerical terms.

This is where there is a difference between QPQs and NQPQs. The stage-gate system is good at ensuring the procurement of QPQs, whereas NQPQs, which can not be translated into objective definitions or measures, are at risk of being insufficiently managed and embedded. Product qualities that can be turned into quantifiables (QPQs) do not appear to be at such risk, because they are defined early in the process. They remain tangible, measurable and assessable throughout the stage-gate process. This is, for instance, evident in the documentation that follows the stage-gate process. In the early phase the NQPQs are often presented in documents as descriptions of intended customer reactions or how the product should be benchmarked against competitor products, whereas QPQs will be presented as a stated (often numerical) fact or, in rare cases, within a spectrum of maximum-minimum wherein a decision needs to be made (for instance the range of horsepower needed in a passenger car to satisfy customer expectations). NQPQs that are not translated into numerical targets early in the product development are at risk, as the gate review focuses on the fulfilment of numerical targets.

- The embedding of NQPQs follows the general stage-gate process
- The stage-gate system is good at ensuring the procurement of QPQs, whereas NQPQs, that can not be translated into objective definitions or measures are at risk of being insufficiently managed or embedded
- NQPQs that are not translated into numerical targets early in the product development are at risk, as the gate review focuses on the fulfilment of numerical targets.

New findings/new details

As described in the literature (e.g. Cooper, 1986; Baxter, 1995), the stage-gate process needs statements of targets in order to measure progress against those targets. Furthermore, those targets tend to be broken down into sub-targets (often part related) and tend to be made numerical. Snelder & Schoormans (2004) describe how relating even the most abstract attributes such as 'elegant appearance' (a NQPQ) to concrete attributes might be a helpful way to ensure that the abstract attribute is built into the product.

This research confirms that the stage gate system is used to manage all product qualities (no matter how unhelpful that may be) and that even abstract qualities are translated into concrete. The research has shown that those NQPQs that are not translated into QPQs early in the product development process are at risk, as they otherwise might not be monitored through the gate-stage process.

Snelder & Schoormans (2004: 804) also state that breaking down abstract product attributes to concrete attributes companies might be a limitation because: *'it reduces the meaning that abstract attributes can have for consumers'*. This research supports this statement by confirming that NQPQs that can not be translated into objective definitions or measures are at risk of being insufficiently managed or embedded.

New findings or added details to existing finding

- The embedding of NQPQs follows the general stage-gate process
- The stage-gate system is good at ensuring the procurement of QPQs, whereas NQPQs, that can not be translated into objective definitions or measures, are at risk of being insufficiently managed or embedded
- NQPQs that are not translated into numerical targets early in the product development are at risk, as the gate review focus on the fulfilment of numerical targets

Confirmation of findings

- Stage-gate process is used by all the researched companies
- Integrated product development forms the basis of the product development process
- Embedding of NQPQs is happening throughout every part of the stage-gate process
- Assessment of NQPQs is often subjective and based on selection among alternatives
- It is common for NQPQs to be discretionary – there is no system to ensure that they are in the product

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

The briefing and specification process of NQPQs

The findings from the exploratory stage regarding the embedding of NQPQs in the product specification, were all confirmed in the descriptive stage, and new

details were added. There seems to be a broad interpretation of what is understood by the process of requesting and breaking down product qualities in the product development process. Words like the 'brief', 'specification' or 'spec' are used frequently, but alternative terminology is also used like 'the business case', or 'list of product assumptions' is used to describe where product qualities are defined verbally. There seems to be a tendency to understand the brief as the initial description of the product offering to the customer, also sometimes called the 'design intent'. This is the closest we get to a description of customer satisfaction. Here NQPQs are often described by the emotional response that is sought in the customer. For instance they must be perceived as being novel or technically innovative, fun to drive, easy to use etc. The brief might have some specification of how this is sought through quantifiable measures, but is usually mainly non-quantifiable in its character. This leads to the development of a more specific description of the product qualities that product developers are seeking to embed, called the specification or the spec. The specification is often referred to as a document that defines the features that product developers are planning to embed, commonly described in a format where quantifiable measures are dominant. The specification is sometimes also referred to as the product requirements, referring to the technical fulfilment of customer request /requirement.

The difference between a brief and a specification seems to be determined by the degree of detailing rather than their being by two different types of document and the transition from brief to specification can appear gradually. The brief is seen as the overall product intent and description of key characteristics whereas the specification is a list of specified product entities that can be used to construct the product.

The product brief and specification are important documents that follow the product, as a kind of recipe for what should go into the product. In the descriptive stage it was found that the case-companies do not seem to have a clear definition of what a product brief and the specification contain in terms of NQPQs. The transformation from brief to specification seems blurred. Some NQPQs are not translated into a specific quality, feature, material or manufacturing process when other product qualities are being defined, and they might remain in the initial brief and not be translated into the specification. The specification is then, for instance, given to the engineering department as they tend to work towards embedding objective (or numerical) product qualities. Hence the design department and the engineering department might not have the same understanding of the product they are trying to build together. The common understanding in the case-companies is that if you want an engineer to design something you have to give him something to design to, hence a breakdown of numerical product requirements. He then builds his solution by solving each element of the specification and then adding these parts together towards a whole.

- The blurring between product brief (business case, design intent) and product specification (fulfilment of brief mostly in QPQs) means that NQPQs go missing

New findings/new details

The observed dis-connection between the brief and the specification seems to be a source of much confusion. The product development literature can be indistinct, with help coming from some authors, such as Pugh (1991) who suggest that the brief explains ‘what’ the product should be and the specification explains the technical characteristics that will achieve this, which he calls the ‘how’. Often this means that major architectural decisions have been made and hence the specification also embodies an element of describing ‘how’ the product should be. This separation of ‘what’ and ‘how’ is also seen in one of the tools most written about – Quality Function Deployment (QFD) (Trott, 2002; Clausing, 1994; Sullivan, 1986) where the first ‘House of Quality’ maps customer needs with technical requirements.

This research has observed some of the impacts that the lack of clarity can bring to the real-life practice of product development. Firstly, there is little reference to the methods for obtaining the understanding of the user needs (the ‘what’). According to Engelbrektsson (2000) *‘Although the need for methods for elicitation of customer requirements in the early phases of products development process is apparent, and many different methods or approaches have been proposed, very little systematic and comparative research has been done that evaluates different approaches [...] The elicitation of customer needs and requirements are generally not included or is only vaguely described in the product development literature (e.g. Andreasen & Hein, 2000, Ulrich & Eppinger 1995)’*. The marketing literature would counter this, but for those practitioners involved in product development the functional division is telling: the brief seems to be a multi-disciplinary document, where the whole team is trying to understand the product intent. Then marketing are left to fill in the detail of the needs. Only after this do engineering and design re-join the process by offering solutions and technical specifications.

In the case-companies it was not clear, in any of them, where the specification came from and how it was built. In some descriptions it was clear that marketing were driving the process by suggesting precise specification content (they would argue that the car must have a certain feature or performance). But the process of product development continued while marketing were gathering their data, so the specification was dominated by technical requirements driven from suggested solutions. An example of this confusion: *‘...so management comes to us and say we want something uplifting. And for 6 month I hated the word, because everything had to be uplifted, there was no question mark....I remember giving a 30 slide presentation, and by slide 15 I had got the word on all 15 of them! And I just thought there’s got to be another way....in the search for uplifting we just brought everything together; leather ...seat on cars, what is it you want; do you want it warm? Do you want it ventilated and cool? What is it*

that you define uplifting So then marketing looked at these things, some of them, to me they are actually quite uplifting, but they never responded to them. Now we are beginning to expose them to the public and the public have responded: I kind of like that. So we have had to go back to management. You know that scratch resistant paint that you never really cared about – they loved it' (JK031). For NQPQs this confusion of process and responsibilities is compounded by the intangible nature of the product qualities being dealt with. In the case-companies this was observed to put NQPQs at great risk of going missing.

This process of breaking NQPQs down to individual well-defined measurable elements is common practice, with tools such as QFD or Kansei Engineering (Ishihara et al., 1995; Nagamashi, 1995) being proposed to help maintain the fidelity of the translation from 'what' to 'how'. Though the case-companies were aware of these techniques they were not using them. From the interviews the need for some type of tool or procedure was clear, which raises a question over why the case-companies were not using the tools. The interviewees expressed concerns over two aspects of QFD: firstly that the translation process from 'what' to 'how' is not clearly described, it leaves this to the product developers (neither does it offer advice on how to obtain or check the customer needs), therefore the problem is simply not solved. The second issue this author refers to as a lack of confidence in commutation – that it is believed that even if it was possible to deliver a product design that fully met all the technical requirements of QFD level 0, that it was still possible to disappoint the customer. It seems that because the translation from 'need' to 'technical requirement' is not clearly mapped, then the reverse process can not be trusted fully either. In the case-companies that was apparent in all of the described projects – in practice this means that chief engineers (or similar high-level decision-makers) have the personal responsibility to decide that the complete list of technical requirements matches the complete list of customer needs.

For some product qualities this translation seems simple, even trivial, 'reliable' can be translated as '0.3% customer breakdowns in 2 years ownership' for example. But when the customer needs a 'safe' car and that is translated as 'the car must have 12 air-bags' the translation becomes complex. 'Safety', and especially the customer feeling of being safe, is more complex than counting air-bags. Kansei Engineering is unusual as a technique in being proposed as an organised method for creating this mapping. Kansei Engineering uses statistical analysis of customer reactions to find latent relations between design and feelings (Ishihara et al., 1995). It is through statistical analysis that selection of product qualities is made. The case-companies did not use these or any similar techniques however – though the data does not fully explain the reasons for not using such techniques, the issue of lack of confidence in the commutation also exists for Kansei Engineering. There seems to be little evidence for the fidelity of the technique.

These issues of poor process of translation from 'what' to 'how' and lack of confidence in that commutation are exaggerated for those qualities that are not

quantifiable. The case-companies simply ignored any tools and relied on individual experience and negotiation.

The stage-gate, QFD and Kansei Engineering methods all start out with the customer requirement (Baxter, 1995), they are popular in the literature, but less so in practice, and were not observed in the case-companies. It seems that fulfilling all customer requirements is not the same as making a product that will satisfy the customer.

- The stage-gate, QFD and Kansei all have an implicit assumption that:
 - 1) the desired product quality is already contained in a statement of customer requirement
 - 2) the requirement can be broken down into technical specification (numerical language)
 - 3) the delivery of the technical (often numerical) targets will result in a satisfied customer.

New findings/new details

New findings or added details to existing finding

- The blurring between product brief (business case, design intent) and product specification (fulfilment of brief mostly in QPQs) means that NQPQs go missing
- The stage-gate, QFD and Kansei all have an implicit assumption that:
 - 1) the desired product quality is already contained in a statement of customer requirement
 - 2) the requirement can be broken down into technical specification (numerical language)
 - 3) the delivery of the technical (often numerical) targets will result in a satisfied customer.

Confirmation of findings

- The design of NQPQs are usually initiated by a brief or product specification
- All case companies use a set of comparative benchmark products to form the primary basis for the product
- Sketching and models are often used to communicate NQPQs that are difficult to describe verbally
- NQPQs are designed through an iterative process of selection and development

- NQPQs are commonly not clearly translated from design intent (the brief) to product specification (plan for fulfilment of intent)
- NQPQs are often described in terms of an emotional response in the customer, and remain at this level throughout the product development process without no reliable translation into product characteristics
- Lack of objective specification of NQPQs leads individuals to interpret the product objectives
- NQPQs are often developed as a part of a QPQ, being the additional and discretionary qualities of a well-defined non-discretionary QPQ

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

Development phases through which NQPQs go

This section will look closer at what happens to NQPQs that can not be translated into quantifiables.

NQPQs go through different phases within the state-gate process compared to QPQs. All interviewees referred to phases and activities in the stage-gate process when they were describing the design and embedding of NQPQs, even though the stage-gate process does not directly support the embedding of NQPQs. The phases NQPQs go through are; Finding, Assessing and Keeping. The phases are presented in figure 5.2, which also addresses the risk of missing, ignoring or losing NQPQs in the respective phases.

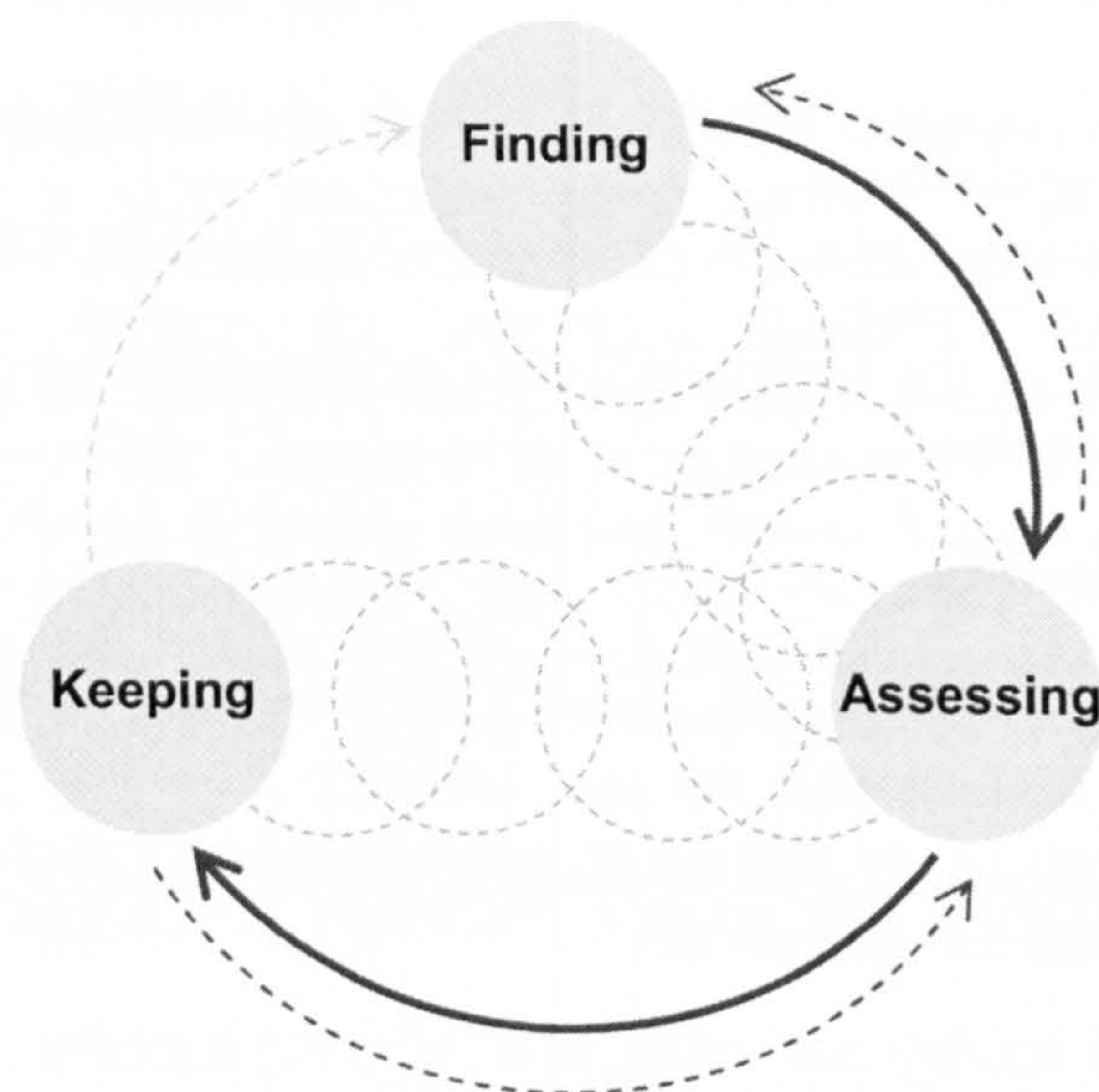


Figure 5.2 The FAK-model illustrating the phases through which NQPQs go.

Finding NQPQs

The phase is here called finding, because it is often what happens, rather than specifying. Based on the product brief, a process of exploration and idea generation is initiated. This is commonly done by the Design function, which will develop mood-boards and sketches based on the brief. By exploring ideas in a visual format they aim at ‘finding’ NQPQs that can be embedded into the final product. Hundreds of sketches are created, and designers talk among themselves about what ideas seem appealing and develop these ideas further. The process of finding NQPQs that can be expressed visually is a continuous interplay between selection or narrowing of ideas and then divergence. In the end a limited set of sketches is shown to a diverse set of managers who will pick some. These are then developed to a stage where physical models can be presented for either more managers or maybe also potential customers in clinics. Some ‘finding’ of NQPQs is based on observing customers, but the commonality compared to QPQs is that they remain undefined, staying as descriptions even into the design stage, whereas QPQs have been specified before they enter the design and engineering stages in the product development process. When designers were asked how they ‘find’ NQPQs they design into the product, they found it difficult to give an answer. Some said that it is ‘based on their intuition’ and seem to lack language to describe it deeper than that. Others seem to express their awareness of what is going on in other product categories, competitors’ products, and society and art in general, and state that they find NQPQs through adopting and developing ideas. Product developers that are more engineering based are often not aware of the NQPQs they are embedding. They only see defined QPQs and focus on getting them right. This is not the same as not being aware of the NQPQs but they might not be assessed on embedding these, and therefore do not regard them as a priority of theirs.

In the early design phases NQPQs are explored, found and selected through interplay of visual representations and verbal discussion about how to interpret these. Verbal descriptions are needed to communicate product qualities that are not easily described in sketches or early models, such as movement, texture and sounds. Often this process of development and selection is partly undocumented, and only the selected NQPQs remain through an accepted model, sketch, image or product sample.

- NQPQs go through three phases of embedding; Finding, Assessing and Keeping
- NQPQs are less likely to be lost in phases of the product development process where they are communicated through physical means like sketches, video and models

New findings/new details

Assessing NQPQs

Assessing NQPQs happens constantly as they are not defined by quantifiable means, hence they are continuously altered because the QPQs seem to have a higher priority. The assessment happens at the level of the individual product

developer's personal assessment, what idea works, what does not work – how one NQPQ works together with other. For example, which combination of stylistic shapes, together with the low seating position and selection of wide tyres, might give the perceiver (customer) a signal of sportiness in a way that is intended. Often the desired overall impression is a hybrid of many existing product qualities (NQPQs and QPQs). For instance the desire to design a pram for babies (one set of NQPQs) targeted at active fathers with an interest in tools for the outdoors (another set of NQPQs). This might lead to a pram that fulfils all the traditional NQPQs such as looks protective, feels solid, easy to drive and park, have good ingress/egress for the baby, good visible access to the baby, good storage etc. And also include NQPQs from a completely different product type: outdoor tools, hence the adoption of ergonomic and adjustable handlebars (inspired by bicycle handles), wider tubes used in the main construction of the pram, matt surfaces, wider and rougher wheels (like on mountain bikes), more outside pockets to put things in (inspired by rucksacks) etc.

Because there is no defined or specified way to reach the desired NQPQs, assessment and redefining happens throughout the product development process by many people. A common way to assess NQPQs is through selection from alternatives, either by the product developer himself, within a group of colleagues or with a manager, or even outside the department, in product teams. Sometimes assessment is taken to the level of senior management. Customers are often invited to assess product to gain an insight into how they perceive the NQPQs. Due to the lack of specification the assessment of NQPQs is often based on personal interpretation, and is not a part of the stage-gate review process. They are not 'ticked off' because they live up to a well defined specification. They are also not commonly visible in the stage-gate reviews because they are not transferable into the format that guides this process. NQPQs are sometimes ignored through general assessing during the process of design or specific assessing like gate reviews, because they are not specified from the start. Failing to assess NQPQs means that quality assurance is at risk. In the worst case there would be loss of the NQPQ because once it is noticed that it has been ignored it is then too late to put it back in.

- NQPQs are sometimes ignored during gate reviews, because they are not specified from the start
- Failing to assess NQPQs means that quality assurance is at risk

New findings/new details

Keeping NQPQs

Based on the assessment a decision about the embedding of an NQPQ is made, but this does not ensure it is kept in the product. The actual embedding might happen in another development stage, where others are responsible, and because the NQPQ is not signposted though a description and criteria for its satisfactory embedding, there is a high risk of losing it. Personal championing is often the

only way to ensure that a specific NQPQ actually gets embedded into the product or by that individual verbalising the existence of the NQPQ and saying what and how it has to be protected in order to be kept and embedded into the product.

The process of finding, assessing and keeping NQPQs is very subjective, because they are not defined in measurable terms. This means that personal or shared understanding and opinion is more influential when embedding NQPQs than QPQs. Continuous communication through dialogue among product developers who are involved in different stages of product development becomes very important in ensuring a successful embedding of NQPQs. Communication where verbal dialogue is supported by physical means such as sketches, models or samples of NQPQs in other products, means that there is a higher likelihood of survival, – being kept in the product throughout development and actually being embedded in the final product.

- Where there is dialogue in the product development process NQPQs have a greater likelihood of survival
- New findings/new details

A requirement capture framework has been developed by Bruce & Cooper (2000), who argue that organisations acquire information and ideas through both informal and formal means facilitated by either soft or hard processes.

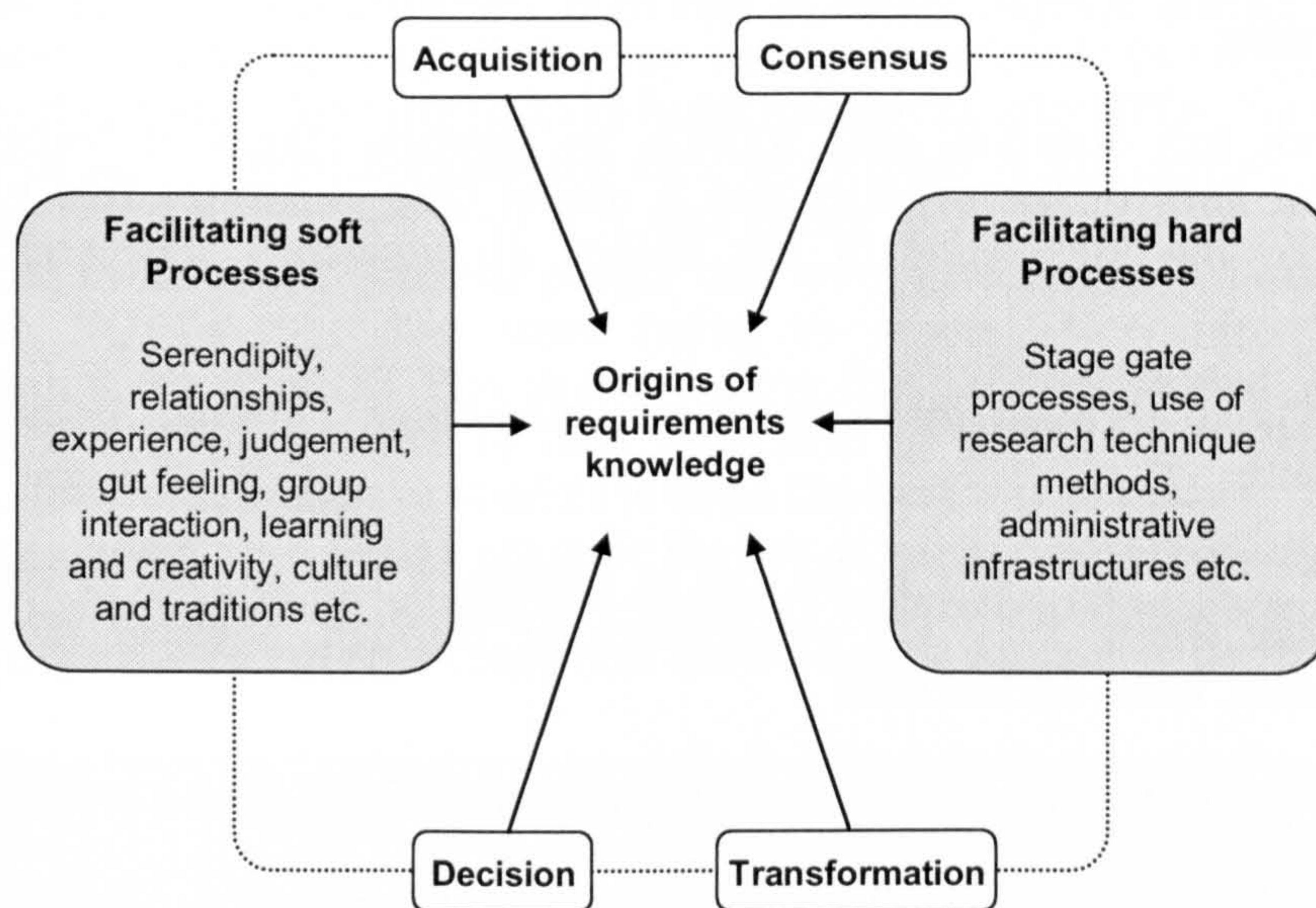


Figure 5.3 Requirement capture framework developed by Bruce & Cooper, 2000.

This framework has similarities to the FAK-model (figure 5.2) as it describes acquisition, decision and transformation which have similarity to the phases NQPQs go through (e.g. finding, assessing and keeping). Bruce & Cooper (2000)

describes how the process entails three key stages: acquisition of information (similar to finding), its translation into requirements (similar to assessing), and decisions about the requirements for the product (similar to keeping).

For NQPQs this process is mainly facilitated by what Bruce and Cooper (2000) describe as soft processes like, for example, experience, gut feeling, group interaction, learning and culture. The framework by Bruce and Cooper is linked to the origin of knowledge during the requirement capture, but it could easily be extended to illustrate facilitation in the product development process in general.

The risk of missing, ignoring or losing NQPQs are increases if they are only facilitated by either soft and informal processes or hard and formal processes, as both types of processes are needed to facilitate effective embedding. The soft processes are good for nurturing NQPQ understanding and development, but do not ensure consistent embedding as it is often driven by individuals' subjective or tacit understanding. The hard processes are traditionally processes that are superior at embedding QPQs, as they are good at embedding product qualities that can be described objectively, and hence they are more independent of individuals understanding and knowledge. Both NQPQs and QPQs benefit from being facilitated by a combination of both soft and hard processes, but as this research has found, the lack of formal (or hard) methods creates a risk for NQPQs embedding. It is important to encourage the development of both soft (informal) and hard (formal) processes throughout the product development process, as they in different ways will support the embedding of NQPQs.

New findings:

This research has observed that NQPQs go through stages of being found, assessed and kept in the product and a model that illustrates this has been proposed. To the knowledge of the author no literature addresses similar observations.

- NQPQs go through three phases of embedding; Finding, Assessing and Keeping.
- NQPQs are less likely to be lost in phases of the product development process where they are communicated through physical means like sketches, video and models
- NQPQs are sometimes ignored during gate reviews, because they are not specified from the start
- Failing to assess NQPQs means that their quality assurance is at risk
- Where there is dialogue in the product development process, NQPQs have a greater likelihood of surviving

Since this sub-theme emerged from the descriptive stage, there were no finding under the heading 'Confirmation of findings' or 'No evidence for confirmation or rejection of the findings'.

Handovers during the stage-gate process

During the different phases of the product development process the leadership of the project seems to shift from one group to another. In the early stage marketing and product planning are responsible for the business idea and initial brief, after that the design function takes over. Later when a concept is selected the engineering function takes over the technical development of the product development. Handovers are not 'over-the-wall' handovers. Over-the-wall handovers imply that the product development processes are sequential, all information and responsibility handed over at one moment with no prior or post involvement. This is not what happens in the integrated product development process where different functional groups are working on the product in parallel and constantly exchange information. But at some point the overall responsibility and leadership of the product is handed over to another functional group.

Handovers are often related to gate reviews, where it is ensured that the objective for one phase is fulfilled, so when the leadership is handed over, there still remains a clear understanding of what is handed over, and it can be documented in documents, drawings and models. Unfortunately NQPQs are often lost at handovers. There is a particularly high risk of losing NQPQs during handovers from 'design' to 'engineering', if they are not communicated in QPQs. Although some aspects of an NQPQ might have been translated into QPQs, there is still a high risk of losing them because the tacit knowledge is not carried over. Tacit knowledge could be handed over if it was either made explicit or if those who were taking over, talked with the people that were involved in the earlier stages about the NQPQs that they were trying to embed. Very often a shared understanding of what NQPQs are and how they are embedded is missing, especially if it is not possible to turn them into QPQs. Dialogue supported by sketches, drawings, images or models is often the best way to make other product developers understand. In one example the use of video recorded customer input, was what made a product developer (engineer) understand that a specific NQPQ was very important to the customer and should not be neglected.

- Handovers are often related to gate reviews
- Particularly at the handovers from 'design' to 'engineering' there is a high risk of losing NQPQs if they are not communicated in QPQs

New findings/new details

This quote illustrates several of the difficulties with NQPQs when they are handed over:...'The people that have to do it, engineers, are not visioning people,

generally. A good example, innovative interior lighting, I think we called it, and someone said make the foot well of the car glow in a nice warm colour, and it make you feel safer and warmer. When the innovation group tested it on customers, they loved it! Oh, great when you go along horrible country lanes it makes you warm, and nice and comfortable. So we said put it down, they wrote it down as a part of the product program (feature list). The engineers eventually got some brief that said: "light the foot wells of the car up", that is what it said. And they went, "how are we going to light foot well up?" Put a light bulb under it...they then presented it to us: "That's horrible, why would anyone want that?" They tested it on a few people, and they went: "it is horrible" How much it is? £5! ...delete it! What went wrong? It was not communicated. The point wasn't put a bulb in the thing. The point was if you put a warm glow here it will make the people feel comfortable and safe. The aim is to make them feel comfortable and safe. What design thing can make that work? That's what it should have been.'

Asked what went wrong, by the researcher, the interviewee continued:

'The innovation group demonstrated some example for customers that looked a certain way, ended up as a line saying: feature description: glowing foot well lighting. And the engineers pick it up and went what have we got And they literally mock up an interior bulb and it looked awful and I was oh, my god...I pushed it for a while as well; "no this is not what we want we are trying to do, bloody hell", and they were "no, we do not know how to do it". The engineers, "we do not know how to do it". That is crap because I know people would do it ... but this feature is going to be deleted out. And they just did not get it at all. They had a white light, that is not what we want. The point is if it glows warmly it makes you feel comfortable. A white light is not going to do it, is it?' (DPb042).

This situation illustrates a typical chain of events that NQPQs go through in an attempt to embed them in the product. Firstly a pre-programme group develops a solution idea based on the design intent of making the car a more safe and comfortable environment for the customer (in this case especially targeted towards women). The solution idea is to have the foot well in both the passenger and driver side of the vehicle lit up by a subtle warm glow, to evoke the feeling of security. They build a model based on this idea and present it to a group of potential customers. These respond very positively with reactions linked to the feeling of security and comfort. Based on this the NQPQ is included on the feature list (specification) of what is to be embedded into the vehicle. When the product is handed over to detail design stages, and engineers start to embed this NQPQ, they do not understand the design intent and the sought emotional reaction in the customer. It is not communicated in the specification, because the crucial NQPQs have not been translated into QPQs. They build it based on the technical facts of the model; a light bulb under the instrument panel to light up the foot well. When people involved in developing the prototype saw it they stated that it is very different from what was intended and it should be altered, but by then it appeared to be the only way to fit the technical solution to the specification and no changes were made. It was tested on potential customers again, but this time without positive feedback. Based on this negative reaction and the cost that the solution would add to the project, the feature and subsequently the NQPQs associated with it were deleted from the product.

A combination of things led to the unsuccessful embedding of the NQPQ. The NQPQ (warm subtle glowing light from the foot well) was developed at the concept stage by the innovation group who understood the design intent well. They knew what customer response they were trying to achieve; they built a prototype and got good customer feedback. The idea was then accepted into the final product, and handed over to detail design. But the handover material was not detailed enough, to communicate the idea or a specification that would lead to its embedding. The innovation group did not try to define the NQPQs in terms of QPQs, for instance by specifying the type of light bulb that would send out a warm glow. A description of how the light should have been put under the instrument panel would also have helped to define some of the non-quantifiable characteristics in the sought NQPQ. For instance, if it was to be a spotlight or a line of several lights that ensured a more subtle light which made it appear as a glow from underneath. Secondly there was too little verbal communication and interaction between the innovation group and the group doing the detail design. This might have hindered an insufficient solution was developed, because some of the non-quantifiables would have been either expressed verbally or tacitly by stating that proposed technical solutions did not embed the attempted NQPQs. Interaction among the initiator and the people embedding of NQPQs physically into the product is very important since an objective, numerical specification of the product quality is missing. During such interaction it is also important to hand over the positive customer reaction from the first test, because it might help, in this case, the engineers to tacitly understand what it is that is so appealing about the NQPQ. Hereby the ability for others to empathies with the customer is handed over. There was no formal check to ensure that the idea was understood and translated into a reasonable solution. In this case a lack of understanding of the design intent, and the lack of breakdown of the NQPQ (i.e. warm subtle glowing light from the foot well) that were present in the initial model, led to an insufficient embedding of the NQPQ in the final model and as a consequence the NQPQ was deleted from the product.

- If the design intent is not handed over there is a risk of NQPQ deletion
- Handovers work better when people talk together – verbal handover provides a richer format for NQPQs to be explained and understood

New findings/new details

Among others, Clark & Fujimoto (1991) have specifically addressed the challenges of a sequential product development process with handovers. They criticise the limited verbal communication and suggest that stages should be overlapping (releasing information early, although it might be incomplete). This research confirms this, and also highlights that NQPQs are particularly affected by the handovers. It was observed that this richer understanding of an NQPQ often failed to reach engineering functions, and that one element of this was to communicate the design intent. Intent was rarely observed to be handed over, so the related NQPQ(s) might then be implemented poorly or not at all.

Summary of new findings:

- Handovers are often related to gate reviews
- Particularly at the handovers from 'design' to 'engineering' there is a high risk of losing NQPQs if they are not communicated in QPQs
- If the design intent is not handed over there is a risk of NQPQ deletion
- Handovers work better when people talk together – verbal handover provides a richer format for NQPQs to be explained and understood

Since this sub-theme emerged out of the descriptive stage, there were no finding under the heading 'Confirmation of findings' or 'No evidence for confirmation or rejection of the findings'.

5.4.2 Theme b – Translation of NQPQs into QPQs

What

It has been observed in all the researched companies that many NQPQs are being turned into QPQs during the early stages of the product development process. Some intended product qualities that are not already quantified go through a process of quantification in order to include them in the product specification in an attempt to embed them in the physical product. This product developer illustrates the viewpoint that 'everything can be quantified', which was a common statement among the interviewees: *'...getting the NQPQs into the car requires the coordination of a number of groups of people and you have to get it into a quantifiable to get it into the car as a non-quantifiable, if you like, okay.... You can quantify everything, okay, the "must-buy" factor, why do I want to buy that small stereo? Because it is small, silver, shiny, it's got the right feel, I really want that gadget, that toy'* (DP039). Here the meaning of 'everything can be quantified' refers to two things; firstly the physical product quality, that the author suggests is an NQPQ, can be defined in numerical terms e.g. it gets translated into a QPQ – secondly the emotional reaction to the product (by the customer) which can be quantified in terms of how successful it is at pleasing the customer.

Why

One characteristic about NQPQs is that it can be difficult to determine if they are in the product or not. The quality is non-quantifiable because its assessment is judged on the basis of subjective (personal) interpretation. By turning the NQPQ into more quantifiable measures, product developers increase the degree of objectiveness within the product development process. The degree of objectiveness that a translation into QPQ brings, makes them easier and more effective to handle in the product development process as they become easier to understand and communicate across the broad group of people involved in the process. This is done to ensure that the final embedded product quality is close to the intended product quality, while keeping risk and cost down.

In product development literature it is common to propose a break down of product qualities into defined and preferable measurable parts. A *breakdown* assumes that when summed up all the parts will add up to the desired product quality. Methods such as QFD (Sullivan, 1986; Trott, 2002; Clausing, 1994) and Kansei engineering (Nagamashi, 1995; Ishihara et al., 1995) all assume that such breakdown is possible without losing any quality. This research confirms that such breakdown of NQPQs to QPQs is happening. Due to the often subjective nature of NQPQs it might be more appropriate to define the process as a *translation* into QPQs, rather than a breakdown. A *translation* indicates that some qualities might be degraded through this process.

Although this research confirms the use of QFD as a concept, it was not found that the case-companies used the QFD method as such, and if they did it was not necessarily in such a systematic way as described in literature. Kansei Engineering was not observed to be used in any companies.

- Companies are turning NQPQs into QPQs because this makes them easier to handle in the product development process; the translation to QPQs is a beneficial way to ensure that the desired product quality is embedded, while keeping cost and risk down.
- NQPQs are transformed into QPQs because it is a good way to give a broad group of people (function, education, time) an understanding of what is needed in the product

New findings/new details

How

NQPQs are often transformed into QPQs by translating the emotional responses sought by the customer into product qualities that can be quantified and put into the specification. Three general approaches to turning NQPQs into QPQs have been observed in this research:

- Benchmarking
- Indexing
- Numerical measures

Benchmarking is being used in industry at many different levels, from looking at competitors' product and processes to more abstract strategic benchmarking (Ahmed & Rafiq, 1998). Traditionally benchmarking is defined in literature as a process of comparing oneself against best competition, in order to set goals so that the company becomes and remains competitive (Balm, 1996). Although the use of benchmarking in this straightforward way has been observed in the case-companies, the method was generally observed to be used with more subtlety, and not always using 'best competition' as the benchmark.

Ahmed & Rafiq (1998) argues that the main type of benchmarking used during product development in the automotive industry can be characterised as reverse

engineering. Reverse engineering refers to the disassembly of a competitor product to analysis and evaluate its comparative strengths and weaknesses in preparation for the manufacture of a similar product (Bridgefield, 2006). Ahmed & Rafiq (1998: 226) refers to the following characteristics when describing reverse engineering:

- *Product orientated involving reverse engineering of competitive product offerings*
- *Comparison of product characteristics, functionality, and performance of competitive offering*
- *Competitive analysis on market-oriented features*
- *Reverse-engineering initiatives involve tear-down and technical product analysis.*

The observations from vehicle manufacturing case-companies confirm the use of benchmarking in reverse engineering, the author also observed that benchmarking was being used in the broadest sense of the word; creating a reference. Benchmarking is used to create a point of reference when defining a desired NQPQ. Juxtaposing alternative solutions to an NQPQ emphasises differences and can help defining the sought NQPQ. By assessing alternatives on a relative scale (bad, equal, better, best), it is possible to establish a benchmark for the desired NQPQs. For example shininess of a product surface can be difficult to define in quantitative measures, so product alternatives showing various degrees of shininess can be presented in order to determine the desired quality by using benchmarks to help the encircling a specification. A common way of transferring an NQPQ like shininess into a measure is by selecting a product sample that has the desired shininess and use that as a master to match the manufactured product surface that is being designed. Commonly, benchmarking helps by defining NQPQs at product level – by representing alternative product qualities. The challenge in benchmarking is to find the right qualities to use as benchmarks because the selection influences the specification of NQPQs strongly.

- Benchmarking is commonly used to define and later quantify physical product qualities, by representing alternative product qualities in a physical rather than conceptual format

New findings/new details

Benchmarking can be done before anything has been designed – using references to determine desired qualities. Index systems are most commonly used later on when there is something to react to. In the case-companies, index systems are used to score a human reaction on a scale of measurement. This product developer describes how an index system is used during the development of a product to check how well it scores on perceived quality (the total index figure is in this example desired to be 8.0): ‘...I would put a target figure for each complete car. Like 8.0 could be one target figure but then I have divided it

down....into exterior quality, interior quality, so I could say that the instrument panel must reach 8.5 or 8.6 and then I have developed a measurement method, that I call TDCQ - Total Customer-Related Design Quality. So I have 340 questions put in a database and controlled by a small laptop ...so we have respondent, could be ordinary customers or internal customers, they would come to a clinic they will look at the car and they will follow the questions' (TB7). As in this quote, it was observed that the case-companies often use index based assessment at the level of the part or whole product, which will sum up the reaction to many NQPQs, whereas benchmarking is often used at the level of a specific quality (shininess). Index systems are often developed by specialist groups. In the example above, it was the person in charge of design quality who broke down the desired index figure to sub-targets. In another of the case-companies index systems are used by groups in charge of perceived quality. It is common to ask in-house people, potential customers or field experts to score the product through the index system. Based on a number of assessments by individuals an average score will be found. Traditionally index systems are fixed on the number 100 as the reference point. The total sum of scores should normally sum up to an average of 100, unless another figure has been set as the desired target sum. If the product being assessed scores greater than 100 in total it means that the embedded qualities are higher than targeted – they are overrepresented. Total scores lower than 100 mean that the qualities are underrepresented. The total score of 100 is often divided into sub-targets.

Index systems are used to assess product quality's emotional response in the perceiver at a more generic level where many individual characteristics are numerically valued and summarised to an overall score. Index systems are commonly used to assess a product as a whole – the sum of many scores gives the overall index figure. The challenge when using index systems is that the point of reference often lies within the perceiver, because they are asked to evaluate their emotional reaction to a product quality on a numeric scale, rather than using external benchmarks as a kind of defined scale (bad, equal, better, best). The strength of using benchmarking as a way of assessing NQPQs is that you get a result defined within relatively fixed boundaries, whereas an index system does not ensure that you have chosen the right comparison products and would fail you if you have chosen inappropriate product qualities to benchmark against. The fact that the point of reference lies within the perceiver can here be seen as a strength, because it tells where an embedded quality lies on a personal scale. A personal scale is not constrained to one product, but builds upon all our previous (product) experiences and expectations. Benchmarking would not necessarily tell you if you are benchmarking against the right things in order to reach customer expectations, whereas an index system is more likely to tell you where your product qualities lie compared to a broader set of references.

- Index systems are commonly used to assess overall product qualities at an emotional level in the assessor. Index systems are used to gain an overall product score on the basis of assessing many individual parts of the product

New findings/new details

The presentation of benchmarking and index systems are described here in their purest form, as separate methods of assessment. In the case-companies a combination of the two methods is more common than stereotypical versions. Combining benchmarking and indexing will simulate reactions to both specific product characteristics and the product as a whole.

Numerical measures often occur as an outcome of benchmarking and index evaluation, by measuring the selected alternative using established numerical scales (metre, volume, kg, miles/hour, reflection of light etc). Engineers are typically involved in this translation by, for instance, translating the 'comfort' of the 'best' or 'top scoring' vehicle seat into numerical measures. NQPQs are rarely directly translated into numerical measures without going through various assessments stages, but some numerical measures have over time become synonymous with qualities of a non-quantifiable character. For example a car's ability to accelerate from 0-60 mph in less than 5 seconds, might be perceived as a 'sports car quality', and together with other product characteristics add up to an overall product quality evoking the customer response 'this is a sports car'.

When

The process of turning NQPQs into QPQs happens mainly in the early stages of product development. Often a design brief emerges early as a description of the product intent from product planning, of which some qualities are quantifiable, but many are non-quantifiable. The brief will then over time be turned into more and more specific product qualities, of which many will become quantifiable. The reasoning behind this translation is opaque and mostly non-documented. Some NQPQs remain non-quantified or are described as a desired emotional response in the customer, which leads to a great risk of them not being carried through the product development process and embedded in the product. The earlier NQPQs are turned into QPQs, the higher likelihood they have of survival, (because it is difficult to argue against a tangible measure/specification), whereas intangible product qualities like 'looks elegant and sporty' or even desired customer responses, like 'must feel modern' can be difficult to ensure if they remain non-quantified.

Where

NQPQs are often turned into QPQs by people creating the specification. This is done between various groups, but commonly instigated by product planning that would develop a rough product description, and then involve marketing and design/engineering in detailing the brief and making it into a specification. They would often use existing product and competitor sets to define and quantify desired qualities, but that is likely to be at an overall product level and not broken down to design characteristics. The transformation of NQPQs into QPQs also often happens when engineers are designing specified functionality or features.

Who

Product planners, marketing, engineers and designers are all participating in the process of turning NQPQs into more quantifiable measures, although they do it to different degrees depending on their role. Product planners and marketing

people look at the product as a whole, and define NQPQs at that level, many NQPQs remain non-quantifiable, but they provide the target at a product level. Designers do not have a tradition for turning NQPQs into QPQs and are more likely to design them by proposing alternative solutions for others to select. However, engineers are involved in breaking the NQPQs down to more quantifiable measures, by assessing benchmark products on a much more measurable level, in order to build in the desired NQPQ. This observation is supported by Bonapace (2000: 262) who states: *'Engineers and technicians are used to quantifying issues. They usually want numerical specifications and clear requirements that leave little to interpret.'* It was observed in all the case-companies that people in control of the product development process use and are practised in the language of QPQs, which goes some way to explaining why the transformation of NQPQs to QPQs is so important if they are to be embedded into the product.

Designers, especially visual designers do have a language for visual NQPQs. This language is often built on shared references in order to express NQPQ ideas, and is crucial in the creation of a shared understanding of what and how a NQPQ, that remains non-quantified, is sought to be embedded. Eckert & Stacey (2000: 524) have made a similar observation in the knitwear industry: *'Knitwear designers talking among themselves describe design almost exclusively in terms of combinations and modifications of design elements that they refer to either by category labels or by their origins – in other designs, or other images.'*

- People in control of the product development process use and are practised in the language of QPQs

New findings/new details

Model development

It has been observed in the data that the process of specifying NQPQs goes through different phases. The phases are illustrated in figure 5.4 below.

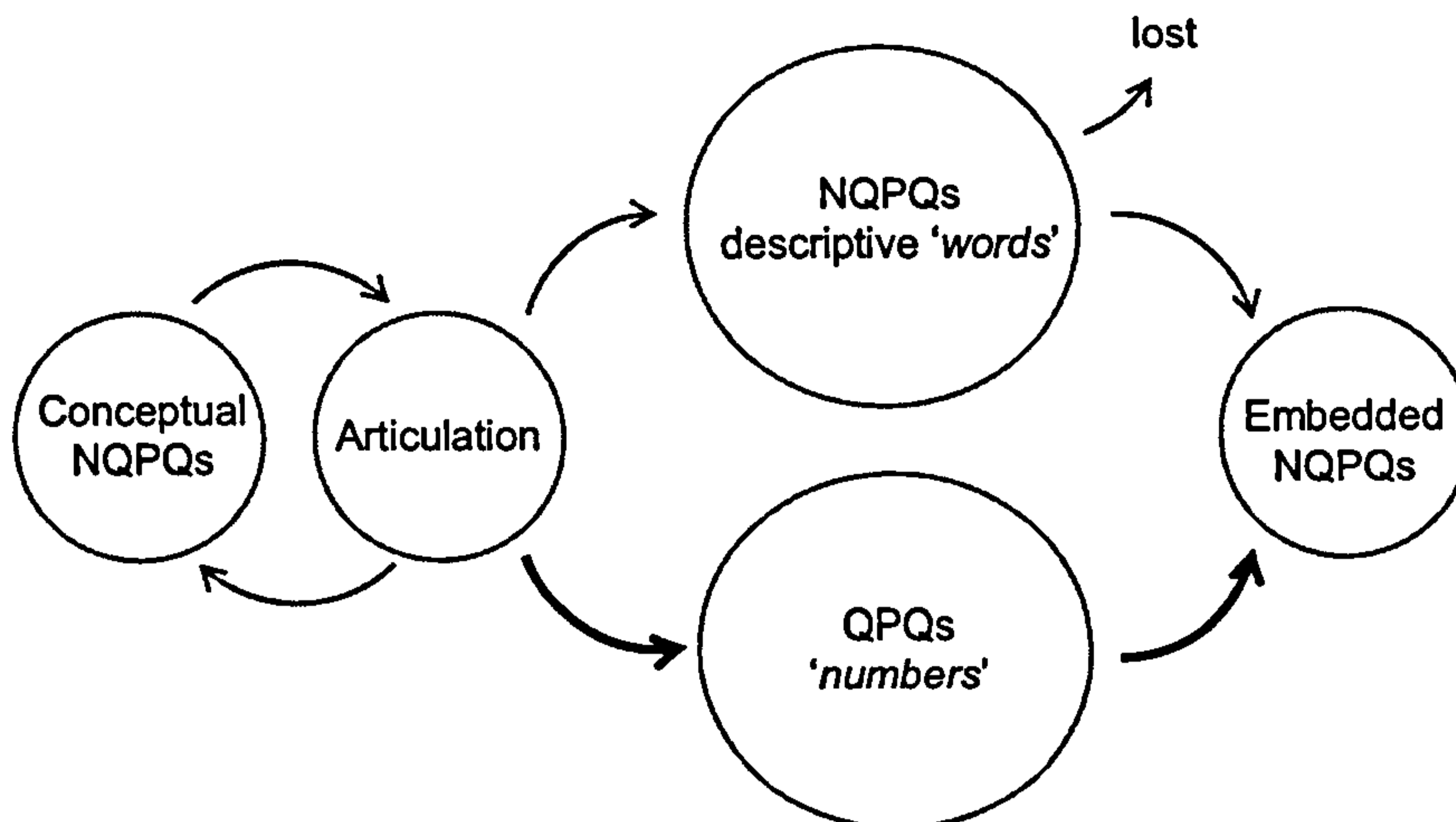


Figure 5.4 Stages NQPQs go through.

The initial process is to articulate a desired product quality – this is often done by the desired end result; an emotion that some of the embedded qualities should evoke in the customer (for example ‘interface looks simple and easy to use’). It could also be the articulation of a conceptual NQPQ (an idea), like for instance the use of a novel material that is believed to evoke a reaction of pleasure or delight in the customer. (e.g. the use of soft-touch material in interfaces). The process of articulating the idea of a NQPQ is often iterative, where the articulation might go through several iterations in order to describe and evolve the idea itself. This process often happens in dialogue among the team members in a product development process, if it has not been specified earlier by marketing or product planning. It can also be a ‘dialogue’ a designer has with the paper when sketching, selecting which ideas to develop further.

Through the process of articulation and discussion some NQPQs will be embodied into the product while remaining non-quantified. They will be embedded through verbal descriptions or shared understanding of the qualities that the product developers are seeking to embed. But most NQPQs will be turned into quantifiable measures, illustrated by the fat arrows in figure 5.4, although some remain non-quantifiable and manage to make their way into the product through personal involvement or a shared understanding. But there is a much greater risk of losing the desired NQPQ if they take the upper route.

Figure 5.5 below illustrates the different methods companies use to make NQPQ more quantifiable.

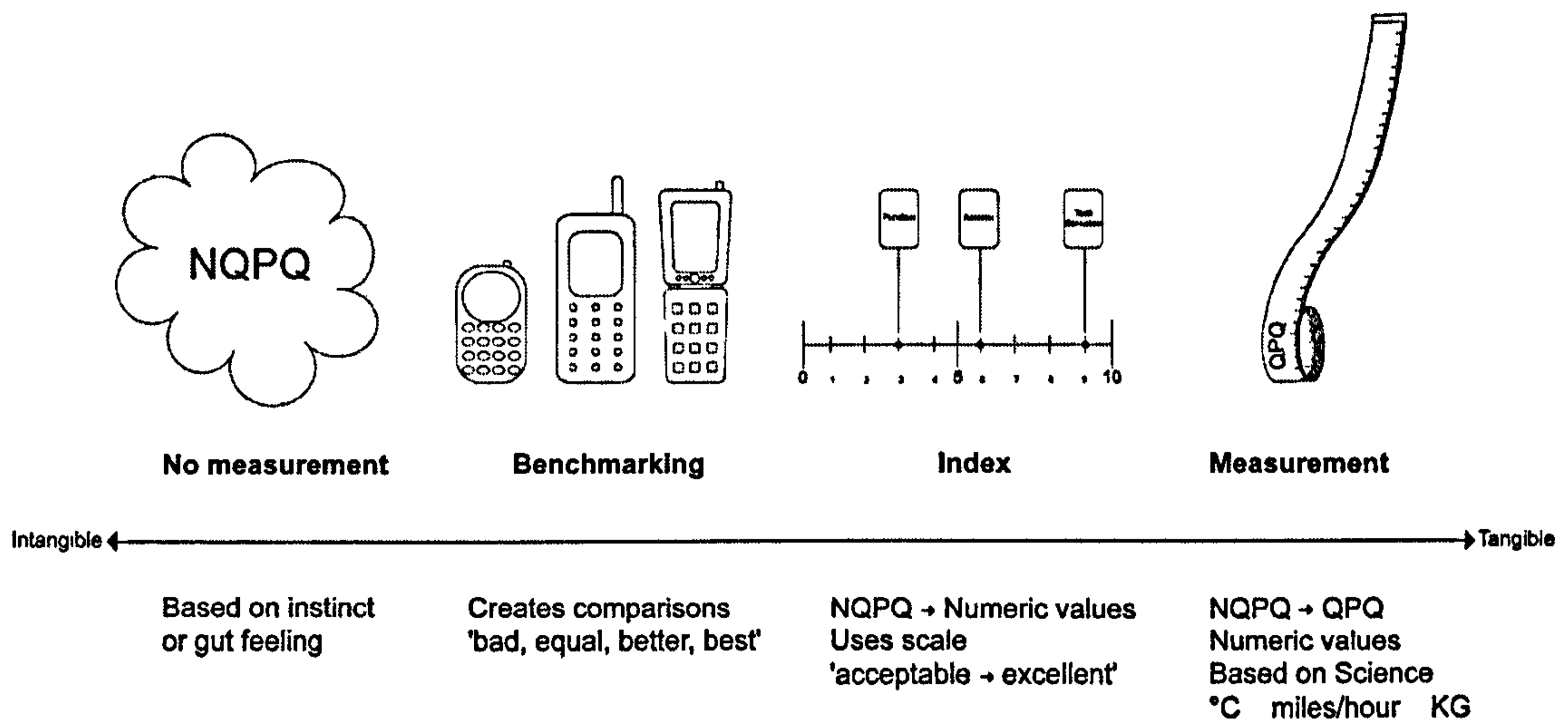


Figure 5.5 Methods used to make NQPQs more quantifiable.

To the left the NQPQ would be embedded as a gut feeling or intuition. It remains intangible throughout the product development process as the desired product intent is not broken down to tangible product qualities. Moving to the right benchmark systems are used to make the NQPQs more tangible through the creation of reference points, by defining a point of comparison for the product under development or to assess/check if it sends out the intended quality. This is done on a scale of bad, equal, better, best, when compared to other products. The reference point can be the desired emotional response or a physical quality. But most commonly benchmarking is used to define physical product characteristics.

Moving further to the right, index systems are used most commonly to create a numerical value of a design object – either the one that is being designed or past products. Index systems are used to evaluate the emotional reaction on a numeric scale and will not directly guide the physical embedding of NQPQ properties. To the far right qualities have been defined into traditional measurement systems where product qualities are defined in the most objective way. Here scientific measures increase the likelihood of desired NQPQ and embedded quality. The move towards quantifiable product qualities increases the ability to handle NQPQs in the design process. Quantifiable product qualities are easier to handle because, compared to non-quantifiable product qualities, they help product developers to determine cost, benefit and risks of embedding.

Summary of new findings or new details to existing findings

- Companies are turning NQPQs into QPQs because this makes them easier to handle in the product development process; the translation to QPQs is a beneficial way to ensure that the desired product quality is embedded, while keeping cost and risk down

- NQPQs are transformed into QPQs because it is a good way to give a broad group of people (function, education, time) an understanding of what is needed in the product
- Benchmarking is commonly used to define and later quantify physical product qualities, by representing alternative product qualities in a physical rather than conceptual format
- Index systems are commonly used to assess overall product qualities at an emotional level in the assessor. Index systems are used to gain an overall product score on the basis of assessing many individual parts of the product
- People in control of the product development process use and are practised in the language of QPQs

Confirmation of findings

- NQPQs are commonly transferred into more quantifiable measures wherever possible
- Turning NQPQs into measurables is done by: 1) quantifying the physical product quality/characteristic, or ; 2) measuring response in a potential customer or expert
- The transformation of NQPQs (into more quantifiable measures) occurs through the use of benchmarks, tests, index systems and numerical targets
- Some NQPQs are kept consistent across products through the use of rules or guidelines – these are often enforced to ensure consistent product identity (brand) and usability
- Perceived product quality (by customers) is sought by product developers to aid the justification of NQPQs, such as specific features, material choice or product appearance.

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

5.4.3 Theme c – Common understanding of NQPQs

In the exploratory stage one theme focused on awareness of NQPQs in the organisation (theme 4) and another theme illustrating where in the organisation people discussed NQPQs (theme 5). These together formed the basis for the theme looking closer at the common understanding of NQPQs in the case-companies. This theme will illustrate examples of common understanding, by looking at what is the common understanding of NQPQs: 1) why embed NQPQs? 2) what are NQPQs? and 3) how to embed NQPQs?

There are examples in the data where the interviewee refers to competitors' understanding of NQPQs, because their common understanding seems to give more successful embedding of NQPQs. One example was when a manager of advanced product development activities referred to an incident where an employee, who had previously worked for an upmarket competitor, after a design meeting stated: '*This would never have happened at (brand name). We would not have spent 30 minutes discussing this because we know it is important for the customer. We would have to find the cost reduction somewhere else*' (FJLb138). This illustrates awareness towards competitors' prioritisation of NQPQ, to a degree where they do not seem to question the reason *why* to embed specific NQPQs. This is believed by the interviewee to be because it is so deeply embedded in the competitor's common understanding of what kind of qualities, and especially NQPQs are making up their product, that they are much more interested in *how* to make it happen and in *what* NQPQs to embed so they identify and support their product (and brand). This illustrates various degrees of implicit shared understanding of NQPQs and how such underlying understandings of what the manufacture can and can not do, when it comes to NQPQs, influence their embedding profoundly. In this example the company referred to have a history for consistent embedding of a set of NQPQs that they understand is important to the customer. This has informed their prioritisations of product qualities to a degree where they do not need to defend *why* to put a NQPQ in when they are in a situation where cost reduction is needed. The research findings are somewhat similar to the broad organisational agreement that seems to exist around branding and physical appearance – these are recognised as being important and so internal dissent is unlikely (Janlert & Stolterman, 1997; Bloch, 1995; Gilmore, 1998, Press & Cooper, 2003).

- There is a shared understanding that the embedding of NQPQs often relies on the organisation's tacit agreement of the importance and prioritisation of NQPQs.

New findings/new details

Some NQPQs are defined through history. The products from one case-company are known for having 'good driving dynamics' – this is an NQPQ that has been built up over many product generations, and remains an NQPQ that is rarely compromised through the product development process. But it started out being a real problem area, and only through continuous development they gained an expertise that is now a part of their NQPQ heritage. The risk is that competitors have now also mastered this NQPQ to a degree where it is no longer a successful product differentiator.

- Using the company's (NQPQ) heritage can support the embedding of NQPQs

New findings/new details

Another common way where NQPQs are embedded without having to defend *why* or *what* NQPQs to embed, is through guidelines or rules. The guidelines then steer *how* the NQPQs are embedded. One of the case-companies has, for instance, implemented a strategy of only using 'genuine' materials. By this they understand that if something looks as if it is made of leather or chrome, it should be so and not a synthetic imitation. Another case-company has guidelines when it comes to the electronic user interface, in order to ensure consistency between models and over several product generations, whereby they will give the customer/user a feeling of familiarity when replacing an old model with a new one. In these guidelines NQPQs are fixed, sometimes in numerical measure, but often they are just defined by the eye, that they look, feel or sound in a similar way.

Denning has generically stated that '*Rules are the beginning of establishing a sense of values, not the end*' (Denning, 2004: 75). This research confirms this statement. One way in which large organisations can signal their NQPQ focus is by making sure that there are rules that ensure and protect NQPQs.

- Strategies, guidelines or rules can protect and focus NQPQ embedding

New findings/new details

In all the case-companies there is an understanding of the need for people to protect and develop NQPQs to a level of survival in order to ensure embedding. For example several of the case-companies have what they call Studio Engineers. These are people working on bridging the gap between design (NQPQ rich) and engineering (QPQ rich), by supporting design in the early conceptual phase. They do this by screening design ideas to see if they can be technically and financially realised as mass products. One of the case-companies recently reintroduced Studio Engineers, because they found a need for having engineers physically based in the design department, as stated by a design manager: '*to be on our side*' (TB). The Studio Engineer helps to develop solutions on *how* to embed NQPQs in a way where they are more likely to gain support by the engineering department. One of the benefits mentioned was the Studio Engineer's ability to speak the language of design as well as engineering. A Studio Engineer will then be able to implicitly communicate the desired NQPQs, by describing in engineering terms *what* and potentially *how* a NQPQ is embedded. The Studio Engineer works as a translator and nurse of NQPQs while they are not physically embedded through fixed measure of form (QPQs like dimensions), feature or material choice. Studio Engineers often help development of technical concepts/solutions important for styling, they aid craftsmanship by knowing how to, for instance, integrate parts, which can result in cost reductions. They also form a bridge between the Design and Engineering departments, which is very important in ensuring successful embedding of NQPQs. A designer expressed it this way: '*I think we had a very good connection with engineering through our studio based engineers. It is imperative for the designer not only to have this connection but also to have a basic knowledge of what is or is not technically possible*' (WBp18).

- Studio Engineers help because they bridge the gap between the group that designs and finds NQPQs and the group that builds them in.

New findings/new details

In one organisation the need for ensuring NQPQs has led to functional groups whose sole purpose is to protect the perceived qualities by the customer. This group which originated as a sub-group of the engineering department, has over recent years reached independence and is placed in the organisational hierarchy with direct reporting to top management. This sets them free from political pressure and ensures that they have as independent a view as possible of how the customer will perceive the product quality. This functional group is involved in all development projects from concept stage to six month post-launch.

- Having a group focusing only on the customers' perceived quality helps the embedding of NQPQs

New findings/new details

There seemed to be an elaborate awareness of the importance of the actual execution of NQPQs. Product developers are aware that there is a big difference between the NQPQs shown through models used to aid product development and the final product. When talking about the embedding of NQPQs comments like *'It has to be designed for manufacturing'* (PG2A) or *'You have to be absolutely confident that you can execute it in an absolutely flawless way...years of experience tells me that it is actually better not to give somebody something if it does not actually deliver what it is meant to'* (MSa180).

Many of the interviewees expressed an understanding of how many individual NQPQs embedded in the product add up to giving the customer a bigger satisfaction of the value the NQPQs provide at an individual level. Unfortunately this understanding is not always shared or managed across the organisation leading to a degrading of NQPQs, often because it is difficult to name who is responsible or there is no function to address this degrading: *'It is that which is the hard thing to put your finger on, is it that plastic switch there? No. It is not only one thing, it is the whole If you cut a little bit of everything it goes.....I do not know how that is managed really...Hum, there is craftsmanship, but they are not really evaluating it ...the vision we said it should be'* (DPb202).

Although there does not seem to be one shared language to communicate NQPQs across the whole of each of the case-companies, there is still an elaborate skill in describing what NQPQs are – especially in competitor products, as in this case: *'The key is to make it consistent. (Competitor brand) as an example is very consistent... It looks a very solid car, you know they have always kept the B-pillar big to make it look solid, to make it look like there is more metal there. They*

have always kept flat surfaces, minimum gaps. When you open the door on a (model name) it is much, much thicker than a lot of its competitors. It looks like it is a more robust door – and it is just the way the dimensions have worked and the way they keep the surfaces flat and where they do not have a lot of spot welding and stuff in there, and (competitor name) is even better with their laser welding, because it is all invisible. Beautiful smooth surface, rather than something being fragmented...The thing (competitor name), I presume intentionally, is doing, I think they are very clever at, is consistency, so it looks, it sounds, and it feels... and I think that is the key' (PG2B085). Not all the interviewees were able to elaborate on NQPQs as eloquently as this person, but most people are aware of some of them. One interviewee described the passive sound from the car and how they now can measure what was previously an NQPQ – the sound of closing the door, so they are now able to craft a door slam that could be made into a brand specific NQPQ.

At a more generic product development level there seems to be a shared understanding about the importance of NQPQ consistency across products. There seem to be two dimensions to this understanding; one is external, affecting the customer; the other is internal, affecting the chance of NQPQs being embedded. Externally it is seen as important to send out consistent signals to customers about what NQPQs the product and brand stands for, so that the customer will perceive familiarity in NQPQs across the entire range of products by one manufacturer. This is often done through guidelines, or strategies that help to name important NQPQs. One company has for instance implemented what they call a brand signature strategy – by defining 20-30 NQPQs as having status as a brand signature, they highlight their importance in defining product identity and aid product and brand recognition. Some NQPQs are translated into QPQs, like for instance a specific shape and touch of the door handle. Before this strategy was enforced: *'...All our products, all the things in our cars, all the commodities; gearshift, knobs, steering wheel....etc. basically everything we had was different from car to car' (ACa155).*

The internal dimension of this understanding could also lead not only to less redesigning but also to co-designing. This would mean that new and innovative NQPQs could be developed across different development projects, sharing the cost and risk. Unfortunately these kind of activities seem less likely to happen due to organisational constraints. One example was given where an idea came up to develop capless fuelling (of a vehicle). The development costs were too much for one model type to take on, and although this idea could potentially be implemented in several models it was not taken on *'...because there is not cross-carline (cross-model) planning in this place' (DP153)*. Although this is an example with a negative result, it still illustrates a common understanding of *how* NQPQs could be better embedded by changing the management of the product development process in an organisation.

Summary of new findings or new details to existing findings

- There is a shared understanding that the embedding of NQPQs often relies on the organisation's tacit agreement of the importance and prioritisation of NQPQs
- Using the company's (NQPQ) heritage can support the embedding of NQPQs
- Strategies, guidelines or rules can protect and focus NQPQ embedding
- Studio Engineers help because they bridge the gap between the group that designs and finds NQPQs and the group that builds them in
- Having a group focusing only on the customers' perceived quality helps the embedding of NQPQs

Confirmation of findings

- Companies are conscious that NQPQs exist in the product and that they have the responsibility to embed them in the product
- Companies focus on NQPQs from a customer point of view as well as how they as an organisation can manage to embed NQPQs
- Companies understand NQPQs in many different ways. For example; how time changes NQPQs, NQPQs from a customer viewpoint, how NQPQs link to the brand etc.
- Many interviewees commented that trying new techniques (such as using customer profiles, product clinics or building scenarios) has helped them understand what NQPQs mean to customers, how they can justify them financially and embed them
- All the interviewees had an elaborate awareness of NQPQs and their importance in the product. They could also give examples of people within the organisation that they felt did not have such an awareness
- The understanding and embedding of NQPQs are becoming more prominent in the discussions between people involved in the product development
- NQPQs are discussed formally and informally in the case-companies
- Discussions about NQPQ happen in direct relation to the product under development and in more abstract conversations

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

5.4.4 Theme d – Customers impact on the embedding of NQPQs

Designing and embedding product qualities that are difficult to fix in objective quantifiable measures, calls for occasional involvement by customer, in order to ensure satisfactory products. Historically customers' influence on the design process has been through customer surveys, often in the format of questionnaires about current products, which would inform the development of the next replacement product. As the use of customer data has evolved, companies have become more aware of the gaps in information such data holds, and have moved from mainly using quantitative data to more qualitative data to inform the specification of a product. It was found that the case-companies are trying to develop their methods of gaining consumer insight and utilising knowledge about their customers.

In the exploratory stage it was found that customers are included in the embedding of NQPQs in various ways. This was confirmed in the descriptive stage leading to more elaborate details about the role that customers play, when they are used and through what methods. These new details are described and compared to existing literature leading to a concluding list of findings for this theme.

The next sections will describe the different roles customers have and when they are involved during different parts of the product development process.

Pre development

Customers are involved in the process of embedding NQPQs throughout the product development process. It was observed that customer involvement can be categorised into three stages: pre, during and post the development of a product. First they inform the pre-product phases. This might even be before an idea for a product is developed and be purely speculative in the hope of discovering latent needs that are not yet fulfilled by product offerings or qualities. It is typically Marketing or R&D functions that seek insight into what customers value in their day-to-day life, or being product specific, what they like about their current version of the product that the manufacture makes. The case-companies are using semi-structured interviews to gather insight into potential customers' product preferences. The focus of the interviews was to gain insight into potential customers' lifestyles, their daily needs and what product qualities they valued in other products. This was done by interviewing people in their homes, encouraging them to talk about products and artefacts they were surrounded by, in order to illustrate qualities that satisfied them. This information would be analysed and the outcome would be, for instance, that customers seemed to value certain product qualities over others, or that there was a preference for certain materials, styling, layout (interfaces). These more generic insights would then inform the development of the product brief by requesting NQPQs inspired by customer insight.

Similarly video ethnography has been used to inform in the pre-development stages in one of the case-companies. By observing customers using products in a real life context, product developers gain new insight into how products are

actually used and what unarticulated difficulties customers might have when using the product. By observing customers loading their vehicles outside IKEA this company became aware of ingress/egress problems customers had with the manufacturers' as well as competitors' vehicles. The benefit of recording these observations on video is that they speak for themselves. In this case the people that collected the ethnographical footage were also involved in the early product development stages of products that sought to come up with better solutions, and by showing footage to decisions makers they were more empathic towards the need for actually embedding new NQPQs that could ease the customers' difficulties.

In literature it has been stated that customer satisfaction is more likely to be achieved through user-centred design, which tend to include the customer in the various stages of product development (Vandemerwe, 2000; Langford & McDonagh, 2003; Cagan & Vogel, 2002). The author's research has similarly confirmed that customers are involved in the design process, though other authors have mainly focussed on broad concepts of customer satisfaction. This research has shown that this may be even more relevant when designing NQPQs.

- Companies realise that involving customers in the design process improves the likelihood of embedding NQPQs that will be successfully received by the final customer
- Direct customer observation in the format of video clips (or real-time observation) has a strong impact on product developers' understanding

New findings/new details

In the pre-development stage customers are likely to be involved in the exploring and finding of NQPQs that could be embedded into the product. Sometimes they are also used to assess NQPQs in an existing product and thereby influence development of a product in the same category or a completely different type of product.

During development

Customers are used extensively during the design/engineering stages of vehicle development in particular. They are mostly used to assess products at different design stages, although some early feedback might lead product developers to further explore and find new NQPQs. It is common for customers' reaction to be sought for the early concepts, so that product developer will get an indication of how customers might assess the product as a whole, and especially NQPQs. In the early stages of car design three to six concepts will be developed in the first phase, internal selection will bring that down to two to three and customers will then be invited to a clinic where the cars are presented and customers' opinion sought. At this stage visual NQPQs to do with the overall shape of the vehicle seem to be the most important to get a reaction to, because product developers need to interest the customer in a further encounter. Other variables, such as for instance colour are eliminated, by making sure that all models are the same.

Brand association is also minimised by not using any logos on the model vehicles being developed or on competitor cars if a comparison judgment is sought. Later customer reactions to haptic NQPQs such as interior feel (seats, instrument panel, door handles) and sound (for instance of the door slam), will be sought through use of what product developers call customer clinics.

One of the case-companies is starting to use more numerical methods of assessment to gauge customer reactions. Here customers might be asked to assess a model of a vehicle by going through a PC supported survey that asks the customer to select the scaleable figure that fits best with their perception of several product qualities.

In one interview a project manager described how a specific customer group representing the customer group that the product was aimed at had assisted in the development of the product from the concept stage all the way through to the final prototype. This group was first assisting by expressing problem areas in the product. As this group was all women, a key concern in current product was where to put their handbag so it was easily reached. This concern led to design of a place for the handbag between the driver and passenger seat in the final version. It also became clear that there were some concerns about feeling intimidated by a big 4x4 SUV when you are a female customer, and likely to be of smaller stature, hence the stylistic NQPQs were adjusted so the vehicle appealed more to females, with softer lines and a lighter touch to closure of doors etc. It also became apparent that the interior is of more importance to females than males, so the emphasis was put on the aesthetic appearance of the inside of the car rather than on the exterior. Although this specific focus group of females was not the only one to assess the NQPQs they seem to have had a big influence in understanding a potential female customer representing a certain lifestyle and particular values. In the literature, customer involvement by the same customer group throughout the development of a product has been described as: '*actively learning about people, rather than passively learning from customers*' (Dahlsten, 2004: 147) (emphasis added by author). Dahlsten continues by arguing that letting one specific customer group representing the target customer added a customer view '*in a qualitative rather than in an absolute sense*' (Dahlsten, 2004: 144). It is important to reflect on the fact that selecting a specific group of customers to influence the product design, might seem exclusive of ideas, but in reality it reinforces a focus that can lead to customer satisfaction for a broader customer group.

Customer clinics are used continuously during vehicle design/engineering all the way through to product launch. The further through the development the more feature specific the assessment gets, asking customers about, for instance, what they think about the appeal of instrument panels, seat design (look, style, colour, touch) or new and innovative features (pen-, cupholders, shopping bag hooks, hidden storage place under the seat etc.). Customers' appreciation of features or qualities aids the decision making process, and can stop NQPQs getting deleted at later stages in order to save cost. NQPQs that get good reaction in clinics are more likely to remain in the product and get embedded into the final version. Some of these NQPQs are sometimes labelled Unique Selling Propositions

(USPs) or the ‘wow-factor’. As soon as potential customers seem to react positively to such qualities it strengthens the likelihood of the survival of those qualities – they ensure that the NQPQ is kept in the product. This is one of the reasons why customer input is sought.

- Customer clinics are used during the vehicle design/engineering to help with the manufacturers’ assessment of embedded NQPQs.

New findings/new details

Post product launch

All the case-companies seek feedback from the market. Typically customer data are sought after a product has been six months in the market. Some of the feedback is very generic, and typically focuses on sales figures, but also customers’ assessment of NQPQs are sought in clinics, surveys or user trails. The mobile phone industry in particular seems to only use customers to assess product post launch.

The influence and utilisation of customers in product development seems to be widely acknowledged, as Brandt & Binder describe: *‘It is widely accepted that successful product development is increasingly dependent on a continuous dialogue with market. New procedures are employed to establish and maintain this dialogue and new organisational ‘functions’ such as market research and usability labs are set up to take responsibility for these activities’* (1997: 111).

Cross refers to *‘listening to the voice of the customer’* (2000: 107) as a result of increased concentration on product quality, but listening might not be appropriate as stated by Watson & McDonagh (2004: 10) *‘...But as customers (users) say one thing, do another and possibly feel something else, listening alone may not be enough. It is increasingly important for product developers (design engineers, industrial designers, manufacturers) to become as intimate with users as possible. One can not substitute another person’s experience, but increased empathy, understanding and awareness can lead to more effective designs’*. This is supported by Cagan & Vogel who claim that insight into customers’ lifestyle should drive the development of product concepts. They argue that *‘ethnographic research provides an insight into user experiences and helps to determine how products can enhance those experiences’* (1999: 3).

Customers are used early in the product development process to unravel latent needs, both rational and more emotional. They are used to assess current preferences in the market. They are mainly used to support the phases of *finding* and *assessing* NQPQs. In the process of finding NQPQs customers primarily provide inspiration for the product development team by providing qualitative rather than quantitative data that illustrates valuable NQPQs in existing products. Customers assist the embedding of NQPQs by helping the product developers to assess NQPQs through expressing their preference or dislikes in product features, parts or the product as a whole. Customers are not directly involved in the process of keeping NQPQs in the product through all its representations,

although their assessment can be used as concurrent monitoring of the NQPQs to ensure their likelihood of actually being physically embedded and thereby kept in the final product. These observations are supported by Bonapace (2000) who states that users can be employed in exploring, assessing, verifying and monitoring phases in user-centred design.

The use of observational methods like video ethnography have become more widespread in industry over the last five years, and customer research consultancies have started to offer it as a service (Leon, 2006). Burns (1999) has described how video ethnography can be used in the identification of potential areas of product improvement, by recording customers' frustration, user sourced product modification, customer needs and wasted time; which supports the observations from this research. Bonapace (2000) argues the importance for user involvement in the product development process in order to achieve user-centred design, and she continues to emphasise that it does not simply mean considering customer requirement while designing and then asking their opinion, but also assessing the performance when customers are using the products. This might be why observation in a real life context is becoming more widespread. Taylor et al. (2002) argue that video ethnography can help to uncover latent needs and allows for a much more in-depth understanding of people's complex response to products. The limitation of customer data has also been mentioned by several interviewees arguing that sometimes customers are not able to tell you what they think or feel. This observation is supported by Jordan and Servaes (1995: 345) who state: *'When asked about emotions and design properties, participants may have found some potential responses more easy to articulate than others'*. This is supported in research by Bruseberg & McDonagh-Philip (2000) where a series of interviews with designers conclude that designers recognise the importance of observing the product in use, particularly in cases where expert users had difficulties reflecting on their routines/interaction.

Different types of 'customers'

Throughout the data collection it became clear that when the case-companies talked about customers' involvement in the product development process, their definition of 'a customer' seemed to be more blurred than the term indicates. And when they talked about customer insight or influence it might not be based on real customers of their products.

In the past consumers were involved in, for example, focus groups based on their demographic and other characteristics that would fit either what the company saw as a target customer (somebody they would like to purchase the product) or a potential customer (somebody that was likely to purchase the product). This is still the case where consumers are involved in the product development process, but also other people are influencing the assessment or embodiment of NQPQs, for example, company staff pretending to be the potential customer.

Even when using potential customers to assess the NQPQs during development, companies are aware that the actual customer might not be the one making a purchase decision based purely on personal reasoning. Car manufacturers are aware that often when a man is buying a car for himself it is important that the

wife/partner also finds the product attractive, and that females tend to emphasise the interior and cabin environment of the vehicle whereas men are more interested in the exterior and the technical performance facts. This means that the manufacturer will consider what NQPQs might appeal to females in a purchase situation and incorporate these into the product through, for instance, cabin materials and touch.

The traditional selection of which customers to use in clinics and focus groups has, in the past, been concentrated on sex and age, but that seems to have changed so people are now selected based on their attitude or customer type. A project leader described this with an example where a product was mainly targeted at young people; the selection of people for a focus group was not based on age, but on people with a youthful attitude or lifestyle.

There seem to be several customer representatives that are not directly representing the customer the product is aiming at satisfying. Sometimes in-house people are used to assess product during development: *'...research does not always mean go out and talk to customers....you know, there are a lot of people that work in this building that are non-technical, they are not really car people, that you can go and talk to and get their view'* (MSa302). It also comes through that many NQPQs are assessed, deleted or kept based on managers' judgement, and that product developers involved in the product development project perceive that judgement is based more on personal preference than years of experience in assessing what might lead to customer satisfaction and delight. Several product developers mentioned examples of decisions made by a manager that seemed to be strongly influenced by his personal or family needs. They argued that the manager was more likely to encourage development, selection and embedding of NQPQs that were aligned closer to what seemed to be the manager's personal opinion, rather than what customer research seemed to support. Interviewing with this particular manager supported this viewpoint, where he confirmed that talking to people in his private context often gave him better and more specific understanding of people's needs and desires of less quantifiable product qualities, than that which he might be able to get out of customer research. The influence of team members as representative of the customer was also observed in one of the case-companies from the exploratory stage. Here one manager described the importance of selecting project team members that reflected the target customer profile in the main by having people in the team that fitted that profile. He described the way of embedding the right NQPQs into the car *'...by putting the right people in the team'* (DGp7) and continued: *'...The first thing you do is you make really sure that people within the team almost fit the profile plus or minus your normal distribution of the target customer. So if you have got a family car, a passenger car, core product. Then the people you put in that product team you make damn sure some of them have families and drive family type vehicles and understand their preferences, their dislikes, because they are going to put that content in the car, in the product anyway'* (DGp7). It is interesting to see that one of the case-companies consciously uses employees' personnel profiles, when selecting core team members, whereas it remains an unconscious fact in another case-company, leading product developers to worry about project leaders' personal bias.

It was found in the exploratory stage that one case-company uses Customer Profiles to guide the development of NQPQs. In the descriptive stage it was also found that another two of the case-companies are using Customer Profiles. Customer Profiles are a description of a virtual customer, usually inspired by one or more of the target customers. A Customer Profile is a description of a potential customer that includes sex, professional position, lifestyle, leisure time activities and sometimes examples of other products they like, or in what context they are likely to use the product that is being developed. The profile is given a name, and this seems to make it easier for product developers to associate with this profile as if it were a real person. Customer Profiles are used as a tool for product developers to give a perspective of the target customer, and to ensure that all involved in the product development of a specific product will see through the same lens, regarding the design, assessment, selection and embedding product qualities in general, and NQPQs in particular. It was observed in the mobile phone company, where customers do not influence the product directly during the development, but mainly through reaction to existing products, that Customer Profiles are used very often in discussion about NQPQs. Product developers would discuss what, for instance, 'Simon' would expect when discussing a particular feature or quality. The discussion would often be centred on this potential customer's likely perception based on his other characteristics, and this would guide a discussion among the product development team that will in effect align their perspective of what they are seeking to embed, if it is a product quality that is difficult or not yet translated into quantifiable measures. By developing a customer profile, although virtual, product developers are given not only a lens for perceiving the product qualities throughout the product development process, but by creating focus it also magnifies what might be of special importance to this type of customer and thereby enhance the likelihood of embedding NQPQs that appeal, satisfy and delight the actual customer.

- In three of the researched companies the use of customer-profiles were used to create a focal point for designing and decision-making – they found this helpful throughout the product development process

New findings/new details

Customers' perspectives can also be summarised through people that sell the product. All companies use dealers to gain access to what the customer values in theirs and competitors' products. Insight given by dealers is important, although dealers might not speak the customers' voice in an unbiased way, but are likely to influence the customer with their own bias unintentional. Often dealers can give the product developer insight into problem areas that the customer might not even have articulated, because they get profound insight into how the customer handles the product or the questions they ask that might not come out in a customer clinic.

Throughout the product development internal and external experts are used to assess NQPQs that a customer as a layman might not be able to articulate or break down to sub-qualities. An example is when car manufacturers talk about

'drivability' – how the vehicle is to handle/steer: *'...Steering is a strange one because (brand name) decided that it is something we want to stand for, so we have gone beyond probably what the normal customer can discern. And how decisions are made really are by the expert engineer and it is not necessarily based on what the customer is going to see, feel and perceive, because it has gone beyond that....and you know even the experts are hard pushed to tell the difference between the vehicles that we make a decision between...and expecting the customer to perceive that is impossible'* (MSa056-065). Experts are also used to assess products for cultural (NQPQs) preferences during development, like for instance that a curved screen on a mobile phone will not sell well because the customer is likely to keep the protective tape on the screen and in the case of a curved screen the fit will be bad and allow aesthetically displeasing air bubbles to appear under the tape.

- Companies are trying to simulate the customer in the product development process either by: 1) having the developer themselves mirror the customer or 2) having experts, managers, salespeople to act as customers during evaluations

New findings/new details

This research has found that when the case-companies talk about the product being a result of customer driven, empathic and built through closeness to the customer, it is a result of many different types of customer.

Summary of new findings or new details to existing findings

- Companies realise that involving customers in the design process improves the likelihood of embedding NQPQs that will be successfully received by the final customer
- Direct customer observation in the format of video clips (or real-time observation) has a strong impact on product developers' understanding
- Customer clinics are used during the vehicle design/engineering to help with the manufacturers' assessment of embedded NQPQs
- In three of the researched companies the use of customer-profiles were used to create a focal point for designing and decision-making – they found this helpful throughout the product development process
- Companies are trying to simulate the customer in the product development process either by: 1) having the developer themselves mirror the customer or 2) having experts, managers, salespeople to act as customers during evaluations

Confirmation of findings

- Companies show an increasing interest in understanding customers' needs and desires in products. Companies try to understand what NQPQs customers value
- All the researched companies have extensive market and customer research
- NQPQs are difficult to judge and assess. A common strategy is to go to customers to get an assessment of NQPQs
- Companies are aware that customers can not articulate latent needs or give a projection of what they would like in the future

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

5.4.5 Theme e – Costing in and costing out

In the exploratory stage it was found that NQPQs often suffer degrading during cost reduction exercises. One of the reasons is that it is difficult to estimate the impact on customer satisfaction. In the descriptive stage this theme was elaborated further.

It has been found that NQPQs are victims of three different types of cost related challenge:

- It is believed that they are costed in early in the design process, but they are not
- Customers seem to be willing to pay for some NQPQs but cost (and price) is already fixed
- Degradation of NQPQs happens at part level, but is then visible at product level

New findings/new details

Early in the design process there seems to be confusion between the act of proposing NQPQs and actually getting them in the product. Often feature-based NQPQs are suggested to the project leader (for example the Chief Project Engineer) and if he finds it a good idea it will be added to the list of possible product qualities/functionalities. At this point the proposer of the feature thinks *it is being embedded into the product*, but it is not - it is only on a proposed list, where it is not directly linked to customer satisfaction or product requirement. This is just one example where an NQPQ is believed to be in the process of being embedded into the product, but in reality the NQPQ goes through phases where it appears to be officially selected into the product through documents such as

the feature list and specification. The list is in effect a wish list, and not a list that represents product qualities that are 'costed in'. In the end it becomes difficult to defend a NQPQ if it was not costed in when it was proposed. A product developer described it like this: *'...we never could afford it. It was a dream, it was never real.....we wrote it down. The vision is not backed up by any facts'* (DP045).

Even when customers support the embedding of an NQPQ (by getting feedback from customer clinics which supports the embedding of a specific NQPQ by showing that customers are willing to pay for it) it is not a guarantee that the NQPQ will be allowed to remain in the product: *'...We will take it to a committee of customers and say what will you pay, they will say £10, good he will say it only cost £5. That is great, finished, my work is done. But the reality is that the £5 will never get into a target for a car, so therefore it is not going to happen'* (DP136).

When NQPQs are embedded in the spec/brief they sometimes go through a process of degrading. For instance it was observed that a silver paint was replaced with a grey paint with added glitter due to a cost constraint. In the overall process this decision could be seen as a minor change by the development team or CPE, or a change that is difficult to assess at the time of the decision, but the overall product quality has changed in an area where the customer is likely to experience it. It is difficult to assess the effect of the decision although the project team, and the project leader in particular, is trying to look at the product as a whole – judging all the product features and qualities to create a total impression of the product (gestalt). All product qualities are affected by cost reduction, but it is often difficult to find the numerical evidence that the overall product perception will change when an NQPQ is altered. Another example is where a product planner compares a product with that of competitors. He mentions that many individual NQPQs were cut out resulting in a product that does not appeal to the customer: *'A great example is our current (model name), there was some original objective for that. The difficult stuff like package, handling, fuel economy... all the really tough things, we targeted the things and we did it. We got a car that is reliable, handles well, quite, nice to drive, lots of space in it, you can get four people in it...but you do not 'want' it – you buy it because it is a small car and you can get 4 people in it. You got (competitor model) that does all those things; 'ish' – not quite as good but you want it! (Competitor model), look at the insides, nice, the graphics were beautifully designed, whatever... Toy, I want to buy this, it is not a practical thing, I just want to buy it! And we just cost-cut everything out of it'* (DP123). NQPQs are often targeted during cost-reduction exercises because they are difficult to defend. By degrading or deleting many minor NQPQs the product loses more, because the whole is bigger than the sum of the parts. The problem is that the impact of leaving an NQPQ out is difficult to define and assess until it is too late.

- Customer perception of product quality is often the sum of many individual NQPQs (and QPQs) but because they are difficult to define and quantify, they often suffer from deletion at the level of a 'part'
- In the product development and decision making process it is easier to delete a quality that is difficult to define (whether it be a physical measurement or an emotional reaction)
- NQPQs are often targeted during cost-reduction exercises because it is difficult to defend them

New findings/new details

In the descriptive stage it became profoundly clear that all the case-companies are under enormous pressure to reduce cost. This pressure means that other factors which influence the process of embedding NQPQs, such as they are believed to be costed in when they are not, or that customer price is fixed, means that the forces work together in a direction where the embedding of NQPQs are at risk.

NQPQs are also often targeted during cost-reduction exercises because it is difficult to defend them. Often the people who proposed the NQPQs are not in contact with the product on a regular basis, or they do not have the expertise to check the embodiment or the power to enforce it, as this marketing employee illustrates: *'...We tried to keep everyone in the loop and even so things still managed to escape us. ... it was not our responsibility to get the drawing and to sign it off....you know... we are not... we are marketing! We do not sign off drawings....in theory all we need to do is to ask for something and say this is why the consumer wants it, can you please deliver it to us, or this is important for the brand, please deliver it for us. And they should, you know, if it is within cost and agreed by management it should just be delivered. But what we have is a very big company and I think scale...and the fact that we are divided into two geographical locations is another important factor ...and just human nature in some respects' (ACb097-118).*

Here is another example where an NQPQ was included on the feature list, but then was deleted because it was difficult to defend, as it was perceived by influential people to be a 'bit of a gimmick': *'...If you look at something that says: "wow, that is a real sort of nice feel" or whatever you want to call it...Where you get the view of "yeah, it is nice, but it is a bit of a gimmick". I think the ones that do not get an unanimous "wow that is a real 'must have'", do stand a good change of getting cost cut' (MSa208).* The labelling of NQPQs as 'must haves', 'wow-factors' or 'brand signatures' seemed to have a big impact on their chances of survival. By labelling NQPQs they become visible and at a conceptual level more tangible. People understand that they are important and they can not just be ignored.

People involved in the design process, physical embodiment and production, are directly responsible for QPQs but do not appear to have the same responsibility for the delivery of NQPQs. NQPQ embodiment and responsibility seem to be discretionary. People are assessed on whether or not they deliver their (quantifiable) part of the product within the financial targets. Managers seem to prefer to fail to satisfy the customer, than fail to stick to the budget. This means that NQPQs are victims of cost-reduction because managers are more concerned with sticking to the budget targets, than delivering a product that the customer will buy.

In the product development and decision making process it is easier to delete a quality that is difficult to define (whether it be a physical measurement or an emotional reaction). In this example the emotional reaction to a mock-up was very positive. An NQPQ (lighting the foot well) was therefore included on the feature list. But when the engineers developed this concept for production, it was done in such a poor manner that the feature was missing key NQPQs, leading to deletion due to a combination of poor execution and the cost of embedding it: *'...When the innovation group tested it on customers, they loved it! Oh, great when you go along horrible country lanes it makes you warm, and nice and comfortable. So we said put it down, they wrote it down as a part of the product programme (feature list). The engineers eventually got some brief that said: "light the foot wells of the car up", that is what it said. And they went, "How are we lighting the foot well up?" Put a light bulb under it...they then presented it to us: "That's horrible, why would anyone want that?" They tested it on a few people, and they went: "It is horrible" How much it is? £5! ...delete it! What went wrong? It was not communicated. The point wasn't put a bulb in the thing. The point was if you put a warm glow here it will make the people feel comfortable and safe. The aim is to make them feel comfortable and safe. What design thing can make that work? That is what it should have been' (DPb042).*

Summary of new findings or new details to existing findings

- NQPQs are victims of three different types of cost related challenge: 1) It is believed that they are costed in early in the design process, but they are not, 2) Customers seem to be willing to pay for some NQPQs but cost (and price) is already fixed, 3) Degradation of NQPQs happens at part level, but is then visible at product level
- Customer perception of product quality is often the sum of many individual NQPQs (and QPQs) but because they are difficult to define and quantify, they often suffer from deletion at the level of a 'part'
- In the product development and decision making process it is easier to delete a quality that is difficult to define (whether it be a physical measurement or an emotional reaction)
- NQPQs are often targeted during cost-reduction exercises because it is difficult to defend them

Confirmation of findings

- NQPQs are often degraded during cost reduction exercises
- The reported difficulty in protecting NQPQs is that the case-companies can not estimate their impact on customer satisfaction and revenue
- It is difficult to protect NQPQs during cost reduction because functional and technical QPQs are perceived as essential while and NQPQs are not

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

5.4.6 Theme f – Decision making and responsibility

In the exploratory stage it was observed that managers' roles in the decision making concerning NQPQs were twofold; they would either seek consensus or they would steer the decisions in a specific direction based on the manager's expertise. In the descriptive stage new data were sought in order to elaborate further on the decision making process concerning NQPQs. An initial understanding of decision making might centre around the stage-gate process and meetings, because it is here that progress is assessed and decisions are discussed and presented, but commonly it is not in this forum their decisions are primarily made, as was found in the descriptive stage.

Decisions to do with NQPQs are made by many people throughout the product development process, and they are made as a result of a process involving people as diverse as competitors, customers and field specialists. Within the product development process some decisions are made by individual product developers while designing individual parts of the product. Other decisions are made at a higher level where parts come together to create the product. Here it is more likely that managers are in control of making a decision. The fact that many NQPQ decisions are made by the individual, and that those decisions are rooted in subjective assessment is described by Throop: *'Designers make subjective aesthetic assessments throughout the design process. Subjective assessments are central to framing design problems and refining their solutions (Throop, 2004: 1)*. During product reviews and preparation managers and senior managers are influencing the product through selecting among alternative product solutions or making alterations based on their perception of the product and what they believe the customer would appreciate.

- The decision making process is intertwined in a complex meeting structure, where smaller decisions are made. Most decisions are discussed and decided away from the structured meetings like stage-gate or team meetings

New findings/new details

What informs the decisions

It was observed that decisions concerning NQPQs are made on the basis of various inputs. In the early stages the comparative set is used to steer NQPQs decisions. When it is decided where the new product is positioned in relation to the comparative set, the desired NQPQs are, if at all possible, then broken down to QPQs to aid embedding. But the comparative set remains a reference point for decision making throughout the product development process.

Drawings, and especially mock-ups and more elaborate models like various part prototypes inform the continuing decision making about NQPQs, but especially in the design phases. They are often the start point for discussions, where they, supported by dialogue, they help the decision makers to understand how NQPQs fit into the overall product idea and how they should be interpreted in the overall perception of the product. Having drawings and models or other physical artefacts is very important for the decisions concerning NQPQs because these are often the best way to communicate them and to influence the decision concerning their embedding.

- Visual or physical stimuli like drawings, models or prototypes are important in decision making

New findings/new details

In some instances NQPQ decisions are made through pre-set rules or guidelines. Guidelines are, for instance, used to ensure consistency of design in the user interface of mobile phones. Other examples are rules about only using genuine materials (when it looks like leather it must be real leather and not a synthetic material) or characteristic shapes of the product that enhance product (or brand) recognition (typically the grille of a car, or headlights).

By having a comparative set, guidelines and NQPQs fixed into QPQs through models, measurements and various other parameters, objectivity is sought as a basis for making NQPQ decisions. But, as stated by Throop: *'Designers, unlike engineers, routinely employ cultural and aesthetic considerations to frame problems, analyze needs, synthesize possible approaches, and choose optimal solutions. Many of these considerations are subjective in nature. Even design issues that seem to be objective may in fact rely on the subjective way that designers or their clients frame a design problem'* (2004: 2). Although Throop only refers to factors that are influencing the embedding of NQPQs, these should not be seen as exclusive. It is key to understanding the process of embedding NQPQs that minor decisions are made all the time by the individual product developer.

How are NQPQ decisions made?

There seem to be three main ways to make decisions concerning NQPQs:

- Consensus – among a group (product development team, steering committee etc.)
- Non-consensus – a manager decides (this can happen at various levels)
- Power (based on determination rather than rank)

Consensus and non-consensus approaches were observed in the exploratory stage, and these were confirmed in the descriptive stage. When asked, managers tended to mention non-consensus rather than a consensus approach, because it is believed that if you try to please everybody you will end up with bland NQPQs. But when observing product developers in the descriptive stage it became apparent that support is sought through many small encounters among people involved in the product development process in daily conversation, where designs of NQPQs are discussed. This observation is supported in literature by Cuff who describes it like this: *'An issue is raised, discussed, a related issue is raised, then a third, and none is decided'* (1991: 191). According to Cuff many issues in design project are 'emergent', they are not determined by a single meeting but emerge over time *'as a series of understandings modified by new information and opinions'* (ibid). This idea of emergence of understanding over time seems more appropriate than describing it as a process of seeking consent, although it might be the end result.

- Managers span two potentially opposing roles: consensus seeking or steering a decision through resistance from the team.

New findings/new details

On a higher level, project managers might talk to representatives of steering committees before they are going to be present in a meeting concerning design decisions. And sometimes even top/senior management get involved if 'lower' people will not agree or let go of a NQPQ idea/quality/vision. Sometimes NQPQ decisions are a result of compromise because the financial backing is lacking, and decisions are moved up the hierarchy, if for instance project and product managers can not agree on a solution: *'...Sometimes we can use an off-set of something we have had to compromise on somewhere else, not to fund it, but say look – we've got to draw a balance here. So for example on this particular car we gave up on the 'slush-technology' on the instrument panel, so we have given up a little on that but it is still good, but it is not as good as we wanted, so we have to make up for it else where ...to make a nice soft material elsewhere.... That paint that we want to apply on these finishes or this in-mould decoration really, gives a much better ambient feel so overall this is a better balance, but somewhere someone has got to pay for it and that question we would like the*

steering committee to answer. They have got the power to do this, of course' (PG1a333).

Knowing influential people and preparing them can be a very useful way of ensuring that NQPQ decisions are made according to an individual's personal belief. In this way some NQPQ decisions are made on the basis of a personal opinion or belief, some are supported by data and some are reached in consensus among a group of people, as one interviewee stated *'the higher in the hierarchy you are – the less data you need to support your view'* (SK194). There are various examples of how decisions are influenced by people using power. In one case-company a design manager was mentioned by an interviewee as someone that was able to speak to everybody in their language, meaning that he could communicate with engineering, marketing, product planning etc. and appear to understand their perspective and function while still pushing for what he found important. His mantra was 'refinement down to the smallest detail', and this seemed to go well for any aspect of the product and especially emphasising design and NQPQs. In this case the power lies in being a great communicator, but there are other examples where product developers have been able to push a NQPQ purely out of personal belief in something that they have been in a position to embed into the product by pushing it rather than gaining support from others. Strong willed individuals are able to influence NQPQ decisions by arguing the NQPQ case to decision makers. These individuals are often managers, but that is not always the case.

- The higher you are in the hierarchy the less supporting evidence (customer data) you need to have for an NQPQ to get embedded into the product
- Embedding some NQPQs can be heavily dependent on personal champions that guide and argue the product quality into the product, by being strong willed or argumentative

New findings/new details

In one of the case-companies a functional group has been designed with the sole purpose of overseeing the embedding of 'perceived quality'. This group has the right to veto any decisions that they believe will degrade customer perceived quality to a degree where it is unacceptable. This group has a strong impact on NQPQ decisions, and has a very elaborate understanding of NQPQs. In effect this group acts as a policing mechanism, constantly checking that decisions about NQPQs are implemented and if not, that they are at least readdressed, as this manager explains their involvement in the early phases: *'...We will validate the info digitally (drawings/models). Go through every shot line, surface, texture, to make sure that we have captured every concern we could think of. Feed back to relevant people ensuring that we can fix whatever'* (PG1a).

Sometimes a decision is changed during the product development process, because people are no longer involved. This example shows where the person involved in finding and embedding NQPQs in the early stages, leaves the project and the quality is left to others: *'...Don't let the graphics designer leave the*

project before it is ended. No matter how good the remaining designers are, the graphics will be left behind. I have been called to many meetings to answer questions about why the graphics look the way they do. Sometimes I have not been able to answer, it was simply too long ago since I worked with it. In other cases many others had touched the graphics after I left. I feel that graphics looked good in the beginning of the project, but lost many of their qualities during the process' (WBp41). This is a big threat to NQPQs because many small design changes can have a profound effect on the NQPQs and product as a whole. Many small changes can lead to NQPQ degrading and sometimes even deletion, as people who were involved in the early phases of exploring, finding and embedding, are left behind when the product is handed over. The continuous ensuring of NQPQs being embedded into the product through various stages of the product development, are often dependent on peoples' ability to see and understand them. As some NQPQs remain ill-defined and non-quantifiable throughout the product development, sensitivity to how new decisions affect the product is very important. Otherwise a NQPQ decision might be unintentionally altered because it is invisible to the people that are involved in the process downstream. In academic research this has also been observed by Eckert & Stacey (2000: 536): *When the recipients are unable to reconstruct the new design from a shared context, or understand its implications, the only way to judge it is by the originators' authority and confidence'.*

New findings or new details to existing findings

- The decision making process is intertwined in a complex meeting structure, where smaller decisions are made. Most decisions are discussed and decided away from the structured meetings like stage-gate or team meetings
- Visual or physical stimuli such as drawings, models or prototypes are important in the decision making
- Managers span two potentially opposing roles: consensus seeking or steering a decision through resistance from the team
- The higher you are in the hierarchy the less supporting evidence (customer data) you need to have for an NQPQ to get embedded into the product
- Embedding some NQPQs can be heavily dependent on personal champions who guide and argue the product quality into the product, by being strong willed or argumentative

Confirmation of findings

- Managers' judgement can have a big influence on the NQPQs
- Estimated revenue value influences the embedding of NQPQs
- Customers are invited to judge NQPQs at various design stages

- A Perceived Quality group can be given a specific responsibility to judge the NQPQ embedded throughout the product development process
- Decisions to do with NQPQs are made during gate reviews on the basis of whether or not people feel that the NQPQs are embedded in the intended way
- The decision making process to do with NQPQs is often very dependent on the individuals involved in the team, and on the leader. Personal opinion and the ability to convince other people are important factors when making decisions about NQPQs
- It is not clear who has the responsibility for the NQPQs. In the vehicle case-companies the project manager (financial responsibility) and the Chief Project Engineer (product responsibility) are both involved in the overall responsibility, but there is no clear delegation
- The higher you are in the organisational hierarchy the less data you need to support your decision about an NQPQ
- Marketing has a big impact in the decision making process on NQPQs
- Design (department) and advanced activities groups (innovation) are often involved in the early development stages of NQPQs, but some are not represented all the way through to the manufactured product
- The design department is in charge of designing most of the visual NQPQs, but they do not necessarily have a strong say in the decision making process
- Consensus decisions are commonly sought, but they are also believed to give bland design/NQPQs, so the non-consensus decisions are now commonly sought across the case-companies
- One company emphasises the importance of creating a product team with the people who understand which NQPQs are important by mirroring the target customer in the choice of team.

There were no findings where there was 'No evidence for confirmation or rejection of the finding'.

5.4.7 Theme g – Communication of NQPQs

This section will discuss different ways of communicating NQPQs in the product development process, and how they aid the process of understanding and designing of NQPQs.

From the analysis in the exploratory phase it became apparent that more investigation into the process of communicating NQPQs was needed. The observations during the exploratory phase seemed to indicate that the way

NQPQs are communicated and understood among product developers are crucial for their embedding. This section will present findings from the descriptive phase and link them with existing concepts and findings from literature.

Communication in the design process of NQPQs is to be understood in its broadest sense: dialogue between a few people; individuals communicating ideas on paper to show others or just to evolve their own understanding; one way communication like presentations and communication across functional groups within the organisation.

The means of communication in the design process is dominated by verbal communication and representation of the final product in the format of drawings and models. The starting point will be to understand the role of drawings and models better and then link it to verbal communication. Finally a discussion about the link between communication, understanding and types of knowledge will be presented.

Drawings

Drawings are of paramount importance in the process of designing and are used for many different purposes throughout all stages of design (Scrivener et al., 2000; Akin & Lin, 1995). In this research it has been found that they are used to illustrate ideas, develop concepts and externalise and embody the product intent in the early stages. In the later stages they communicate details and numerical facts in order for production to manufacture the product. All the way through the design process drawings remain the most information-rich representation of the final product. The development and interpretation of drawings is what provides a vast majority of the embedded product qualities.

Different types of drawings

This section will form a discussion on the basis of observation. First a description of how sketches, drawings and models are used in the product development process will be presented and then new insights extracted and juxtaposed with existing categorisations of drawings.

Drawings are used early on in the design process in the format of sketches. On the basis of the product brief, designers will normally start to develop conceptual drawings of the product. The designer would usually start this process individually, playing with themes/ideas that have been instigated by the verbal description of the product intent. This process is often also inspired by mood boards illustrating the desired product ambience through images, colours and stylistic representations of existing products, the context of where the product is going to be used and the atmosphere/ambience. At this stage sketching allows for imprecision and abstraction of the product details, hence the product quality is the focal point at this stage. The core quality of sketching is that by being ill-defined at communicating detail, the rapid format indulges the perceiver to seek verbal confirmation about how the sketch should be interpreted. The format also invites alterations, and the sketch works as a medium for a conversation on paper – this conversation can either be between the creator of the sketch and the sketch, or very often the creator of the sketch will present and discuss it with

fellow designers. At this stage drawings are used to aid thinking about potential interpretation of the brief and consequently the design of potential product representation. Sketches work to develop and communicate desired product features and qualities. In the early stages sketches do not contain any numerical measures, they are deliberately kept vague.

Drawings and 3D models

When many conceptual sketches have been developed – often hundreds – a selection is made of the best ideas, and new drawings will be made by combining ideas from various sketches, by for example merging the rear end of one vehicle with the front of another. Slowly the drawings become more and more detailed, transferring the sketch to Computer Aided Design (CAD) drawings, and in the automotive industry clay models will be the next stage of detailing. Models are also used early when developing mobile phones. They are likely to be developed to a stage where mechanical functionalities represent the final product well, but software functionalities might not work. Later prototypes are used to get a better understanding and communicate things that you can not see in a drawing. They are helping to get closer and closer to the actual final product, by adding more and more detailing. Various models are also used throughout the product development process to get reactions from customers, experts and suppliers.

Sketches are used in the design process to turn intangible ideas and visions into something tangible. Sketches are the first physical representation of a virtual product. They help to make sense out of the product brief, by moving from intent to embodiment. This use of images and drawings has been described in literature as visual sense making (Press & Cooper, 2003: 136). This idea of visual sense making can be enriched by adding a categorisation of drawings by Ashwin (1989).

Ashwin (1989) has categorised drawing into three levels of specificity:

- Monosemic; drawings where there is only one correct way of interpretation, such as maps or engineering drawings
- Polysemic; drawings where more than one interpretation is possible, such as sketches of car from which there may be interpretation of speed, strength, power etc.
- Pansemic; drawings which have unlimited interpretations, such as abstract or non-figurative drawings

This categorisation of different levels of specificity can enrich our understanding of visual sense making. As found in the data, sketches are often the starting point in the design process. Their primary objective in the initial phases of design is to make (visual) sense out of the product brief, by moving from intent to embodiment. Sketches can be characterised as polysemic, because they can be interpreted in more than one correct way - they allow for a certain degree of abstraction and impression. This abstraction allows for dialogue, alteration and general sense making through the interplay between visual and verbal communication. The further into the development the more detail and precision

is needed and the drawings will start to communicate numerical information. By doing so there will only be one correct interpretation and the drawings are becoming monosemic. Engineering drawing can be classified as monosemic. The transformation from polysemic drawings in the early conceptual phase to monosemic drawing in the detailing phase also allows for a broader sharing of drawings, because accompaniment of verbal guidance for interpretation is not needed.

Ashwin (1989) has also categorised drawings according to their communicative function; Referential, Emotive, Conative, Poetic, Phatic and Metalinguistic. He states that most drawing for design is a combination of each of the functions, depending on the type of drawing. In this research especially, two of the functional categories add to our understanding – the Emotive and the Referential function. Ashwin defines the Emotive Function as one where the drawing is deliberately designed to evoke certain subjective and emotive reactions such as pleasure or repulsion, whereas the Referential Function is embedded in drawings where the transmitter wants to avoid any ambiguity and remain objective. In the early stages of design, conceptual sketches are used to communicate more emotive qualities where a certain subjective response such as delight, or attraction is sought. By choosing drawing style, colour and perspective to add an emotional dimension, the designer can influence how the drawing should be interpreted. The further into the design process the less emotive drawings become – they become referential. Referential drawings aim at describing something in as objective and dispassionate a manner as possible. This is the case with engineering drawings where any ambiguity is avoided by using standard coding and signs to communicate the desired meaning.

Drawings and NQPQs

It has been observed that sketches are used to communicate more emotion evoking qualities in the product. Their emotive qualities allow them to be a starting point for dialogue about what they represent, hence sketches were often seen to be followed by a story or analogy that enriches and guides the desired interpretation. This makes sketches an information-rich format for communicating NQPQs, but the dependency on guidance for the right interpretation makes it inefficient in the later design phases and they are therefore transferred into a referential format, which allows for only one correct interpretation.

The drawings go from being polysemic and emotive in the early conceptual phases to being more and more monosemic and referential. During this process QPQ becomes more and more well represented in the drawings – the format becomes more and more specific, allowing for much greater detail about a product quality that is defined in a measurable way. NQPQs that are not easily transferred into a monosemic format suffer if they can not be turned into these codes, signs and numerical measures. It is often a challenge to transfer NQPQs into codified, numerical representations without losing some of their quality. The problem is that sometimes when a transformation is made from an emotive non-quantifiable representation to a referential one, the understanding of the

desired product quality might remain in the head of the product developer, and is not then embedded in the product representation – the drawing.

Drawings are often the focal point when product developers are designing product in the sense that it works as a medium in the conversation between people. Schön (1991: 78) describes designing as a '*conversation with the materials of the situation*'. This concept will be elaborated in the next section, which looks at verbal communication.

Verbal communication

Verbal communication penetrates the design process and is used for many different purposes: *'it is used in the communication of constraints and requirements; in group problem-solving and decision-making; in designer-client dialogue and negotiation; in inquiry, research, and testing; in naming, specifying, presentation, and elaborating; and in evaluation, application and interpretation. But such language is also easily overlooked and undervalued* (Flemming, 1998: 42).

From the many designer-to-designer, engineer-to-engineer conversations that the author overheard while on site it appears that language serves two main purposes in the design process: Firstly it is used to verbally understand and construct the product while it is still virtual – so the language is the product. Secondly it is used to communicate knowledge, experiences and approaches that influence the process of *designing* the product. The first observation is supported by Flemming (1998: 49) who argues that in the instances where the material object can not function to propagate itself across space and time, or when there is not a material representation of the product, language is the product. The other observation is supported by Manish (in Gorman 2004: 44) who argues that human knowledge, experiences and approaches are stored and transmitted through the use of language. He goes on to say that *'the language which defines the problem or solution has to have a direct effect on the approach on the situation'* i.e. the process. These two purposes are intertwined and difficult to separate but, by looking at verbal communication through this bifurcation, a new understanding of the design process in general, and NQPQs in particular, emerges.

Dialogue in small groups dominates the early stages of product development. Often a brief is received by a product developer and it might not make sense in some of its phrasing or specification. The designer/engineer will seek verbal conversation with the person(s) who has been developing the brief, in order to make sense of it. Often a few people will be involved with the early physical development of the product, and they will discuss the brief and how to interpret it. The verbal dialogue will soon be supported by sketches and the conversation will be a '*reflection-in-action*'; the interplay between dialogue, sketches and interpretation of the two (Schön, 1991). This process is particularly prominent in the early stages of design, until the product is well defined in specifications, drawings and models. In these early stages the embedding of NQPQs is at risk

because NQPQs rely on interpretation, and if a shared understanding and common language is not developed there might be a risk of losing them before they have even had a chance to be embodied in the product. Through dialogue designers share their understanding of a desired product quality, based on the brief. By talking about what is sought to be embedded they build their own understanding and calibrate this understanding so it is similar to that of others involved in the product development team. Tomes, Oates & Armstrong (1998) describe it as a process of experimentation in which verbal interpretation of the visual and the visual realisation of the verbal are discussed among the team members for critique and modification. During this process designers are likely to use 'shared cultural references' to express design ideas as Eckert & Stacey (2000: 524) observed in the knitwear industry; where designers describe design *'almost exclusively in terms of combinations and modifications of design elements, that they refer to either by category labels or by their origins – in other designs, or other images'*.

- Understanding of NQPQs is often developed and shared through drawings and dialogue

New findings/new details

The importance of drawings has been described by Schön, who argues that the materials of the situation 'talks back', stating that *'drawing and talking are parallel ways of designing'* (Schön, 1983: 80-81). Cooper and Press (2003) have similarly described drawings (and other images) role in what they call 'visual sense making'. Weick (1995) argues that sense making happens collectively, often through verbal communication. This research confirms these statements, by emphasising that not only do drawings and dialogue influence the development of NQPQs, but they also play a very important role when sharing with others, *what* has been developed and *how* it should be interpreted.

The language of NQPQs - what are NQPQs called?

In the product development NQPQs are spoken about in numerous terms. Some interviewees describe them as 'emotional qualities' or 'emotional product', meaning that they evoke (preferably desirable and pleasurable) emotions in the customer. They are also described as 'wow-factors', 'wow' illustrating the verbal expression of a person who is impressed and pleased with what the product offers. Sometimes NQPQs are mentioned in relation to the product being 'innovative' or having 'innovative features', meaning that there is an element of novelty in the product. Sometimes NQPQs are linked to the overall product offering in terms like 'why buy' or USPs (Unique Selling Propositions) meaning the qualities and features that the product offers to the customer. Some NQPQs are linked to branding and serve as signifiers of brand identity, values and qualities.

Most of these terms are not shared or used in a consistent manner across the organisation. They appear in small pockets in the organisation, where they are being added to the common language of individual groups like the marketing,

design or engineering department. A few of the terms have reached a more widespread understanding and use, and can now be characterised as 'labels'. USPs or what one company calls Brand Signatures might not be understood by everyone in the product development process, but most people know that if an NQPQ is labelled a USP or a Brand Signature it can not easily be degraded or deleted – it is sacred. The use of labels can help to signpost an NQPQ that otherwise might be lost (deleted) in the product development process.

- Labels are used for NQPQs because they work as signposts, adding to communication and understanding of NQPQs

New findings/new details

Stories, metaphors and analogies

When designing something where no existing design can be used as a reference for what is embedded, it is common to use stories, analogies or metaphors.

Through the use of stories, the product developer might be given a context of where the product is to be used, the daily life of the user and how the product will fit in and give the user an experience by facilitating a set of NQPQs. Often customer profiles help to set the scene for such stories, by presenting lifestyle and values in a profiled character. Sometimes real customer stories form the basis, at other times it is more the thought scenario – a speculative situation that is described in the story with an imagined customer in focus. An example was the use of a character in the TV soap (Miranda in Sex & the City), for conceptualising car interior solutions. By setting up a scenario of a day in her life, her values and perceived product pleasures were used as a focal point for imagination and selection of design ideas. Denning (2004) argues that the use of stories in organisations can aid the sharing of knowledge and transmit values. In relation to the process of embedding NQPQs, stories work to preserve the virtual understanding of what is sought to be embedded physically. Throughout the interview data interviewees talk about embedding NQPQs in ways that, although often abstract, share the characteristics of stories. One such characteristic is the process of evolution, the notion of a start point, action and endpoint in the process of embedding NQPQs. This historical underpinning is often crucial for the embedding (survival) of NQPQs because they are difficult to successfully transform and embed as QPQs, whereas the richness of stories can exemplify what is sought to be embedded through verbal imagery.

- Product developers often use stories, metaphors and analogies

New findings/new details

Metaphors are used to express more conceptual ideas – for instance 'a floating centre stage' (the centre stage is the middle of the instrument panel that in this case appears disconnected from the floor of the car, giving the illusion of

'floating' or 'hovering'). In reality there is no such thing as 'a floating centre stage' because it has to be fixed somewhere, but the appearance and ambience of something that needs no physical support will help the designer to embed this NQPQ. Metaphors are used to express and understand one kind of thing in terms of another (Lakoff & Johnson, 1980). Metaphors can carry meaning by turning something complex into imagery. In the late 1980s Honda created a catch line to help designers and engineers develop a car that should deliver 'an adult sense of reliability' (Clark & Fujimoto, 1990: 110). But it was found to be too abstract to guide the product and process engineers who would be making the concrete choices about the specification of this new car. Instead they sought an *image* that would illustrate the message the car would send to customers, and came up with the idea of '*a rugby player in a dinner suit*'. This image was chosen because it was thought to evoke association with rugged physical contact, sportsmanship and behaviour of gentlemen – all qualities that the new car sought to convey. It was also believed that the image was concrete enough to translate clearly into design details.

Analogies are also commonly used to describe design intent that is difficult to express in a direct way, but is more directly linked with what is sought to be expressed. Like for instance: 'The speed and movement by which this CD player opens should be similar to the one of automatic doors in the airport.'

The reason why stories, analogies and metaphors are used seems to be that they can contain complex ideas in a simplified and memorable way. This means that they can play a vital role as integrators for people involved in the product development process, because they can help to provide a focus that is otherwise hard to achieve (Dumas, 1994). The richness of description is very important for the understanding, transformation and embedding of NQPQs. It seems from the data that the richer the shared language, the richer the understanding and as a consequence there is a stronger awareness of NQPQs. This view is supported by Weick (1995: 4) who states: '*vivid words draw attention to new possibilities, suggesting that organisations with access to more varied images will engage in sense-making that is more adaptive than organisations with more limited vocabularies.*' But we have to be aware of the potential disadvantages of a shared language as well: Schön argues that when designers '*speak in words or drawings, their utterance refers to spatial images which they try to make congruent with one another. As they become more confident that they have achieved congruence of meaning, their dialogue tends to become elliptical and inscrutable to outsiders*' (Schön, 1983: 81). This can be observed in the case-companies when one group or set of people (design and marketing mainly) work hard to generate a shared 'story' for a product, but fail to involve those who will carry the ideas forward, even to the point of confusing them (such as during handover to engineering).

- Metaphors and analogies are used by companies because they aid the embedding of NQPQs and because they can carry a complex idea in a memorable and impacting way

New findings/new details

Written communication

Written documents exist throughout the product development process, but are rarely seen in the product development environment, although interviewees refer to them occasionally. The first document is the brief, created by marketing and product development. This document frames the product in an emotionally rich format, talking about what emotions the product should evoke in use, the context of use and often a stereotypical user description. Early documents will follow the product and present the comparative set, some technical requirement and in some cases verbatim transcripts from customer clinics that will help the product developer to understand the motive and desires of the targeted customer group. The further into the product development process it is the less qualitative and more quantitative the document will become and often the initial design intent is not even present in the later document. From the interviews it appears that the written documents which follow the product have not got a prominent function during the design process. They will not document the reasoning behind selections and decisions influencing the final product, neither will they present the product in a coherent way, because drawings seem to take over and only communicate the final result.

New findings or new details to existing findings

- Understanding of NQPQs is often developed and shared through drawings and dialogue
- Labels are used about NQPQs because they work as signposts, add to communication and understanding of NQPQs
- Product developers often use stories, metaphors and analogies
- Metaphors and analogies are used by companies because they aid the embedding of NQPQs and because they can carry a complex idea in a memorable and impacting way

5.5 Chapter conclusion

The descriptive stage set out to confirm, add detail or reject the findings from the exploratory stage, and compare these findings with literature. The findings from the exploratory stage were presented as 9 themes. During the second phase of data collection and analysis new findings emerged which suggested that some

themes were so intertwined that they should be combined. A new theme concerning communication of NQPQs emerged out of the new (and old) data. This led to the presentation of 7 themes as the outcome of the descriptive stage.

By collecting data through new sources, such as document analysis and observation, triangulation was sought. In case-company A 20 new interviews with a broad set of people involved in the product development process added depth into understanding how they embed NQPQs. The researcher spent two weeks staying with case-company B. Here observations of designers were gathered, as well as interviews with a number of people outside the design department. New data from Case-company C was centred on a series of interviews with the leader of Perceived Quality.

The descriptive stage has contributed to a richer understanding and new answers to the research question. The embedding of NQPQs happens through a stage-gate process which is predicated on quantifiable product qualities, which is shown to put NQPQs at risk if not translated into quantifiable.

The process of translating customer needs into technical specifications is shown to be challenging, even for simple and technical customer needs. The translation from brief to specification is poorly defined, with unclear responsibilities; there are no tools used by the case-companies to support this. The prevalence of metaphors, stories and drawings to create shared mental models is partly an attempt to meet this need to have a clear link from product back to the customer, to aid product development decision-making.

Handover from one function to another was problematic, even for concurrent engineering environments, putting NQPQs at risk as they were not fully understood by the receiving function. The primary tool to avoid this is for NQPQs to be translated into QPQs by the originator, then to argue that QPQ into the specification. The Finding-Assessing-Keeping model was introduced to explain the stages that successful NQPQs go through, for example the designer may find an NQPQ but then fail to convert it into a QPQ; This would mean that it was unlikely to become part of the formal assessment system – the stage/gate review – and was therefore at risk of being lost.

Various solutions to this were observed – some in the area of management decision-making, where it was seen that some NQPQs survived into the final product through support of personal champions, and that the higher you are in the hierarchy the less supporting evidence (customer data) you need to have for an NQPQ to get embedded into the product. Other organisational solutions were observed – having specific roles (such as a Perceived Quality function or using Studio Engineers) to help maintain focus on issues of importance to the customer throughout the product development process; or using specific techniques such as labelling or having brand rules. Using customers themselves was also observed as becoming more important; whether they are passively involved in early stages (such as being videoed using a similar product) or actively involved in assessing the proposed product against other similar products. There were no observations of co-creation or other extreme forms of customer involvement.

Some of the customer interactions were through benchmarking or indexing activities, which allow the product developers to retain their numerical emphasis while involving customers. Less structured approaches for involving customers were not frequent later on in the process. This is an example of the tools and techniques becoming more quantification based as the product development process progresses. Another example is the manner with which the case-companies responded to cost reduction pressures. As the pressure to reduce cost increases later in the product development process, the engineers were seen to respond by removing NQPQs. These were an easy target, because they may not have been in the specification. If the NQPQ was in the specification it may have been poorly defined, and even if clearly defined it may not be able to defend its inclusion when under attack to 'explain how much more the customer will pay for this quality'.

Under such an attack, many NQPQs are dropped. It appears that one of the main reasons why such an attack is likely to be successful is the lack of a shared mental model – different actors understand the rationale of the NQPQ in different ways. Without shared understanding of why, what and how a certain product quality is proposed, then one group under pressure to achieve their targets can target those product qualities they least understand. The more successful examples described the use of metaphors, analogies and stories to aid the embedding of NQPQs, because they can carry a complex idea in a memorable and impactful way.

Chapter 6

Discussion

This chapter presents the author's thoughts based on the research project.

6.0 Chapter structure

This chapter presents thoughts, observation and concepts of potential interest to the reader. This chapter is presented in two parts; firstly section 6.1 brings the author's perspective on important observations, secondly section 6.2 presents a model where the answers to the research question are positioned. Section 6.3 concludes the chapter.

6.1 The author's perspective

This section will elaborate on some thoughts that the author finds relevant in the research. These are typically based on observations or findings.

The necessity for transforming NQPQs into QPQs has increased as a consequence of the increasing number of people involved in the product development process and their increased specialisation. Since the design and product development process evolved from including only individual, or a few designers, such as for example craftsmen, to big multinational corporations, it has become more and more important to communicate the product intent in ways that are less ambiguous. When individuals were in charge of the whole product development process, it was not as important as it is today because that individual would understand the product intent and embed this throughout the design and manufacturing process. Today the product development process is characterised by increased specialisation and roles in the product development process leading to many handovers. The specialisation and periodical involvement in the product development process today means that the implicit understanding of product qualities that are less quantifiable are less likely to be embedded as intended unless they are made more quantifiable. It appears that there is a tendency to

turn product intent into features early in the product development process. It is, for example, difficult to follow how NQPQs move from conceptual qualities like these: 'This vehicle is trustworthy, honest, hard working, fun, loyal and dependable. It helps me take pride in a job well done' – into product qualities such as 'good storage space, flexible comfortable seating and catch on rear door'. There seems to be no explanation as to why these (customer satisfaction) features are selected, as there is no stated explanation or documentation. It appears as if there is a very quick and unexplored translation between the conceptual qualities wanted and the features that potentially fulfils this. This indicates that **there is a big leap from design intent to feature**. The leap makes it difficult to go back and check that the feature fulfils the initial design intent, which indicates the risk that **product developers might forget the intent and only focus on the feature**.

Throughout the research it was observed that people involved in the product development process preferred to communicate by using the support of numbers whenever possible. Numbers are perceived as less ambiguous and less influenced by subjectivity. Although numbers can aid clear communication of desired product qualities, they can also change the focus of what they are communicating. Boyle argues that whenever numbers are used to measure something, the qualitative aspect of what they are measuring – which can be the most valuable aspect – gets driven out (Boyle, 2000). Communicating through numbers increases as the number of people involved in the design of a product increases, because they have had to practice communication through numbers in order to embed product qualities consistently and efficiently across different functional groups over time. **There is strong evidence of a desire to communicate through numbers**.

The emphasis on product qualities that can lead to customer satisfaction through emotional fulfilment is highly acknowledged in the popular media and academic research. Much has been written about the importance of a product's ability to provide emotional satisfaction to the customer, and although many companies openly acknowledge the importance of these less quantifiable product qualities, it is not always echoed in their product development. Companies that focus on emotional satisfaction, often deliver it through a focus on design-for-experience. In the observed companies, there seems to be a difference between product categories. The rapid technological evolution in the mobile phone industry, seems to influence the mobile phone company in a direction where NQPQs play a significant role in ensuring product differentiation and brand identity. In a market saturated with mobile phones that provide the same functionality, design-for-experience has long formed the focus for product development and is largely centred on NQPQs compared to QPQs. There seems to be a tacit understanding that NQPQs are more difficult to copy, hence they are valued highly throughout product development phases. In the automotive case-companies technological development has not provided such radical changes and many product developers still see the core product qualities as being the provision of functionality and reliability. **The automotive case-companies appear to struggle to maintain a deep understanding of what sells**

their products – they are very engineering-based, and do not seem to recognise the current notion of designing-the-experience.

It was observed that NQPQs are communicated well through the use of drawings and images. People seem to better understand the ideas when they are supported by visual stimuli. Sketches and drawings are dominant in the conceptual stage, where the design function is responsible for the physical design of the product. Unfortunately these sketches and images (e.g. mood-boards) and initial drawings are then substituted by technical drawings which can only communicate well-defined or quantifiable product qualities. It could be beneficial to product developers across the organisation if they saw more of these early sketches etc. as they are likely to give them a better understanding of which NQPQs that are sought to be embedded, as well as understanding how the different product features and qualities come together as a whole. Although images and sketches carry more ambiguous information and allow for more diverse interpretation, they are also able to communicate product qualities that technical drawings can not (e.g. by using different perspectives the product can be made to look tall, solid and give the perceiver an emotional reaction such as security). Models are more widely used throughout the different stages of design, but tend to be dismissed when a decision has been made and are then replaced by technical drawings. Models should, whenever possible, remain visible in the product development environment as they work as stimuli to see the product as a whole, showing how parts come together. The use of customer observation or verbatim recorded on video is today mainly used to inform concept generation of new ideas, but it could be beneficial for engineers to be presented with this customer insight. Throughout the research it became apparent that many technical product developers focus on parts of the product that are not in direct contact with the customer, and that the customer might value aspects of the product that are different from the aspects valued by the product developer. **Information-rich formats such as sketches, drawings, images, models and video could be utilised and shared better.**

There seem to be tools that can help the consistent embedding of NQPQs, for example the use of virtual customer profiles, guidelines and labels (such as: brand signature, wow-factor, USP and must-buy's). It appears that the common characteristic of all of these is that they can help to create a shared framework or a mental hook in the minds of the product developers across the organisation. The reason they help is probably because they work as signposts – they make NQPQs visible. For instance a label can verbally signify a specific NQPQ (e.g. USP or a wow-factor). **Virtual customer profiles, guidelines and labels all work to help ensure NQPQ design and implementation.** Encouraging (cognitive) visibility of NQPQs, through the use of signposts, will help avoid missing, ignoring or losing NQPQs in the various stages of design (e.g. finding, assessing and keeping). The use of signposts can also make it more likely that NQPQs are included in the budget for the product.

It was observed through the research project that the transformation of NQPQs into QPQs seems to happen without sufficient awareness to what might not easily be translated into quantifiables, and therefore be at risk of being lost. The

tendency to turn NQPQs into QPQs seems to be so ingrained in the product development environment that many product developers do not seem to notice this process. The author believes that **if people were aware of the natural tendency for their colleagues and for themselves to transform NQPQs into QPQs, it might make them better at identifying situations and moments when they could lose NQPQs.**

The language of NQPQs is sometimes poor. This means that it is rarely shared across functions (e.g. design, engineering, marketing). This affects understanding and embedding of NQPQs profoundly, and it would be beneficial if actions were taken to develop and deploy an NQPQ language. This could be done through development of a shared terminology (e.g. labels, USPs) and shared conceptual models of the process of embedding (e.g. Finding-Assessing-Keeping). Improved understanding and communication could also be encouraged through shared examples (e.g. a material surface database). **Conceptual models about the process of embedding NQPQs might help people to create mental models that make them more aware of what is happening to the NQPQs during the different phases of development.**

Throughout the product development process there seems to be a misalignment between the people in charge of developing NQPQs and those who make the overall decisions about them. It is common that one group develops the NQPQs based on the design intent (e.g. a design team being responsible for the development of a innovative door handle by using a new locking technique and material) and another group will make a decision whether it is actually going to be in the final product (the project team might decide that the solution is not affordable). The design team have the responsibility for designing a product according to the intent, but they do not have the power to make important decisions, which might influence how well it is embedded. This indicates that **ownership is often not aligned with decision making power.**

Looking at a particular product that has been received well in the market (sales figures and customer satisfaction) and praised for being different from other products in the market, it appears that it was not developed as a result of having a great amount of resources (people, budget and time), but actually the opposite. Examples of small scale projects (e.g. small budget, low volume) seem to work to the advantage of developing products with successful NQPQs. One of the reasons might be that the team works better because less people are involved. This makes it easier to develop a common understanding of which NQPQs to embed. In the development of a common understanding the team is also likely to create a shared language, and thereby improve communication. The limited financial resources can also work to the advantage of NQPQs in two ways: firstly there is a need to be more creative in designing product qualities that will lead to emotional customer satisfaction. This means coming up with new and maybe radical ideas, such as cutting down on materials (e.g. instead of having a car door with plastic/fabric on the inside, use the painted metal in a decorative way to save one or more parts). The other aspect of financial constraints is that there is a higher willingness in terms of trying something new. Because of the size of the project it is also more likely that ownership and decision power stay together,

ensuring that NQPQs that are being designed are not degraded or deleted before they are embedded into the product. NQPQs benefit from continuous involvement (and ownership) throughout the phases of finding, assessing and keeping. **Small scale projects can lead to products that are high in terms of NQPQ novelty.**

When talking to product developers many examples of the importance of good leaders, in relation to NQPQs embedding, were given. Good leaders are individuals who have great communication skills and are able to explain NQPQs to product developers whatever their discipline. They are often people who are able to communicate the value of NQPQs and how they are to be embedded in very simple terms. They often have a rich language, communicating the message through scenarios, analogies or one-liners ('should feel like being in an airplane', 'focus in the steering wheel design should be on refinement down to the finest detail'), but are also able to speak in a more numerical language (defining an NQPQ in quantifiables, e.g. 'steering wheel moulded in one piece', 'not having any gaps over 0.15 millimetres'). These leaders are often able to see what the customer sees in the product, and communicate this at moments when technical aspects may be uppermost in developers' minds. **It is good to have leaders who communicate the importance of linking ideas back to the customer and understanding the customer in a deep way.**

Many companies have design strategies that emphasise what will make them different and define their identity to the customer (e.g. brand signatures; specific form features; part re-use policy across multiple products). The strategies may, or may not be good strategies, but that is difficult to judge as they are often poorly implemented. It is not clear what people have to do or how they should do it, and even if there is clear strategy the implementation is not always followed up by regular checks. An example was one company that had developed a list of 30 brand signatures (e.g. features, decorative brand elements, specific finish of surfaces etc.) where at least 10 should be incorporated in every product. Unfortunately the strategy was not policed which in this example led to a re-design of the door handle. Not only did this bad implementation lead to additional use of resources, it also meant that the opportunity to reinforce brand characteristics in the product and build brand recognition was spoiled. **Design strategies could be implemented and policed better.**

The literature on the exchange of tacit and explicit knowledge can help us better understand the embedding of NQPQs. Nonaka & Takeuchi (1995) developed the model below illustrating different types of knowledge sharing.

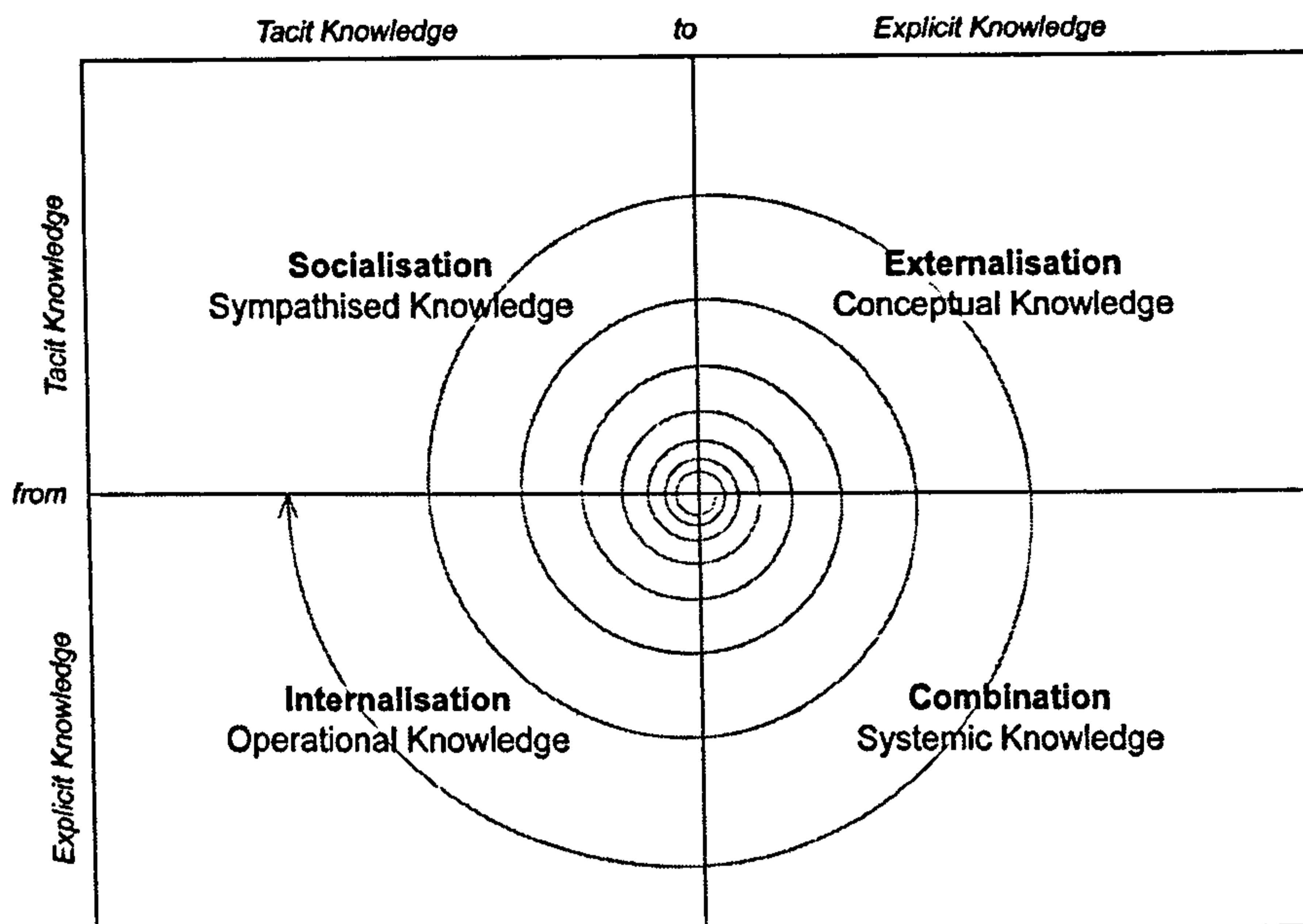


Fig. 6.1 The knowledge spiral (Nonaka & Takeuchi 1995: 71).

Nonaka & Takeuchi (1995) argue that knowledge is created through the interaction between tacit and explicit knowledge, hence the model showing four conversions: 1) from tacit to tacit knowledge, called socialisation; 2) from tacit to explicit, called externalisation; 3) from explicit to explicit knowledge, called combination and 4) from explicit to tacit knowledge, called internalisation.

Each of these four modes of knowledge is now discussed in relation to NQPQs to see how knowledge is built in the case-companies.

Socialisation

Sharing and development of tacit knowledge that remains tacit is called socialisation. It is what happens when product developers interact around NQPQs, sharing their experiences and, through this, creating tacit knowledge such as mental models. This process can happen without using verbal language, but through observation and practice. This is, for instance, what happens when designers brainstorm ideas through dialogue and sketching among a team. Another example of socialisation is when product developers are involved in development projects where their own profile fits the target customer (e.g. a product developer that is a mother, knows the needs of customers with children and will be able to see the product from this viewpoint when designing the product). Another example is where customers are observed (video ethnography) in order to become socialised with their experiences.

Externalisation

Externalisation is triggered by dialogue, so as soon as product developers start asking customers to describe their emotional response to the product the tacit knowledge is becoming explicit. Externalisation can also happen among team members through collective reflection in which, for example, metaphors or

analogies are used to verbalise what is otherwise hard to communicate. This happens a lot among product developers involved in the conceptual design phases. And although tacit knowledge is here being made explicit, it might not be in a fluent, consistent way but merely inconsistent and abstract, leading to reflective dialogue of what is sought to be expressed. It was observed through the research that there is a lack of dialogue and discussion about NQPQs across functions, which means that the transformation of tacit knowledge through externalisation is not happening at handovers and this leads to unsatisfactory embedding of NQPQs.

Combination

When new explicit knowledge is combined with existing explicit knowledge from, for example, another product developer or functional group, it is called combination. This knowledge creation happens when, for example, an individual exchanges and combines knowledge through media such as documents, meetings or databases. Knowledge about NQPQs is often struggling here because it has not been made explicit in the first place, which often means being translated into QPQs. An example of combination is when guidelines or strategies steer the embedding. The explicit knowledge forces an explicit embedding of NQPQs that might otherwise have been lost. On the other hand if NQPQs are translated into QPQs there is a higher probability of their being combined and embedded with other product qualities which are explicitly defined.

Internalisation

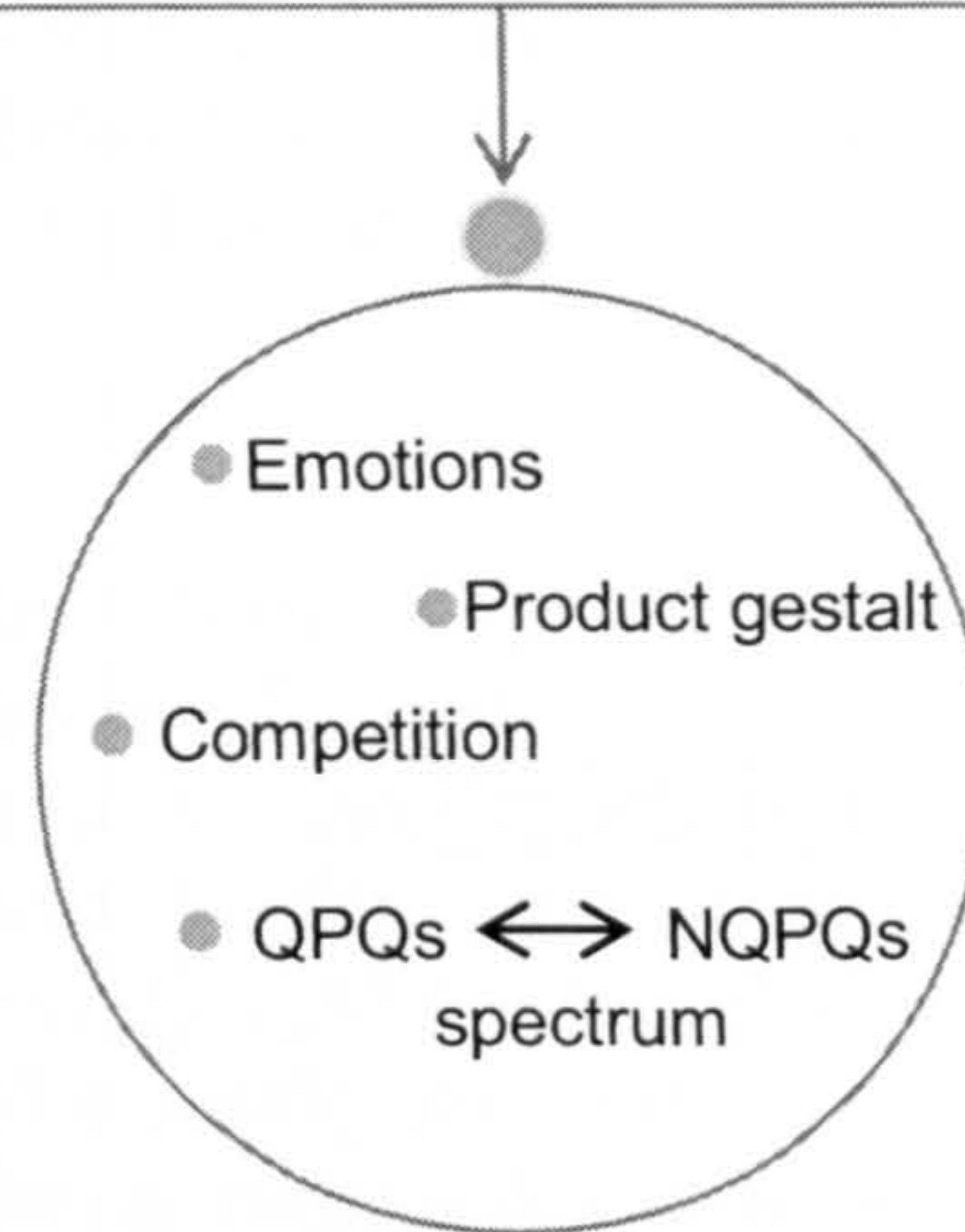
The process of embodying explicit to tacit knowledge is called internalisation. Nonaka and Takeuchi (1995) argue that it is closely related to 'learning by doing'. When experience through the three previous types of knowledge; socialisation, externalisation and combination are internalised into the individual's tacit knowledge, it is stored through shared mental models and know-how. As documentation helps individuals to internalise what they have experienced, it is helpful if the explicit knowledge is verbalised or diagrammed into documents, manuals or stories. When it comes to NQPQs there is a lack of internalisation of knowledge based on written documentation. Most of the internalised knowledge about NQPQs is based on stories and previous experiences; if a process to embed NQPQs seemed to work well before, it is likely to be repeated next time although it might not be called internalised knowledge.

6.2 Research findings

This section presents a model where answers to the research question are summarised. The model is built throughout this section piece by piece, ending in a complete model showing how the answer comes together.

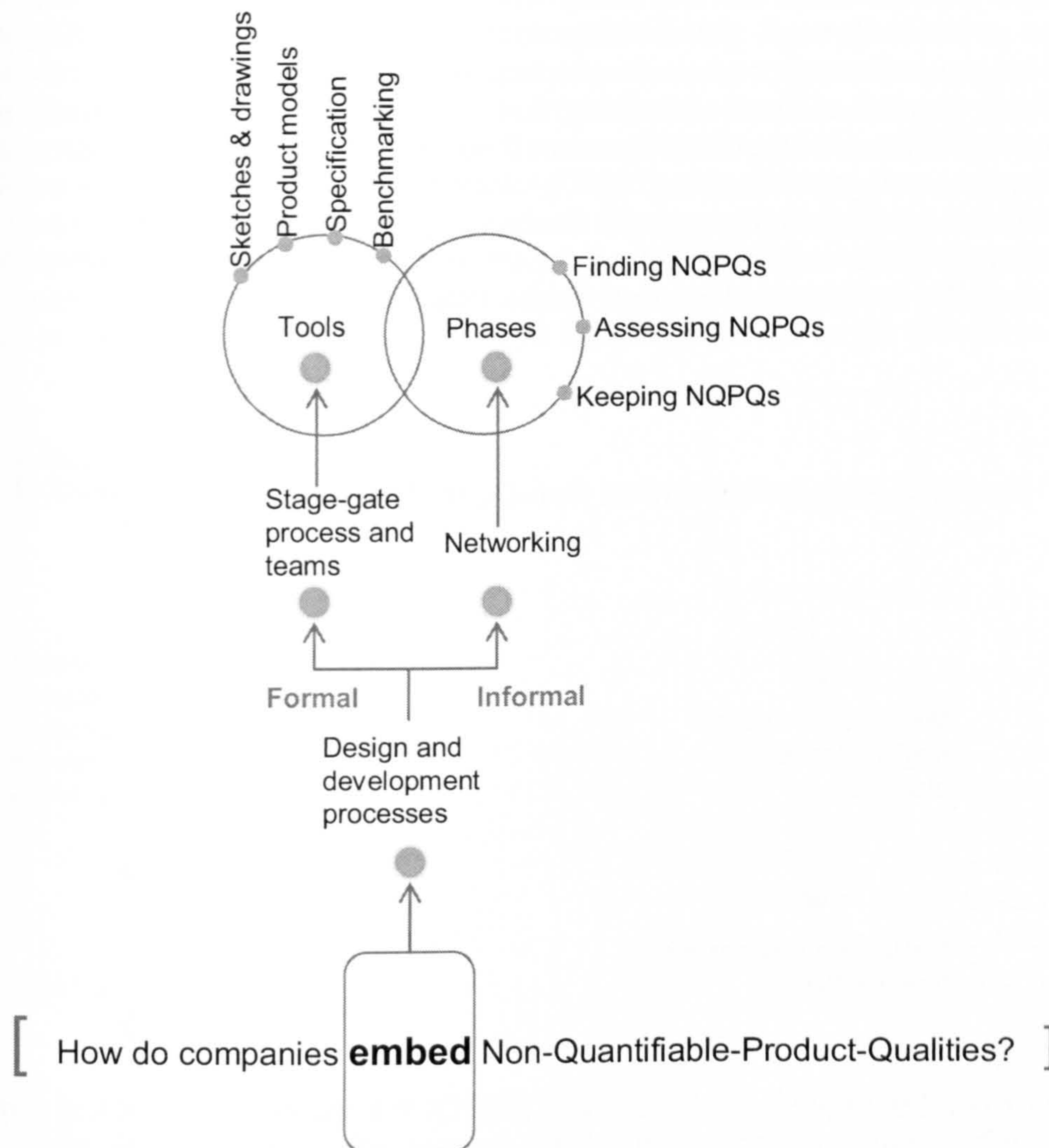
The model will answer the research question backwards, so each section is focussing on the part of the question that is encircled.

[How do companies embed **Non-Quantifiable-Product-Qualities** ?]



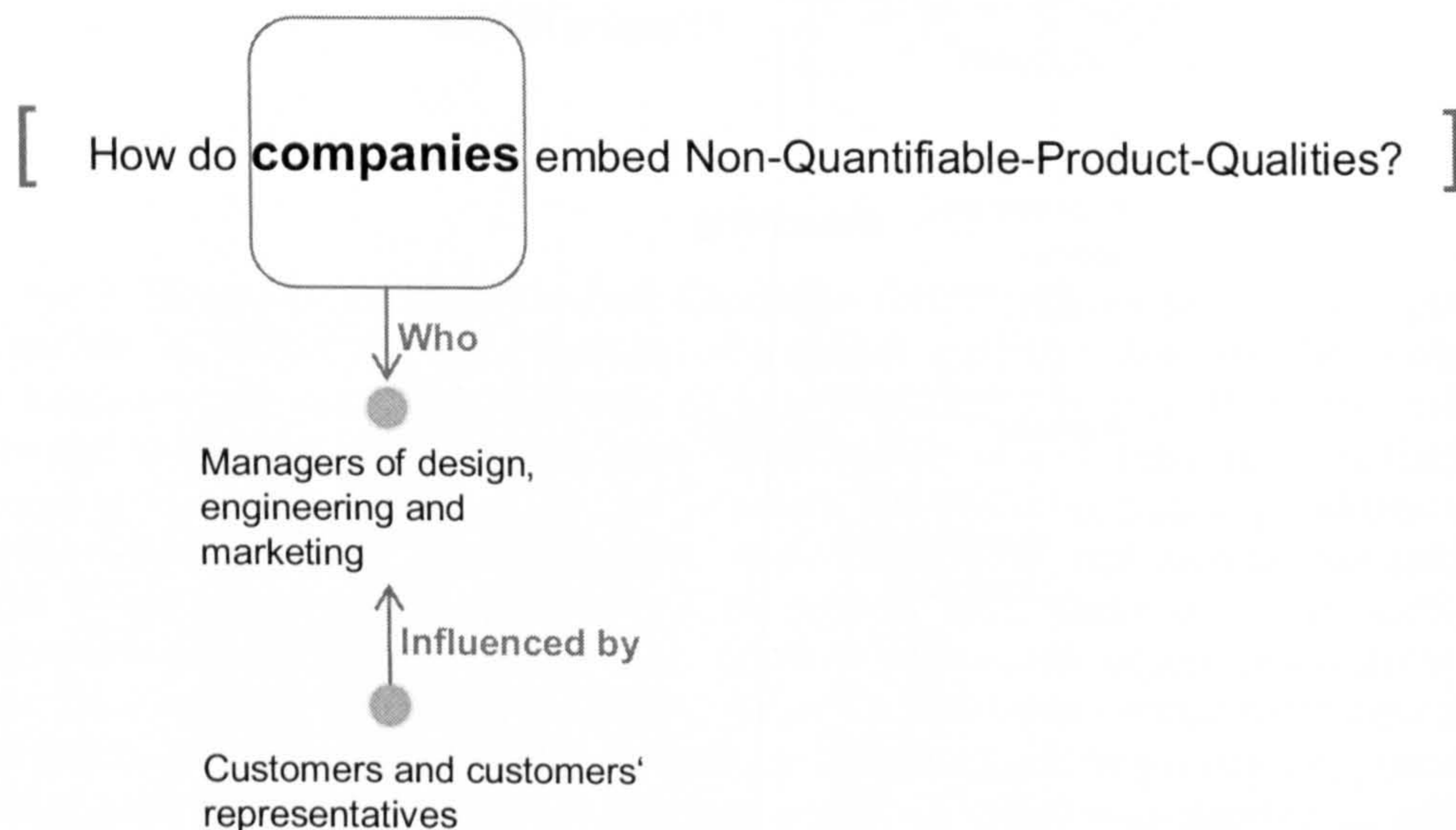
The term Non-Quantifiable-Product-Qualities (NQPQs) has been developed by the author to define the broad group of product qualities that are the centre of this research project. Characteristic of these qualities is that they are gaining more and more interest by consumers, manufacturers and academics as they are becoming an important part of the product. In the past many products were merely developed and purchased for their functional use which competitors could break down relatively easily and embed into their own products. As companies gained easier access to the same technologies, competition grew and other means of product differentiation and added customer value were developed in order to maintain competitive advantage. NQPQs such as product appearance, styling, and ergonomic usability became a part of what was needed to achieve customer satisfaction as the importance of emotional satisfaction emerged. Over the last decades industry has focussed more and more on how to please the customer by focussing on product qualities that are difficult to quantify. It was found in the case-companies that these qualities very often were described by their desired reaction in the customer: the wow-factor, emotional product qualities, delight factor. Or by what makes the product stand out of the crowd: Unique Selling Propositions, brand signatures, brand qualities. Sometimes the qualities are not described but merely the context in which they are going to be assessed e.g. the focus is on the customer's perception when using the product, which in recent years has been named design-for-experience or empathic design. There appears to be a large gap between the product developers' understanding, tools and day-to-day struggle to embed NQPQs into the product, and how academia thinks about them and has conducted research into them (e.g. mainly lab-set ups out of context and often based on design students). In most products, especially consumer products, there are both QPQs and an increasing amount of NQPQs. These co-exist and work together to deliver a particular impression. This impression of a whole product is called the product 'gestalt' and it is recognised

that often customers buy the 'whole' rather than a specific functionality or quality.



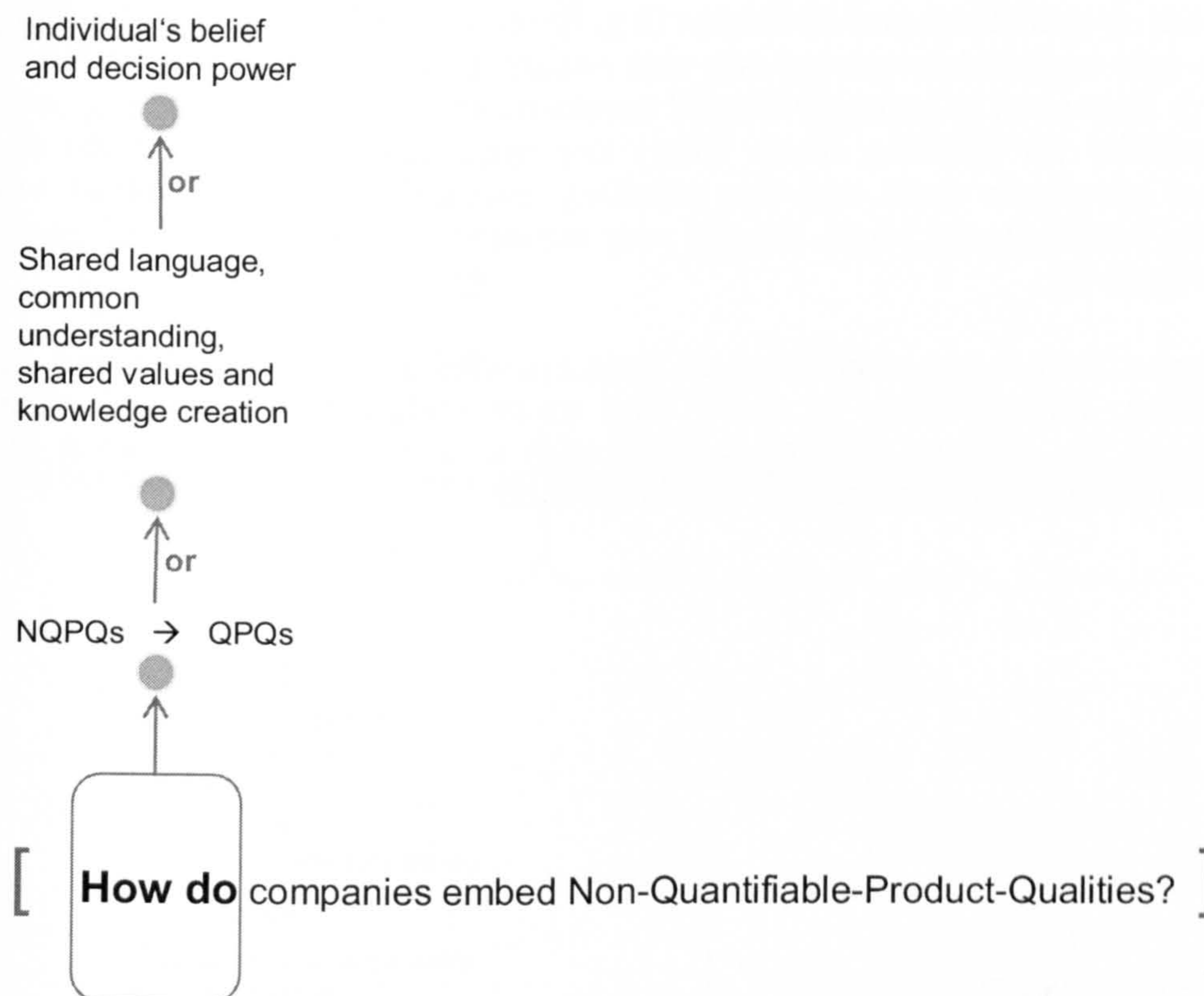
This research found that the embedding of NQPQs happens through two types of product development process; formal and informal. The formal process is managed through a stage-gate system, which is good at embedding product qualities that are well defined and preferably described in quantifiable terms to ensure consistent embedding. One of the more significant observations in the case-companies was the dominant tendency to turn NQPQs into QPQs, as this was seen to be the only way to get them embedded into the product through a product development process managed by a stage-gate process. It was found that the use of reference products helps this translation, either through a fixed group of competitor products (e.g. the comparative-set) or more independently by finding benchmark products to aid the design and embedding of individual NQPQs. In the formal process some NQPQs also find their way into the

specification by being translated into the specification as written expressions (e.g. 'best in class entertainment') while others fail to get formally into the specification. Other NQPQs are embedded through a selection among alternatives, often communicated in sketches, drawing and models. It was found that those NQPQs which are not easily translated into QPQs can be embedded into the product through the development of a common understanding and shared language among product developers, but that it is a part of an informal networking process and not something that is instigated through the stage-gate system. It was observed that NQPQs seem to go through three informal processes of finding, assessing and keeping, and because these remain informal there is a high risk of missing, ignoring and losing NQPQs. The informal process of embedding NQPQs was also found to be highly influenced by individuals' opinions, ability to communicate and decision making power.



In order to understand the embedding of NQPQs it is important to look at *who* is doing, influencing and managing this process of embedding. Because the research question was framed as 'embedding of NQPQs through companies' product development process', the researcher had to target a broad spectrum of people involved. It was found that the embedding of NQPQs is done mainly by people with practice in three fields of product development: marketers, designers and engineers. These product developers are all participating in defining the product intent and then translating that into product qualities through the use of formal and informal processes and tools, thereby playing a large part in finding and keeping the NQPQs in the product. Managers also play a large part in steering the development of NQPQs and keeping them in the product throughout the product development process. It was found that they tend to have two approaches; either by seeking consensus among product developers or by non-consensus, steering decisions based on strategies or personal opinion.

Managers' awareness, understanding and opinion of NQPQs are often more important to the embedding than is immediately apparent. The embedding of NQPQs might be done by product developers within the company, but as they are difficult to assess on behalf of the customers, there is a tendency to include customers in the process. Customers inform the process of embedding NQPQs in many different ways. Customer research is becoming more qualitative, seeking deeper insight into customers' emotional response to products through studies of their lifestyle and values, but also more passive research is done by the use of ethnographic studies or observation of customers using products. These types of insight mostly work as stimuli for finding NQPQs. Customers play a more active role in assessing NQPQs through customer clinics or focus group sessions that occur throughout the product development process. It was also found that a customer view is not always represented by a potential customer, but perhaps by in-house people or team members who fit the profile of the target customer.



The methods and processes described under the heading of 'embed' is partly answering the 'how do' part of the research question. Whereas the focus under 'embed' was on the act of building NQPQs into the product through the stage-gate process, this section will elaborate on answers found that give a broader perspective on how embedding happens. The most common method observed was to bring the NQPQs into the standard process and procedures of the company by turning them into QPQs.

From the case-companies it appears that a lack of shared understanding and common language of what NQPQs are (how to describe, define and assess them) influences the process of embedding. When it is not possible to describe and ensure the embedding of a product quality through quantifiable measures, their embedding becomes dependent on an individual's ability to understand the design intent and imagine the NQPQ that is sought. It was found that large organisations seem to struggle to deploy such understanding across functions, partly because there is little communication about NQPQs in their own right. More than one example was given by interviewees of particular companies where the staff shared similar values and this meant that certain critical NQPQs could remain non-quantifiable but never the less they were guaranteed to get into the product. There are some examples where the case-companies have started to develop terms that help make NQPQs more visible and comprehensible (e.g. wow-factors, USP). It was also found that concepts such as virtual customer profiles are helpful as they provide a lens for the product developers to see how a potential customer would react to the NQPQs embedded into the products. Other tools such as guidelines and strategies (e.g. brand signatures, usability guidelines and no-fake-materials-strategy) can also ensure a better embedding of NQPQs, although they need to be implemented across functions and someone has to take responsibility for policing them. Many organisations struggle to make these informal processes work and the resulting ambiguity is only resolved when individuals with strong ideas, usually very senior, make decisions based on their own judgement.

Companies have a great amount of tacit knowledge about NQPQs and their embedding, but in order to make that more widely available and utilised throughout the product development process it is necessary to make it more explicit through socialisation and externalisation.

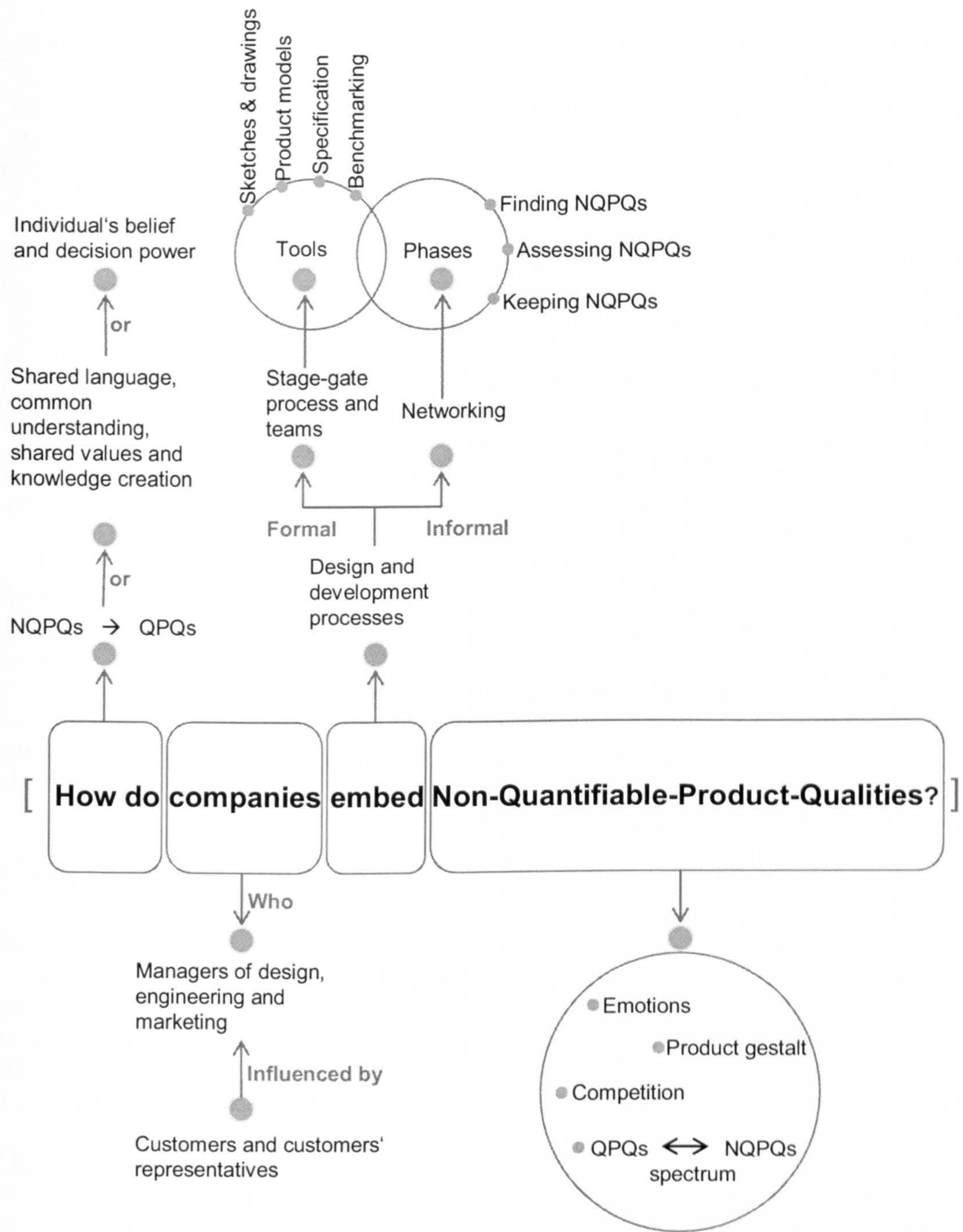


Figure 6.2 Answers to the research question.

6.3 Chapter conclusion

The first part of this chapter presents the author's perspective on some of the most important research observations and findings, and what implications they might have on NQPQ embedding. The desire to communicate through quantifiable measures often leads to translation of NQPQs into QPQs, without enough emphasis on what qualities could be lost in such translation. This also affects the urge to turn design intent into features. The emphasis of features and functional qualities means that some of the case-companies have not recognised that many products today are based on a notion of designing-the-experience rather than just designing the product. Communication of NQPQs can be enhanced by the development of shared mental models, shared language and better utilisation of drawings, mock-ups etc. Other observations such as the lack of alignment between ownership and decision making power, and the importance of having leaders who are able to understand NQPQs have been highlighted. Interestingly it was found that small scale development projects seem to have a good effect on NQPQ understanding and embedding, adding a kind of focussed, sheltered and risk willing environment that leads to more novel NQPQs, and potentially higher customer satisfaction.

A discussion of NQPQs embedding based on Nonaka & Takeuchi's (1995) ideas of knowledge creation through interaction of tacit and explicit knowledge, highlighted a need for more focus on socialisation and externalisation in order to activate the spiral of knowledge creation.

The second part of the chapter summarised how different parts of the research objectives have been answered. This is illustrated by a model grouping different parts of the findings to the research question.

Chapter 7

Conclusion

This chapter summarises the thesis as a whole, demonstrating the contribution to knowledge it makes and suggesting directions for future research.

7.0 Chapter structure

This chapter sums up the research project and the findings. The novelty of the research and its contribution to knowledge are presented. Strengths and weaknesses of the research are discussed, including its limitations and generalisability. Finally recommendations for future research and practitioners are suggested.

7.1 Novelty

Less tangible product qualities, such as NQPQs, have only recently become a specific subject in academic research. Most of this research has focussed on either the product qualities or customer response. The outcome of previous research has commonly been a development of isolated tools to be used in a single phase of the product development process. These tools have often included a kind of assessment or categorisation.

This research is novel as it focusses on product qualities that are non-quantifiable in the product, a distinction that has not been made by earlier research, but focusses the research on the embedding of product qualities rather than their later emotional assessment by the customer.

Previous research has often not been based on an empirical inquiry into NQPQs embedding in the applied field of product development. Some research has been done into the work of design teams which also includes designing of NQPQs, but the observations have only included the design phase and not how other phases impact on the design. This research is novel in its scope as it attempts to follow the design and embedding of NQPQs throughout the entire product development

process. By focussing on the *process of embedding*, new insights have been found into phases where NQPQs are at risk and the influencing key factors have been addressed.

The presentation of this research project and discussion of the findings with academic and industrial contacts, has led the author to conclude that this work is novel within the field of product development for a mass market.

7.2 Contribution to knowledge

This research has contributed to knowledge by answering the research question on how companies embed NQPQs through their product development process, This has led to the following contribution to knowledge:

Nine themes emerged from the data in the exploratory stage (presented in chapter 4). Within these themes 56 initial findings about NQPQs and their process of embedding were concluded. These findings were then used as the starting point for the descriptive stage (presented in chapter 5) leading to seven confirmed themes and 43 major findings (new findings/new details).

Each of the seven themes represents a key factor of influence in the process of embedding NQPQs. For example, we know that:

- The process of turning design intent into product qualities is sometimes disconnected
- A stage-gate process is broadly used to manage the product development process, but it is hostile towards NQPQ embedding
- There is a tendency to translate NQPQs into QPQs as they are then easier to manage throughout the product development process
- The use of reference points such as a benchmark or index system is common in the process of embedding NQPQs
- Strategies, guidelines or rules can protect and steer NQPQ embedding
- Dialogue and the use of sketches, drawings and models help to translate tacit knowledge into shared tacit or explicit knowledge and can help the development of a shared understanding and a common language
- Customers play an important role in the process of embedding NQPQs. Initially this is to find out what product qualities they value, but later they are invited into the product development process through clinics or focus groups where they assess the embedded NQPQs
- Tools such as virtual customer profiles, brand signatures, or labelling of specific NQPQs help the product developers to make NQPQs more visible

- Managers play several roles in the process of embedding NQPQs spanning from consensus seeking to non-consensus seeking. It was also found that NQPQs are heavily dependent on personal champions

Additionally, three conceptual models were developed 1) illustrating the development phases NQPQs go through, 2) showing how NQPQs either remain non-quantified or are turned into QPQs to get them into the product, and 3) illustrating different methods used to make NQPQs more quantifiable.

7.3 Reflection on strength and weaknesses of the research

This section reflects on strengths and weaknesses of the research data, methodology and findings. The degree of generalisability of the research findings will also be considered.

7.3.1 Strengths

The research is based on data collected in five large (100+ employees) international manufacturing companies across Europe. They all had in-house R&D, design and engineering functions. This gave access to people involved throughout the product development process. Three of the case-companies were vehicle manufacturers, giving a broad insight into how the automotive industry perceive and embeds NQPQs.

The findings are built from a large amount of data. The first stage of the research provided 25 interviews, resulting in 350+ pages of transcript. The second stage resulted in another 25 interviews, two weeks of observation in one company and a series of documents that followed the stage-gate process.

The research project was structured in two stages, the exploratory and descriptive, where findings from the first were investigated further in the second stage, so improving the validity of the findings.

All case-companies were presented with the initial findings after the exploratory stage to initiate a dialogue about how they perceived the findings. This was followed in the descriptive stage by presenting the new findings to a management team of one of the case-companies, where proposed recommendations for practitioners had been requested.

7.3.2 Weaknesses

Out of the 50 interviewees the production function is weakly represented. The data represent the perception of people who are involved in the product through the production stages, but none from the manufacturing plants.

In the descriptive stage all the case-companies were vehicle manufacturers. This can be seen as a strength to the insight it gives to the automotive industry, but it might also mean a lack of generalisability into other industries. Some indications were given in the exploratory stage that the mobile phone company and Hi-Fi company perceive the product they design and manufacture more from a design-for-experience viewpoint.

The research project was focussed on non-quantifiable qualities embedded in the physical product, not in additional services, packaging or promotion products. This means that aspects linked to branding, brand perception and brand identity are only included if they are embedded through the selection of non-quantifiable qualities that are represented in the product.

7.3.3 Generalisability

The research findings are based on the five participating companies. Three of those are vehicle manufacturers, which should be taken into account when assessing the generalisability of the findings, as they might be specific to vehicle manufacturers. Based on triangulation across the five case-companies, across interviewees spanning multiple functions, across stages of the process, across roles and across levels of the product development hierarchy, as well as access to real-life observations and documents, the findings are felt to be robust. Each participating company had a complex product, and a well-structured product development process, as well as a marketplace which differentiated between products on a variety of levels. These characteristics of the business environment have shaped some of the problems and some of the research findings, and hence it is sensible to suggest that generalisation of all of the findings to similar such environments is reasonable. For those businesses operating in different environments many of the findings may still apply, indeed the author feels it is likely that many will apply, but the research data can not be stretched to make such a claim. Therefore the findings of this thesis should be seen as relevant to those organisations which: have a complex product in a complex marketplace, and have an organisation of sufficient scale and sophistication to support an organised product development process that co-ordinates the efforts of a number of people and functions.

What can be generalised is that manufacturing companies need to be aware of their *actual* process of embedding NQPQs, and not only trusting the stage-gate process. The research has also highlighted that companies who try to embed NQPQs consistently in their products use customer insight and validation throughout the product development process, as it seems to be the best way to ensure a successful embedding. Although all of the case-companies are large organisations with well established market research functions, a general finding is that companies need to get closer to their customers, and including them throughout the product development process. Understanding cultural differences and include them in the design of NQPQs is increasingly important if customers are to be satisfied with products for a mass market. Finally companies need to actively seek to understand their NQPQs better. They can do this by starting to

discuss what NQPQs they are trying to embed, communicate them more clearly by turning tacit knowledge into more explicit knowledge, and make sure that they are included in the product development process in their own right.

7.4 Recommendations for future research

There is a need for more empirical research into the applied field of product development. Insight into knowledge sharing of product intent, and how such intent is materialised is needed.

Research is needed into how organisations can improve the development of a shared understanding and common language, which describe less defined product qualities. It could be valuable to use the three conceptual models developed in this research (see figure 5.2, 5.4 and 5.5) and to assess how they could improve product developers' understanding of NQPQs, for example, if the application of the conceptual Finding-Assessing-Keeping model (figure 5.2) will make them more aware of where the company is at risk of missing, ignoring or losing NQPQs. Or whether enhanced awareness towards the tendency to make NQPQs more quantifiable, through for instance benchmarking or an index system, is useful. Some research into how sketches, images, drawing and models (mock-ups or early prototyping) are used during the design process has already given us valuable insight, but further research into how they affect product qualities that remain non-quantifiable throughout the product development process is needed.

Research is also needed into how product development documentation can be better spread and utilised across the organisation. For example, if images could be linked to product specifications to illustrate NQPQs that are more effectively communicated visually.

7.5 Recommendations for practitioners

Based on this research, training is recommended to improve understanding and actions that can help the process of embedding NQPQs.

Product developers that come with an engineering background need to learn about intangible and tacit product qualities, such as NQPQs. They are likely to understand what they are when they are described, but they lack a language that can help their understanding and awareness deepen and become more elaborate. By, for instance, asking product developers to bring a favourite product and describe the qualities they appreciate, it is likely that they will realise that many of them are of a more intangible nature, hence difficult to describe in quantifiable means.

It was observed that studio engineers can be helpful, as they bridge the gap between the design and engineering functions, by improving communication and understanding between them. They facilitate translations of intangible ideas and

ensure that technical solutions are developed with attention to their NQPQs. The embedding of NQPQs can be improved if more such 'bridge builders' were used throughout the product development process. They are especially useful during the handovers as they are able to see both the design and the engineering perspective.

It seems that companies that want to make money, through satisfying customers in saturated markets, need to become more aware of how NQPQs are handled in their product development process. In saturated markets product differentiation primarily lies with the embedding of NQPQs. Such companies need to understand that a traditional stage-gate process is a hostile environment for NQPQs and take precautions.

Practitioners could benefit from being aware of the tendency to try to turn NQPQs into QPQs, as they should focus on what product qualities they might lose in the process of translation.

Verbal communication is very important when embedding NQPQs. Discussing NQPQs within product development teams, using stories, metaphors or examples of NQPQs in other products appear to be helpful. Creating dialogue is more important for NQPQs than QPQs as they are more easily and effectively communicated by numbers. By using concept sketches, images (for example mood-boards) and product samples, understanding of NQPQs can be enriched and more explicit. This can reduce the risk of NQPQs being missed, ignored or deleted.

The development and use of virtual customer profiles can help practitioners to achieve a shared perspective. By having a named and well described character, a focus is created which allows product developers to imagine how the (virtual customer) profile would perceive and respond to the product, although it is hypothetical.

Seeking a closer link between customer insight in the early stages of design and the creative part of the product development process would be beneficial for developing NQPQs that customers would value and ensure that the NQPQs are embedded. This could for instance be done through linking footage of customer data (interviews, focus group verbatim or observation of customers interacting with the product) to the NQPQ that is sought embedded.

The people who propose NQPQs might not be those who make sure that they get embedded. Being aware of this might help practitioners to ensure that more NQPQs are actually embedded in the product, as this research has found the decision making power does not always follow ownership of NQPQs.

One key finding was the lack of clear costing of NQPQs in the budget. This means that intended NQPQs might be deleted as a result of poor budgeting, leading to risk of customer dissatisfaction. This could be foreseen already in the planning stages and eventually a budget could be earmarked for specific NQPQs.

7.6 Thesis closure

During the course of this research the author set out to study how companies embed Non-Quantifiable Product Qualities through their product development process. The findings produced by this research have given new insight into how product developers perceive the process of embedding. It has also provided suggestions for continuing work in this area, and in other industries, as well as possible solutions towards overcoming some of the problems identified.

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Appendix A

Interview questions to case-companies

This appendix presents the questions used to guide the semi-structured interview collected in the exploratory stage

Introduction

- Who I am (name, PhD-student)
- Who is the interviewee (name, position/role, how long they have worked here, background)
- Introduction to research
 - this interview is part of a process
 - Emphasise that it is the individual perception that counts.
- That the data is confidential – the company will get feedback in a report. Presentation if wished.
- Is it okay to tape the interview.

Overall questions product qualities

1. What QPQs / NQPQs do you feel you have in your product?
2. Do you design products that are primarily developed on the basis of measurable and quantifiable qualities or the non-quantifiable features and qualities .

(quantitative e.g. a piece of extension leads - qualitative e.g. chocolate).
3. How do you differentiate between NQ and Q product qualities in your products?
4. Most consumer products have both NQ and Q product qualities, so how do you get the balance right?
5. Is this balance changing over time?

(due to competitors access to technology/ insight into you customers etc.)

The Design Process

6. How do you think you get NQPQs into your products?
7. What tools/techniques do you use?

Words, written documentation, drawings, images, photos, mood-boards, multi-boards (all sorts of info), benchmarking with other types of product/competitors product, the use of other senses; feel/textures of surfaces, sounds, smells (taste....)?

8. How do you get NQPQ into the design brief?
9. How do you ensure that someone takes responsibility for the successful inclusion of NQPQs in the different phases of the development and manufacturing?

Some of them might be linked to a technical feature others more the overall of the product, some in the services linked to the product.

10. How do you know when NQPQs are there or not?
11. How are decisions made when a product is good enough to pass a 'gate' and go onto the next stage (from a NQPQ point of view)?
12. How are the NQPQ documented and/or tested throughout the product development process?
13. How much should be based on customer insight? (because maybe the customer can't tell you)

How do you get that insight? (Quantitative data: surveys/questionnaires or qualitative data: semi-structured interviews? ... other ways?) If not on what then?

Design Process (product planning)

14. Do you deal with NQPQs differently for new products and minor updates of existing products?

Brand and values

15. How much of your NQPQ are linked directly to your brand qualities?

Are there some brand qualities that can't be based on specific physical qualities, but has more to do with the overall product? If yes, how do you know you got it right throughout the PD process if you can't evaluate it properly before you got the final product?

16. Have you made any specific investments into NQPQ?

Have you lately employed or sub-contracted people specific to add to the companies ability to deliver NQPQ? Designers, psychologists, anthropologists etc.

17. Can you describe important types of NQPQs for your company?

How do you break them down? Different types of NQPQ, for instance: usability, appearance, 'anthropological' match (different cultures values, behavior, tacit knowledge (formed by previous experience with products, life, their world...)) and other NQPQ are embedded in(to) the product?

Do you feel the need to differentiate between types of NQPQ? If yes, which? (usability NQPQ, aesthetic NQPQ, semantic NQPQ . If yes, how?

18. Please will you give three examples of a NQPQ in your products?

19. Can you think of two examples of **where** you got the NQPQs really right and **why**?

20. Can you think of two examples of **where** you got the NQPQs really wrong and **why**?

21. Where (if anywhere) do you talk about NQPQ within the company

PD team, marketing, strategic level...?

Appendix B

Sample interview transcript

This appendix is included as an example of the interview transcripts that was made from the data collected in the exploratory stage

Interview with GB, Product Development - Innovation, (company name), July 2003.

1MG: To put you into the overall context of these interviews. I've spoken to XX this morning and I've basically emphasised the confidentiality as well, because he talked a lot about how you map things and stuff like that. One thing is to sit and talk about it, but in order to really understand the process, I need to see your tools, I need to see how you're doing it. You know one thing to say is 'oh yes we do it like this, this and this' that's very explicit. But I'm sure there's a lot of things that are just embedded in how you know that's the culture.

So a little bit about your background and then we'll head onto questions. If you're really pressured for time today I'm back down here on Friday and I still need to set up two interviews with people at (company name) so if you want to...

2GB: OK. Well I mean it might be interesting for you to do that anyway, so that's no problem. I've no problem meeting again.

So my background then, obviously I'll give you my card, but I joined XX directly from a mechanical engineering degree actually in the UK. I joined XX therefore as a graduate engineer on their graduate rotation programme. So I've had a career now of nearly twelve years – eleven or twelve years in XX. Half of that has been in engineering. Some of that was, if you like, in the testing part. So actually taking real prototypes and measuring the information from those vehicles in real scenarios. Real world use and on test tracks, and through to the manufacturing of prototype vehicles through to, if you like, engineering of components and systems for particular vehicles. We call it like a Component Engineer role. But in effect you're project managing a group of components or systems on a vehicle.

3MG: Yes because they integrate, into the car.

4GB: Yes, the integration of those and also a lot of our components are developed by suppliers rather than purely ourselves. So in many cases you're project managing groups of suppliers who are developing products with you.

And then I moved into what we call Product Planning as a function. And it is as it's described. So we plan our future products, and in that time basically I've spent a couple of years actually planning particular vehicle segment products, so that was the mid size or C segment products and getting involved with various issues there. And then got the opportunity to run a Innovation Project which was targeted on a specific customer the echo boomers.

5MG: What are they used for?

6GB: Echo boomers were basically people born between, if I get this right, 1978 and 1998 and we focussed on the front half of that. So they're people that are between sort of 16/17 and 23/4/5 ish now. And understanding what their attitudes/values are and looking then at their transportation needs and wants. And then what we did is develop several vehicle concepts so, full vehicle concepts to suit their needs. And, more importantly, attitudes and emotional aspirations, so obviously that's a lot of style.

But also feature contents and layout of the vehicle to meet their other needs and wants, and they're social and group needs. And basically that was the start point of the group that I'm in now, and as you'll see from my business card it says 'Advanced Product Group'. That was one of the things that we recommended as part of that, is that we should be innovating on an on-going basis. What we saw as the power of innovation was being consumer focussed and generating interesting things from that. Not necessarily just being innovative. So it was much more of a consumer focussed approach than an innovation approach.

And for the last four years we've basically been trying to battle the XX system into understanding and taking that on board, with limited success. But in the last six months to the point that we're actually running now some very specific short term, by short term I mean 3 month, innovation projects to develop – and I have to say it's small scale to start with and some quick wins – but some feature solutions/feature ideas to meet whatever needs are for a particular customer group for a particular vehicle product that we will either be developing in the future or will be updating in the future.

And that's where we're at today and over those four years we've obviously been building up a lot of experience in the field of innovation and consumer empathy. Hence we came across Andy and Richard Barrett with the consumer empathy tools and empathic design tools that they developed. And have been exploring tools such as that and others to help feed the innovation process that we've now got agreement to do. But as I say on a very focussed format.

So that's really where I've come, how I've developed via some projects to becoming if you like the guardian now of some of these innovation processes and innovation projects.

7MG: Excellent. Just to put something right from the start, when I talk about non-quantifiable products qualities I talk about all the things that can't be measured. So some people might call them intangibles as well. If it's easier for you to convert that's fine.

I would like to know which qualities – quantifiable as well as non-quantifiable do you see (Company name) is mainly embedding in their products. Can you see an overall theme or...?

8GB: I think over time, we have developed consistency. Certainly, by over time I mean over the last ten years, we've developed a consistency in terms of our – what we used to call 'driving dynamics' as an attribute. And that is measurable by experts, but not necessarily, I hate to say it, but an average consumer and customer. So by that we have spent a lot of time, money developing our vehicle dynamics and the combination of that and ride quality for vehicles to the extent that we are clearly a market leader. Certainly for our brand position in terms of our price points, if not for everybody... in that, and the press can appreciate it because they are driving lots of cars back to back. They're expert drivers and can appreciate that and you can measure to a certain extent that by the ability of the car to go around corners and how fast it can go round a set circuit or what have you.

But most consumers and customers don't necessarily see it or are able to measure it in the way an expert would be. So that's probably an area where we've spent, as a company a lot of time, certainly in (Company name) Europe, a lot of time improving.

I think what we tried to do about three years ago is re-align our...you could argue actually, create a brand strategy for Europe. And we basically looked at what have we been consistent at and what are we strong at, as well as what are the gaps in the market place. And pitched ourselves there, and in actual fact most of our consistency is in the area where there was an opportunity to fill a gap and was around this – the quality of the drive of the vehicle. And we actually changed the words from 'driving dynamics' to 'Driving Quality' because in actual fact what we'd got, I don't know whether it be by accident or not, but we actually developed also vehicles that were quite easy to drive. And easy to sit in and see out of and especially once we got to the (name of vehicle model), when we first launched that, that was a very radical car for the market place in the sense that it was – not the styling – although the styling was radical. But radical in the sense that we were the first of the main stream manufacturers to actually make the driving position more upright and higher. Which of course has fantastic knock-on effects for visibility, ingress and egress.

The down side is actually the driving quality – the vehicle in the sense of the dynamics and the ride quality. Because many people feel – there's a perception that you need to sit low and leaning back in a car to be in tune with it, so certainly sitting higher is against that. There's a feeling that the taller the car the less well it will handle – all factual. But you can do a lot to counteract that, in (model name) has got still world class and leading dynamics in virtually any vehicle segment as a mainstream family car for it's dynamics, despite the fact that it moved upwards and taller. And that's something, you know, a unique position that we'd got to. So not only do we have the driving dynamics, which is not really that measurable for an average consumer. But we've actually made the car also a better car in terms of it's driving quality i.e. ease of use, the features, the functions, the ergonomics are much better and more intuitive. And that's something we're deliberately trying to build upon by trying to change the emphasis from driving dynamics to driving quality, because quality is all around those other attributes as much as anything else.

And again that's something that I think is not really measurable by a lot of people is 'well, what's a good layout?'. What's a good ingress/egress. I mean yes you could always measure it by it's easy or not easy, but it's very subjective. And that's really why I think that's a perfect example of how we've moved from a position of sort of that mediocrity, to a position of strength and leadership. By...as I say made part of it is deliberate and parts of it been by accident. But it's something now we're very conscious of we've built in as part of our 'this is our brand differentiation and we're going to deliver it.'

The other down side of it not being particularly quantifiable is you can't sell it. 'cos how do you get people to know that. You can talk about it as much as you like in the media and press, but until somebody sits in the vehicle... Because basically most people purchase by style. If the decision is theirs, then they're buying by style or price. So you need to get somebody into the vehicle to realise actually this car is a lot easier to drive and a lot better and more rewarding to drive than the whatever other competitor of the same price point or size.

And that's where we will struggle with that brand strategy because it relies on the experience, the actual physical experience of being in the car. And again that's why I think it's relatively un-quantifiable because you can only do it subjectively versus another car when you get into it.

9MG: I mean from what you've just said it seems like it has moved from earlier you just designed something, and then you realised that you were actually designing something quite good from a non-quantifiable point of view. Then you started to measure in order to ensure that you would keep doing this. So then it also seems like you are aware that you can measure all these things but at the end of the day the customer would look...the customer would not even get into the car if you don't get the styling right and the whole brand perception and things like that.

So how...I mean would you say that you still primarily developed on the basis of the non-quantifiables or the quantifiables or is it a balance?

10GB: I would say, yes, it's a very difficult one because you know your simplification what I said of course is deliberately over-simplified. And I think one of the things that, you know, we have developed good handling and good dynamic cars over time, quite deliberately in places, and that's a consistency that we've decided to build upon as our strength. I'm sure we've not deliberately designed bad layout, bad ergonomically designed vehicles either. But over time the market place has moved, and you know, (Company name) in terms of the (name of vehicle model) have played a major part in stimulating the shift which you can see. Even in the last year or so with the launch of several other new mid-sized cars and some of the smaller certainly cars, which are growing taller and more upright in terms of their seating position and overall height. To deliver those ingress/egress qualities, forward vision and other qualities and better improved package i.e. the space for the people in the front and the back and the luggage within the same overall length, because everybody's just moved upright and forward.

But overall I would suggest we still develop our cars around style. So probably still one of the most critical decisions is around the styling. So in our whole development process the ergonomic attributes are battles, trade-offs, arguments between those people, the engineers who are trying to package things within the styling. But overall we still recognise that the styling is what's going to sell, and it's the styling that still carries the bigger, difficult and senior decisions with respect to what the thing's going to do in the future. But of course those trade-offs are going on behind those scenes which is 'well if this is going to look like this, this is the best layout we can get, this is the most ergonomic layout we can deliver' and so on.

I think one of the downsides of that – I'm not saying it's totally wrong – one of the downsides is that in effect a lot of ergonomists spend time policing the execution rather than actually feeding in what it should be. And likewise in my arena it's the same thing. You know we have maybe, just pick something at random, we might say 'our customer group needs to get two pushchairs in the back of a vehicle, and this is a requirement'. And unless we can make that a (Company name) law, our design laws our specifications, it just becomes another trade off that we have to try and police later. Rather than it being 'no this is absolutely what we will package' and the vehicle design, both styling and engineering will suit that requirement. And we find it very difficult, I think, to put those rules and laws in place without necessarily clear understanding of 'no, that is a requirement and therefore that is sacrosanct'. We do do that, we do put those rules in place, but it requires a deep understanding of the customer and what they're going to do. And somebody strong enough and believing in that that it will not be sacrificed over and above other issues which may have bigger business implications but, you know, what's the trade off; deliver what the customer needs or make something work in the business sense.

And that I think, (company name) are not in a unique position in that, that you know... The business climate and the cost structure of a car is such that we don't make a lot of money and we have to sell a lot of cars to be able to break...not only recover the costs of the investments but then also break even.

And typically, I don't know the numbers but I would suspect that of a vehicle if it's going to be produced for four years, we probably can only make any profit on that in the last six months of that four year cycle. By the time we've recovered all the investment and whathaveyou so...

If that's what the prices are we've got very little scope, so the business then ends up carrying a lot more weight than maybe some of the customer requirements. And so sometimes we will, and we will continue to deliver compromised products...

11MG: Of course.

12GB: But would be rather have a product out there that's compromised or no product? And that's always if you like the ultimate decision that somebody could throw back in the face of the people who are trying to police these attributes – the customer attributes – and the wants and needs.

And I guess that builds into my area of innovation is that we're trying to deliver high impact be it rational or emotional things, features or just executions of things in the car. Preferably innovative to meet some of these consumer 'wants'. And again be it rational or

emotional. And... the difficulty there is how do you measure any impact of that business case. How do you? I mean you know, how does VW in the new VW Beetle – how did they justify spending the ,however much it costs, five Euros or whatever it is ten Euros for the vase on the dashboard, when they can get no volume for it and they don't sell any more cars for it and they don't sell it at any higher price? 'Cos that will have been at the time, that will have been the business scenario. 'Well this is the cost of the car, we're going to sell this many in this price – put the vase in', – make no difference to that business equation other than you've made the cost of the car higher, so we're now losing more money.

But the reality is that that's helping sell the car. Whether that be actually sustaining the volumes that they said they think they could get, and has sustained the prices. Or whether it means actually they can sell more cars at the same price – I don't know. But I've heard customers say I would be prepared, and I do pay more, because it's got the vase in than if it was one without the vase. But it doesn't offer any functional benefit at all.

13MG: Promotional.

14GB: But how can you price for that? You can't. You can't even say we're going to sell more cars until you know how well it impacts. And that to me is all...is everything your study is about is that. And all of my innovation activity it has the same problem.

You know and we even got asked yesterday, we had a review of one of these first more formal innovation projects and the Vice President of the Product Development Organisation actually asked 'how confident are you that your innovative features are going to make it through to the marketplace?' And at the end of the day...one of the other Vice Presidents actually from Marketing said 'well, yes but we've got this crazy situation where we're schizophrenic'. You know we stand here and say oh these ideas are fantastic, we must have them. And the next meeting we go to and it's oh now the business equation is in front of us – do we want to do this or not and then they take it out.

That's the reality but I think if people can be convinced to understand some of the other benefits of these non-quantifiables, then that might stand a chance. But unfortunately the business climate means if it doesn't have a number or a positive number to support the cost, which is a negative then it doesn't...it's very difficult for people to keep it there and not consider deletion.

15MG: Do you differentiate between the quantifiables and the non-quantifiables – I mean do you talk about them like 'oh this is a real risk feature or do you sort of say 'this is a chance we're taking where if we can measure all this...' or...is it unconscious?

16GB: I don't think we... If we...and we do do this, we list if you like all of the product assumptions for a programme. During it's development we'll say, you know, new air bag, new steering column, new whatever. Or modified this or slightly revised part here. Typically we don't specify what they are or not, because that product assumptions list is grouped by our own internal requirements. So they're all metal parts or they're all body parts or they're all engine parts.

However I think people, when they're coming to some of those trade-offs, so for example the chief programme engineers in effect will, together with his marketing person, understand that there are some that are what I would call discretionary items and some which are mandatory and some which our programme 'wants'. And there are probably more categories than that but the mandatory's are fairly obvious. You have to do it for whatever reason be it legal, is an obvious one. Be it if we don't change that then we can't get something else. So it's sort of like an inter-link. And then the discretionary items are basically anything that could be taken out that's not absolutely required which would include non-quantifiables as well as quantifiables.

And that's really ...this is probably the level of the thought processes that go behind it. And then it's a matter of signing a dollar value, being an American Company we work in dollars, to what we think in terms of revenue we can get for a particular item. And so we will literally do it almost by feature as well. Well for anti-lock brakes we can get \$200 of revenue, average revenue by market. And if we don't sell it we'll lose 1000 units per year

in every market or something like that. So those numbers get put against it. But if it's something like instrument panel bars, yes if you can't put any volume against it, and you can't put any revenue against it. So instantaneously that draws a higher profile for deletion because it's carries a cost, an investment and...

17MG: So how do you get that balance right between the things you can actually quantify and things you can't quantify?

18GB: We don't.

19MG: You don't?

20GB: We don't. Basically we'll write the list of all the things we want. We add up all the costs and investments and we trade that off against all the revenue and the volumes and then it's basically down to discussion and negotiation as what we can afford, what's discretionary and how discretionary is it?

I'll give you an example from a commercial vehicle programme I was involved with. In fact an update to the Transit, the (Company name) Transit van. Where we believed we had to develop the system called ESP so the electronic stability programme so that helps you in a manoeuvre that will try and stop the vehicle from sliding or spinning. And we will have to develop that feature because the German market place is going to see it as a requirement. It might not be legal but if we don't have it, we won't be able to sell, but we can't prove that.

So all we could say was well this was going to cost us X million dollars to develop, it's going to cost however much per vehicle to install it. We'll have to make it standard in Germany, so therefore it's sells less number of vehicles so we'll lose all that money because we can't charge for it because they'll see it has to be standard. We can't raise the price, or maybe we can but only a certain amount. But if we don't sell it we'll not sell any vehicles in Germany.

But you can't say... you can't use that threat to say we have to have it in. In terms of a business equation you have to do that in a verbal discussion. So it's a matter of people having that trade off. We had that discussion, you know, well the marketing guy's saying 'we have to have it', and the engineer's saying 'but why? - it's costing me all this money and I get nothing back for it, so why would I keep that in my programme?'

I'm going to spend four years and hundreds of people developing this thing I get no benefit for. But in Britain I can charge £500 for it - fantastic. So I'll have it for Britain but it's actually the British market won't pay for it because there's not enough volume or what have you, so why would I want to do it. And the finance guy was absolutely adamant - 'no way, what the hell are we having this for?' And he kept trying to delete it and I had to keep writing it back in, because I said we will not be able to sell vehicles in Germany. 'Well then give me a revenue for it', was his answer - 'give me a price - you need to make money otherwise don't do it'.

And at the end of the day it needed those...it needed that person and the chief programme engineer we call him - the guy who ultimately runs the programme - to actually have the agreement and discussion to be convinced that yes we do or we don't do it. And these are the risks associated with not doing it, and these are the risks associated with...

21MG: So can you see this changing over time, now that you've been here quite a long time? I mean is it easier for you to get things like this understood in the company.

22GB: No, and that example on that commercial vehicle on an electronic stability programme - that's a fairly rational item. And it's quantifiable in a sense that you know what you're buying it for, you know why you're specifying it. I mean it's there, it's there for a reason and a very functional item.

23MG: But if you don't understand that has a value to the customer...

24GB: But if it's a vase or if it's just - if we want to do a better executed storage bin.

25MG: Yes.

26GB: But again it's...one of the things that...to answer this question from the senior person yesterday how are you going to...how is this stuff going to go to the market place? It's totally down to the people that are going through those discussions and trade-offs buying into the value and the benefit of what you've developed and your idea if you like and keeping it in there.

So if the top man says 'no, no I really know why that's important, I understand the customer needs, that's going to generate huge appeal and impact. I'm prepared to live with the cost' - then it will stay there. But unless you've got either some good champions or conviction within the whole of the sort of if you like the whole project team it's going to be subject.

27MG: But can you back it up, could you even back it up?

28GB: No.

29MG: I mean I presume you would know this thing about the German market from market research.

30GB: Yes I mean that sort of thing... But yes on that...

31MG: I guess it's not difficult if you open every German magazine and they say 'oh this is now a standard'.

32GB: That's right. But again what was thrown back in the face there was 'well, you know, it's only speculation. So why don't we do it when it happens? (*laughs*) And we were saying 'well the marketing community backed up by myself said we don't believe we can take that risk...so we should do it'.

33MG: So the way you would embed these non-quantifiables is really through discussion. I mean things that would come out like apparently somebody would say you know 'you need to have this, otherwise you can't...I mean it's impossible to sell it in the German market'. But how do you embed these qualities in the process? How would you know in the first place that you need this for the German market and things like that. How do you ensure it?

34GB: There's two questions there – one 'how do you know what they are', and the second 'how do you get them in there and keep them in there'.

I'll answer the second part first and that's how do you get them into the, if you like, the programme assumptions and keep them there is a matter of convincing the people. So just follow on of the previous discussion is you've got to convince the people why you need it and get the right people to be convinced to keep it in to that list of assumptions. And that's a difficult discussion and to a certain extent as we're humans, that's why we have people that work in different functions and they represent those functions. The marketing community would be typically a community that would defend something that's something more emotional than rational that you can't get a price for or get some revenue for. And it's a matter of them being able to prove and justify based on whatever voice of the customer information they have – be it research or what have you. Or in this ESP example obviously predictions from the marketplace to say this is what's coming.

So that probably answers the second part of the question. The first part which is how do we find out what those requirements are. If we take the simplistic electronic stability programme, the ESP thing, in Germany, that's just the marketing community knowing what's happening in the marketplace and hearing it and saying this is what's going to happen. And they've got their networks of sales forces and so on in each of the marketplaces that generate that information.

We, I believe, go through a process of if you like asking for programme wants. So when we're setting up a new programme, whether it's a clean sheet of paper or not that we're

saying 'right, what is this thing going to do in 2006'. Well these are the things that we think we'd like to do – change the appearance – improve the engines or whatever'. But lots of those wants come from lots of places. So they might come from the marketing community, which would obviously have issues with the existing vehicle or ideas of repositioning the vehicle in the marketplace with respect to its brand positional price point. And therefore that might require certain actions. You know you might need to have leather seats if you want to improve position in a more luxury point.

They'll also come from existing product data, so where do we have better satisfaction versus other's attributes. You know what do we want to improve on, so if you like the improvement actions. There might also be actions there that come from within the team and they say 'well this is a great idea we'd love to it – I've seen somebody do it – this is what we should put in'.

And they'll...all those sorts of things get baked in. And one of the things I'm trying to do with the innovation activities is provide yet another input which is the innovative stuff, which are obviously, a lot of those are going to be non-quantifiables, and have those in if you like in that melting pot as well.

So to summarise that then a lot of it's going to come from existing data or what's going on in the marketplace people tapping in. To reinforce that marketplace knowledge, we also need to go out and do some research. Quite often we actually do – I'll use the term research differently. Quite often we do an assessment of the marketplace and our customer grouping. So, I think you probably heard from Paul Jee we will make sure we know who we're going to target the product at, so we've got our target customer group, and we've categorised that. We've got data of different...cut in different ways – attitudinal; cohort; demographics – all that sort of stuff, so I won't repeat all that. But obviously we'll understand who we're going for and we should typically have enough information about that particular customer group to say 'right we know who they are, we know what they do, these are the things that are important'. We could feed in data from new car buyer's surveys and all that sort of rubbish and basically come up with a profile, and if you like a prioritisation list, which would say 'well comfort and lighting is important to typical buyer of a whatever vehicle, and attitudinally that's who they are and that probably would appeal, so therefore we need to prioritise the lighting actively'. So maybe we need to do improve lighting and something else. So you can prioritise some of those big funnel of assumptions.

The other aspect which is actually more to do with the research is not just mapping that consumer but actually maybe going out and speaking to them. So doing some advanced research and I would say that's typically done in a fairly traditional fashion. So identify who the target is, recruit them, have focussed groups but explore different attributes so... Depending on the scope of the programme you might say 'we're going to be developing an all new line up of (model name), so do we do a five door, a four door, an estate or a wagon, and a coupe or what do we do?'

So you might want to go out and get representation of each of those vehicle purchases and then explore to them well with the four-door person why do you want a four-door? Because you might decide actually we don't want to do a four-door. We might just want to do a five-door and a wagon and save the money. But of course when you go and speak to the four door, there's very good rationale and emotional reasons why they want to have a four door because that's what a traditional car has four doors and a flat tail gate). And 'I don't want the big hatch and I don't want them' and so you understand a bit more about that. So that's the sort of research that would be done.

Also you might get more specific than that so you might say well this new programme action is actually only going to improve the interior functionality of the vehicle. So you can then have actually a bit more focussed research around interior and functional attributes and in fact that's just what I've started doing now. Where we've picked families, well small families, and we're going to look at improving interior stowage and flexibility for a particular vehicle.

And so one of the reasons why, OK, well lots of the people know all that information but in fact what you need to do then is actually explore how they used it and what are the things that they don't know they need and all the usual stuff. So the met/unmet needs/problem areas and so on. And that's a bit more into my area of expertise where we're trying to get much more empathic in our approach to things. And it doesn't need to

be to deliver innovative features it just happens that we're doing that under the guise of developing innovation or innovative features and solutions to the vehicle.

But you could use that approach equally satisfactorily just to come up with the right idea even if it's not innovative. And in fact I'm sure my innovation project will deliver 200/300 ideas that are just good ways of doing things, not particularly innovative and there might be five real innovative solutions that have never been done before. But all that's valid.

And that's the other approach of getting those ideas, of getting those intangibles as well as tangibles into if you like that big melting pot which I call the Programmes Assumptions List which over time gets rationalised and rationalised to make sure that it all makes sense.

Both in terms of engineering feasibility, manufacturing feasibility, investments and variable cost and revenue and volume.

35MG: From top perspective or in the beginning phases, how do you get some of the intangibles into the brief?

36GB: Yes, a difficult question. Obviously a lot of the products in the car industry are replacement products anyway. So they're revolutionary, occasionally evolutionary products. Very rarely does something come along that's completely new from left field. So intrinsically in that you've already got a degree of knowledge about what's important and why. And I know some of that's paragons, you know, why do doors always hinge on the left hand side – on the side rather than from the top – well that's just because that's how doors are.

So if you wanted to sell a door that flipped from the top edge you'd never make any money because, not that it's not a bad idea or it doesn't work, but people are conditioned because that's how it's always been. So in actual fact sports cars will probably go on for a long, long time whether people like them or not because there's a conditioning out there. You know, there are some people that say 'well that suits my image'. Whether it actually meets any needs or not is irrelevant in terms of functional needs. In fact most sports cars don't deliver any functional needs at all, but what they do is deliver on the emotion.

39MG: But do you write it in the brief?

40GB: Well yes, and it will be specific to that activity, so if it's...we need to update Transit Van. Well a transit van is a transit van. We know it needs to deliver rational, functional requirements so it will be it has to deliver the capability of carrying so much weight, so much width or whatever and that's fairly easy. Emotionally it doesn't really need to deliver very much at a vehicle level. But one of the things that we were trying to do in that programme was actually trying to understand how customers do feel about their vehicle. Because some of these customers do actually live with it. Many of them don't, they just drive the vehicle and in which case the people that pay for it don't care at all what the drivers want. In fact they'd rather not give them anything because that would be wasting money on something that doesn't offer any value.

But other people actually live with the vehicles and want to have it a bit more comfortable and a bit more homely and so on. You know, in that sense we felt we understood a little bit about the customers but we went out and verified that with the range of people. You know the people that just drive it, the people that own it and drive it and the people that just own it – and get those different perspectives. So in that way we could actually write it into the brief – 'no it will deliver this and it will deliver this by these two customer groups'.

And when we're talking about, for example, the project I've just started where we're saying well it's a family vehicle so small families so one or two children. Intrinsically we know that they probably have a lot of things to store in the car because there's knowledge already about those people with our cars, we've been selling to families for years. But we want to improve on that because we believe there's an opportunity there, strategically there's an opportunity there to make it better. Even if they've got no problems today, there's an opportunity to make it better.

And that's the differentiation, I think, between what I would call traditional programmes and the innovation stuff. And it's that innovation stuff where you know we're trying to

create a little bit of stretch and a little bit of leap. But of course I still need to set off a team with a bit of focus so we've actually had to analyse the data to say actually flexibility and stowage is important to families with children. That will be the brief – go away now and study that.

So now, the team, we've gone away and studied what are the areas that are important, especially with a focus on flexibility and storage, and the brief will develop and the project will develop from there.

41MG: So how do you ensure someone takes the responsibility for the successful inclusion of the non-quantifiables in the different phases of the development process?

44GB: Right at the beginning. So I get involve with basically writing what the strategy for the programme is and the initial list of assumptions, which is clearly,...I would say in most cases, is an element of judgement as to whether it all adds up to the affordable business equation. And invariably there will be things that come in cheaper and something will come in more expensive.

45MG: So what you are describing is on top of individual briefs to individual vehicles.

48GB: Just explain the question again.

49MG: I'm just asking about what I understand is a design brief for one vehicle but what you're describing is that more for a line of vehicles?

50GB: No typically we do it by vehicles specifically, just one at a time.

51MG: OK fair enough.

52GB: Yes. There are some people in the organisation that cover more than one, and I'm one of those people. But typically when I've finished my work in the timeline sense, the team that takes on that work is dedicated to that programme for the next however many years it takes to deliver. And whereas I've been involved, as you probably gather from a stories mid-sized cars, commercial vehicles, and large cars and small cars as well – so it's everything.

So yes, right at the very beginning of the programme. And in terms of our product development process – we call it FPDS, (Company name) Product Development System – our first formal gateway where we report out, my input is to that gateway essentially.

55MG: OK, yes.

56GB: Which is the, 'we think we need to do for this vehicle for these reasons for this customer, da da da da da. And these are the things it will do and these are the things it will therefore have'. And my input in terms of innovation is obviously part of that, and that's where I start.

So in terms of making sure it gets there it can get there on the first day, because I've got an element of influence on that first gateway, on that first review. The issue after that is, as we talked before, is well the team - that Gateway One or what we call 'Kick Off' starts to ramp up in terms of the numbers of people that are coming on board. And areas like mine start to ramp down, so it's not a day one to day two handover. There's a sort of an overlap.

57MG: Yes, of course.

58GB: But it's basically down to me convincing those people and convincing them what I've done is there for good reason, why all the good reasons and to keep them in there. And then beyond the few months later it's out of my control.

59MG: So you don't come back and sort of check whether you think it's in there or not.

60GB: No there's no formal check. There's no formal... if you like 'role' to do that. Although we will...because this sort of operating is relatively new in terms of our development cycles. We will individually, because personally we're interested, we'll probably check back. But the formal system, the system wouldn't necessarily create that. But one of the things that we did in terms of improving our innovation activities... We put forward a proposal saying 'actually, because some of these are not quantifiable', and we didn't use those words but in effect the same, there needs to be a mechanism whereby they don't get deleted without a good reason, and a good cross-functional group of people agreeing to it. And we said a programme can't delete an innovation feature, or something that's a key wide buy for consumers, without it being reviewed by the head of that vehicle and his marketing person, his brand manager. Because he's supposed to be the representative of the voice of the customer.

In other words sort of the...by title Chief Programme Engineer – more product orientated person could actually decide to take something out without it being necessarily agreed to by his cross-functional team. And what we're saying is, not only does that full team need to be used, but in actual fact we shouldn't let that programme make decisions on innovation or consumer-important emotional areas without actually going to a level above.

So we've added in some administrative burden. But what we believe is right about that is that people that have a more broader perspective across several vehicles, have a bigger ownership of the (company name) brand, and a greater understanding of why we need to improve our innovation in terms of our brand image, and just generally across the board. We'll be able to veto or assess that decision or that proposed decision to delete an innovative emotional feature or execution. And in fact that's what we've been pushing for.

Reassuringly these two vice presidents – the Vice President for Product Development for Europe and the Vice President for Marketing for Europe - actually independently came to that same decision. Only yesterday when we were speaking to them said 'we need to make sure that it comes to a meeting such as the one we were in which is at a vice president level not at a programme level, so there's like two or three levels below them needs to come right up there. So they were going even higher than I'd necessarily recommended. So that at that senior level they can ,in effect, demonstrate the importance of the innovative feature or the consumer want that may not generate any business improvement. In fact probably makes the business equation worse.

So that was a very reassuring thing that just came up yesterday, alone. And that's it – that is the only mechanism.

61MG: But that is the process – how do you actually check that it's in the product. I mean would that lie within the process?

62GB: No, I mean that's just down... Well this is part of that same recommendation that, because we have a list of programme assumptions if you like, that's the guide book from the beginning to the end. And the programme can delete things out of that list of assumptions.

63GB: So the programme list of assumptions is the guidebook from start to end. But the programme team currently can delete things from that and not tell anybody, essentially.

66MG: You can actually lose some of...

67GB: Yes, but they're in full control of the programme. They are challenged, they are empowered, they're paid to deliver that programme to the end. Of course what happens is when they at times review with other people and more senior people, somebody might, and the emphasis is on might, notice that there's something not delivered or question it. But invariably the times that those things might get noticed are times when it's already too late, because long lead items have already committed, design's already committed. So that can then either add turbulence to the programme, or because they don't want to add any turbulence to the programme it gets left.

And I'm not trying to say that the programmes are doing the wrong thing. They are managing the business equation for that programme. So if they needed to delete something to save \$100 so that they actually broke even at the end of the year, that's what they have to do. Because if they don't break even then we're out of business.

So they're doing it for good reason. One of the things that obviously we have an issue with is making sure that they're only deleting – or they don't delete things that actually add value but don't show up on the business as a positive. And they need to make more informed decisions. They might still end up deleting it, but we'd rather them be more informed as to 'oh actually look this really does add value'.

This one thing – the one vase in the VW Beetle – might actually make the difference as to whether this is successful or not. Probably not that clean cut, but if they'd have done it without the vase would it be as successful? Probably. Would it have as much media?

68MG: The publicity.

69GB: Yes, would it have as much media – maybe not. Would it catch people's...the customer's emotions as well – probably not! But you can't add that up – you can't quantify it. And that's the whole issue.

So no there's no catch. And that's one of the things that by making that team go to that forum, we're basically saying for them to delete anything that was declared at the beginning as being 'key innovation' or of some of these emotional aspects, they have to report.

But a problem is, just in terms of an administrative thing, you know, if you've got 200 non-quantifiables they're not going to report every single one of those by programme. So what we try to do is prioritise and say basically we've got key unique selling propositions, key 'why buys', these are big things. This is the...this is like having a full length glass roof on the car – it's a pretty major part of the vehicle – if you take that away customers will notice it - management should notice it as well. Whereas something like a great working door switch for a window is so small, it's sort of a bit negligible.

So we actually categorised our innovation output as 'the big stuff', the 'unique sample positions' or 'small scale'. And what we said was, and we got agreement to this, we haven't yet put it in into practice because we're just starting. Is that those unique selling propositions, those big things, can't be deleted without the team having to go up to that more senior forum. And I think we've got agreement to that now, so that's a control mechanism that's in place. We've yet to prove it over the next few years to see if it will actually happen.

At the small-scale stuff. In other words you know the five little tiny door bins and a thing here and there that doesn't really cost much. We said that's just going to be a nightmare to track and control. And in fact for good engineering reasons - they might work out later on that actually a pen holder on the side of the door is actually not very practical and it's better to put the pen holder somewhere else, or in fact actually it's not a pen holder they want it's just a nice little area to put things that is big enough for a pen – and change it. Now that's OK as long as they're obviously doing it for good reason. So there's no point in wasting lots of people's times arguing about that.

So what we said was that that small scale stuff – those things – they all add up to quite a big emotional draw or lots of surprising delights and satisfaction. But on an individual part level they might actually not offer very much. So what we said there is well we should batch all those things together and allocate and protect a certain proportion of the cost of the vehicle and say, and it's probably like \$20 or something – 20 or 30 dollars of the cost of the vehicle, that's protected for this small scale innovation.

Now within reason you can take the input from the Gateway One if you like, and use that as input to that. And you might come up with your own ideas which actually might be better. So we're not stopping you doing anything, but keep that \$20 protected for innovative features that may generate no business positive impact and protect it, and that's great. We think we've got agreement to that.

The issue being again is how do track it and monitor it, and so what we've put in as a proposal is to actually change our review papers so that we'll actually have... We report at each of these Gateways on a standard-ish type of reporting document. And we put a proposal in that we actually fairly close to the front, have a tracking document for the

innovative features. Be it the big ones and the small ones and so they have to report what they've deleted. And we've subtly put a box in that says, you know, number of Features deleted since last Gateway. So it will easily be cheated...

70MG: When you talk about innovative features, would you add all the emotional things in there?

71GB: Absolutely, yes. And this is why I tried to say at the beginning is...there's lots of intangible aspects of the vehicle. And most of which I don't have any control over. What I do have control over is the innovative features – the stuff that 'wow, I'd never expect that to be there', or 'that was great in my home, I've never seen it on a car before'. But of course a lot of that is by definition intangible and emotional anyway. So yes, I am specifically talking about the innovative stuff, because that's something we're trying to improve across the board in (Company name).

74MG: But do you think that will lead the way to, you know, have another sheet saying these things...

75GB: No.

76MG: No? Why, maybe because this is too difficult to define or...?

77GB: Yes, and there's just so many of them. I mean innovation at the moment is high profile because management sees we need it, and we do. But what we're trying to do is not just innovation for innovation's sake, but we're trying to make the innovation applicable in terms of emotional and rational requirements for consumers.

And that's why it's slightly broader than what a lot of people would deem innovation to mean. But at the end of the day it's not all of the non-quantifiables in the vehicle. And the driving dynamics and quality that I've talked about is an obvious one which involves hundreds of people for every programme. Developing all that, yet nobody protects for it. So moving on to that area, one of the things that we do have is something and Paul might have mentioned this and it's called 'Powers'. This stands for Product Attribute Leadership Strategy. And basically what we do at several levels is we break down various attributes of the vehicle and decide how we're going to be on them, how good we're going to be.

So at this top level it might be dependability, quality, driving quality, something like that. At the next level it will be things like within...if we picked driving quality because that's the most interesting, it will be things like ergonomics, heating and ventilation, layout or package of controls, what have you and so on.

And then the next level down it will be you know stalks, specific controls, steering wheel, steering response or whatever. And for each of those there will be lots of metrics be it technical or maybe a bit more subjective as well. And we'll each for each of those decide whether we're going to be a leader, or competitive or amongst the leaders or that sort of...and those are the sorts of categories we use. So we're either the leader, or we're best in the, no we don't say best in class any more,...we say leader, amongst the leaders, so near the top, or just competitive.

78MG: OK.

79GB: So we're as good as everybody else as the mainstream. At the upper most levels, that's determined already and we're just about to finish off I think right down to the deeper levels that what each of those are. So...

80MG: But they are all made into quantifiables.

81GB: Yes so in effect they're all made into...although they might be very subjective measurements, but it says that in the area of ergonomics or forward visibility, we'll make sure that we've got vision angles of this, and we're going to be amongst the leaders in vision. Which might include even the thickness of the pillars, or the colours so that it

doesn't appear dark, you know, you use light colours and it doesn't look like it intrudes – whatever.

And so we have got very good...product wide all the attributes of the vehicle we've in theory we've got defined like that. And therefore the engineers have got targets that they can work to, even in some of those relatively non-quantifiable areas such as – vision's a good one because there's metrics for it, vision angles, but there's also that perception of space which you can't measure but... If we're going to be leadership in vision, there's only so much you can do with vision angles. Then the rest of it's going to be down to the intuition and the, if you like, the drive of the team to influence the other areas of the vehicle that would impact on the vision.

82MG: So how do you ensure that you've got it in there?

83GB: Because they can only measure it in a subjective appraisal or with the quantifiable attributes, so... Vision, they would, I'm not an expert, but vision they will actually measure obviously – the legal vision angles, but they'd also get a survey of appraisals that actually do many statistical driving appraisals of people and get feedback.

84MG: It would be easy for you to document the test for the development process.

85BG: Yes, and there is one for all of those things. And we call it a VER – Vehicle Evaluation Rating and we've got a standard scale and all the vehicles, once they're at a driveable level get assessed against that scale for all those different attributes. So you're given your list and you go off and you drive the car or sit in it and pretend you're parking or looking around and you make an assessment. And we do that to check that so it's subjective.

86MG: Now everything is broken down and you can test that. What about the coherence, the whole perception of the product? Do you accept that? I mean one thing is to get it right down to elements, but it comes together as a whole and you could send out mixed signals.

87BG: Good question. We do...obviously do market research around the vehicle as a whole at various levels. I have to say, a lot of which of course is around the styling. And that's obviously the styling clinics, you know, do you like this shape or that shape or softer here or sharper here or whatever. And we do also eventually get people driving the vehicle, but by then it's a bit too late. So a lot of these internal drive appraisals using this evaluation rating will be looking at the integration of those all the attributes coming together to make a good car.

And I think to be honest most humans can't separate off one area for too long anyway, because they're always going to be influenced by how well it integrates and how intuitive it is. But therefore as a...I think common practice, we actually have these evaluation teams cover people from different areas.

So there are groups within (company name) that are obviously very specific. I am the electrical person and there are other groups of people which are much more, in fact they're role is integration. They actually...we've got people called vehicle integration, and they look at what's the coherence and what have you.

88MG: So would these people be a part of the decision process...

89BG: Yes.

90MG: ...saying 'yes this vehicle can now move from this gate into the next gate'.

91BG: Yes.

92MG: OK. How do you document things like this?

93GB: That's again there's a standard Gateway/review papers that...to go through that. And that's in terms of reporting upwards, but they have...I'm sure they have tracking

documents that feed into those review papers that actually look at all those attributes and put them together. Otherwise the documents would be really *thin* (?)

94MG: Would you say that you deal with either the intangibles, or let's just say the innovative features, differently in a new project compared to a product update?

95GB: Um. Yes we don't get very much chance to practice that to be able to answer your question. But I would say of the two products that I've been involved with, which have been all new, rather than updates. And in fact, let me quantify what I mean by 'all new'. We do what you might call a minor fresh thing or a mid-cycle action – those two types of programmes are where the vehicle might get a new grill or new lights, yes? We then do an all new programme where in effect the architecture, the platform, the structure is all new but it's still...it's just the next generation '(model name)'.

We then do in the vehicle that's all new, for example (vehicle model name) or the (other vehicle model name) where we didn't have one of those before and this is a whole new vehicle into the market place. So we obviously don't do many of those, I mean there's not many of those in the industry altogether. When we get the opportunity to do those I would say that we have probably got more influence on the consumer, the empathy, the emotion than we would on other aspects because you're starting with a fresh piece of paper. The replacement and cyclical programmes carry with them a huge amount of knowledge, baggage if you like to call it that also, but to a certain extent you always go through the debate – even on an all new programme which is in effect a replacement.

Well '(model name A)' was (same model name). If we think we're going to carry on the (model name A) we need to be careful we don't alienate. So for example '(model name B)' was so radically different to '(previous model of model B)' there was a justification for a new name-plate.

So rather than the being called (name of previous model), because we were moving so dramatically different, and in fact we actually produced (model name C) and (model name D) at the same time. So that we could still appeal to the consumers that weren't actually ready yet to move into (model name C). And that was a very deliberate and strategic thing to do.

But on those sorts of things you do have clearly more influence on who's the target customer. Do we actually want to grow them and move them, which is what we did to a certain extent with (model name C). Do we want to move the brand into being a different type of people, in which case you can do that with a new vehicle, a new 'name-plate' as we call it or 'badge'. And therefore you've obviously got much more influence over the non-quantifiables be it the consumer needs and wants and some of the emotional aspects that go with that.

Cyclical programmes are a bit harder just by their nature. You've got limited scope and you also know who they are and you should have got it right by now incrementally. That sort of attitude.

96MG: How much would you say that these intangibles are directly linked to brand qualities?

97GB: Very much so I would have thought. In many cases for (company name), the generic intangibles in effect have become...or are our brand or key elements of our brand strategy. And we've already talked at length about the driving quality, so that is the answer to your question I think...

With respect to the smaller stuff, like maybe the innovation side of the equation which obviously I'm personally interested in. That is probably not really...it does link to our brand, because part of our brand strategy is about being 'contemporary'. And therefore clearly that...that's an important part but, again, it's a discretionary thing. Can you be contemporary without being innovative? Yes!

Furniture design is contemporary all the time. It doesn't necessarily mean it's innovative. But as you can see from that chair behind you there are innovative alternatives to seats which is both contemporary and innovative, but you can still be one without the other, so...

But it is an important link there.

98MG: Have you made any specific investment into these intangibles?

99GB: At the corporate level I can't tell you, it's all those sort of big ones. Other than the driving dynamics and the quality is an area where we, proportionally, we've probably spent a lot of time and money over the years, and we've already talked about that in length. In terms of the innovation – no. The investment made is basically me and two or three other people have been allocated a workload.

100MG: But there is still some sort of investment?

101GB: But yes, there's a very small level of focus and commitment in the sense that there's a few people allocated to do it. Real money? – not really.

102MG: No. Do you feel that it's changing?

103GB: It will be...without wanting to get into the politics of it there's, and again because I guess it's non-quantifiable, there are issues with convincing certain people that we should do it. Even my direct management structure don't really believe in and see the value in innovation, yet they're charged with it.

104MG: Unbelievable – I don't understand it.

105GB: So I have to bypass them and speak to the Vice President to say 'by the way I need to get...I need to spend £5000 supporting an innovation project, you know. And they look at you to say, yes we've told you innovation is important - that's nothing – you should just do it. And yes, but my - and you can't say but by the way my Director doesn't believe I should do it and therefore said I had to come and speak to you when we've already spoken to you. So sometimes it's the internal system (*loud bell ringing*) which is the problem. 'You phone them...'

106MG: Can you mention two examples of where you got the intangibles really right and why?

107GB: Yes, I mean, something I've been involved with personally – no. But I believe a good example that was often stated is, and again it started in (vehicle model name), was the remote control stalk for the radio and the audio system. I think it...certainly our ergonomists would say that that's the first thing they've really managed to get ergonomically right in terms of design from the start rather than policing it to be acceptable – an acceptable ergonomic design. And I know those people – the ergonomists have regularly quoted 'our success thing' and little things like that I don't mind if they're little but things like that you often hear customers talk about 'oh yes, it's really good'. And that's one of them.
Historically we've had a few successes around things such as the (model name of C segment car) – the original model had a pen holder in it, and it was one of the first European cars that had a pen holder. But that was obvious. It wasn't a pen holder stuck in the back of somewhere else but it was right in front of you.
OK, most pens didn't fit in it, you had to have a slim pen rather than a fat pen, but you know, we got a lot of media review from it and a lot of customer feedback.
And then other things on a similar sort of smallish scale, I would say that's something that, again, it's something you need to have lived with a (company name) to realise the benefit is the heated front screen. And that is actually innovation – that's taking a technology from a different industry, aviation and aerospace, applying it to a car – because why would it...in fact it's probably as important in a car. And we've had it patented for a long time so other people couldn't actually do it. But the patent now is open – people can...other manufacturers can use it and yet (company name) and (other company name), although we own (the other company) now, are the only people that have a heated front screen. And yet, how many people would know (company name) have a heated front screen and that's a great thing – I must have it – until they've had

one. And the number of people I speak to, or I've heard in market research say, 'oh yes, I had a (company name) and it had a heated front screen, it was brilliant!' And they love it when they've got it, or even more impressively when they've changed car and they've gone to something else and the thing they hate the most is 'I don't have that heated screen and it was fantastic'.

108MG: Why did they get it...obviously this is something you've taken from the aerospace industry or you know... But do you know why you got it in there?

109GB: I'm sure it was somebody like me, somebody in terms of technology, yes. Good application. I'm sure there was some research done...The heated screen is an expensive thing, and initially, how do you know if you can charge for this thing. I'm sure they did some pricing research that say 'if we did this, how much would you be prepared to pay for it?' And I'm sure we've done a business equation that says well once...if we can sell 10,000 cars a year with this thing on globally around the world, that covers the cost of the paint and the developing of the technology and manufacture – is it worth a risk? And somewhere along the line they've probably heard enough research to say yes we'll go for it. We think we can charge customers £400 for it and that's what we need to do. And I'm sure now we're just living off the back of that success. It probably costs us £300 to make and we sell it for £400 so we make £100 every car we sell it on.

112MG: What about the two other examples – do you know why they ended up with the radio, the pen-holder...?

113GB: Again, I would suggest that, to a certain extent, it would have been if you like voice of the customer. So in like a scenario of use somebody might have said oh and it's really annoying I don't have anywhere to put my pen. There may have been some competitive assessment, somebody's seen it somewhere on a competitor. So there might have been a follow strategy, I don't know. And there might have also been just genuine belief that this is something we should be looking at.

It's actually quite rare that (company name) would lead. And in fact there's...the heated screen example is somewhere where we led, which is quite unusual for (company name), in terms of recent times. So we tend to be a follower and that's why I suggest that maybe actually we did it for competitive reasons. But I think, again, even where there's a competitor out there with it, there's still...somebody's got to be convinced that we need it until every competitor's got it. You know when there's only one...somebody might still debate 'well they might not be successful'. But when two or three you have to do it just to be competitive. So I don't know those examples because they're quite historic to know how they got there. But I would suspect there was an element of on the following items, not the heated screen, there would be an element of either competitive assessment or somebody's heard it through an empathic means of some sort. Or it's come up in the research.

114MG: Have you got any examples of where you got it wrong?

115GB: I'm sure there are...(long pause). I'm sure there are. I can't think of anything straight away. The first thing that came to my head was when we launched the new (model name) recently. Since it was launched it became apparent that the door mirrors were too small. People found that they weren't actually very big and we've just launched a freshened version which, you know, for most people it's literally just a grill and a change to a radio shape or something. And one of the things they've done is changed the mirrors to be bigger. And that's an interesting example because the original mirror design must have met our vision requirements and our other design requirements because otherwise we wouldn't have done it.

116MG: But perception...

117GB: But the perception was different, yes? So there's a non-quantifiable on a very rational functional thing – component. And how could we go from...how do we measure whether

it's too big or too small and now find with customer feedback is it's too small and we've had to enlarge it. How do we not get there in the first place and therefore why are we in the position where we have to change it. So it's an interesting example there where we obviously met all our criteria and yet we still didn't quite deliver. And in a non-quantifiable sense these mirrors...the customers, I'm sure must have said, 'these mirrors are a bit too small, for a big car I don't seem to have much mirror'. Whether they could see any more with a bigger mirror or not is probably not actually what they're complaining about – there's a perception – big car needs big mirror – maybe. It could be how far away they are from the glass, the thickness of the doors made them feel they're much further away, it could be that they feel much lower in the car 'cos the belt line's higher and therefore I need to see more so I need a bigger...yes, absolutely. Absolutely. Perception of vision and roominess or being enclosed can work both ways. And one of the things...I had a fantastic opportunity verbatim from a guy that works for me – drives an old Peugeot, you know doors are very thin, he borrowed my new (model name) I had, the doors are quite thick. It doesn't necessarily mean one's safer than the other – I'm sure they are, but one of the comments he came back with he said 'the doors are really thick – I felt so much safer and much more solid and much more enclosed and felt really...I was really protected', and what have you, 'and I still felt it was reasonably roomy'. So to him there was a good balance between the amount of glass and light coming in versus the amount of darkness and enclosure of him being enclosed with thicker feeling doors. And he really felt he was much safer and he said 'I really felt really uneasy when I got in my old car again because I felt there was nothing there protecting me'.

There might have been, as I said, the same amount of metal there and it might have been, unlikely, but it might have been just as safe but the fact that they were thicker and just the angles of the tops of the doors meant he felt much safer because it looked thicker – the perception was it was safer.

120MG: But it wouldn't have been in the brief?

121GB: Not at all, I'm sure. Although we are trying to make those sorts of things be in the brief, but it's very difficult. I don't know how good we're getting with that, but there certainly aren't those pals that I talked to you about. I don't know them all but I certainly believe that's part of, for example, driving quality. They're trying to bring in attributes within the perception of package of space that cover those things but of course they're quite difficult because they're non-quantifiables.

122MG: Where else in the company do you discuss these things?

123GB: I don't know. (*laughs*). Obviously our marketing community are probably pretty good on this stuff. And I think there are...there will be individuals that are very good with this stuff – ergonomists are the obvious ones. And I think some of our more forward thinking or open minded package people – so they're the people that look at what's the spaces – how are we going to use the space and put people or, you know, the thickness of the doors. That I think they're getting much more in tune now with these perception of space, perception of roominess, perception of visibility than we probably have in the past. So, I think we're moving a long way forward and there is probably more and more of that coming in now, whereas historically we probably talked much more about just engineering, the parts.

124MG: Do you find that you sort of lack a language?

125BG: Certainly if you move through the organisation from marketing through to manufacturing there's clearly a different language. And a lot of that is just historical and if you like almost social level. But I think, and I'm experiencing it even today, I've got a manufacturing guy in my team and a marketing person in my team. And I can converse with the marketing person and the manufacturing guy is saying lot's of expletives 'I don't know what you're talking about'. 'I don't believe the customer's buy cars for emotional

reasons', 'they just buy a car don't they?' 'They just buy the car they want and they pay the price that they can afford – what's all this emotional bollocks?'

126MG:I understand.

127GB: And because unfortunately that's his perception and belief and...

128MG:Because you're not conscious of that all the things going on.

129GB: In many ways he's not conscious and we're trying...over time he'll get it I'm sure. But of course to him because it all sounds very woolly and fluffy it's very easily dismissed. And the problem is it is. And that's...the business when you get to the numbers can't quantify it and therefore it just exaggerates the woolliness. And because we're in business therefore anything non-quantifiable is subject...is discretionary. And at the end of the day you might not be able to speak to me soon because we're about to go bankrupt probably and you know...that's because we're spending too much money on products that don't make enough money. So...and we're trying to improve on them.

130MG:I mean it's interesting because (company name) is certainly perceived as a brand who is strong in tradition. But it's this balance between getting some new features in there, getting out in the market and still be traditional or reliable and all these things which are sort of inter-linked. But if you don't get the intangibles right you're certainly going to lose out. Whether you manage to get the intangibles right under the title of tradition but do you know sometimes it's wrapping. Things move on. So thank you very much for that.

131BG: Cool. Hope that was helpful.

132MG:Very helpful.

End.