IMPROVING PRODUCT DESIGN AND DEVELOPMENT PERFORMANCES IN SMEs WITH USER CENTRED DESIGN ACTIVITIES

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IMPROVING PRODUCT DESIGN AND DEVELOPMENT PERFORMANCES IN SMEs WITH USER CENTRED DESIGN ACTIVITIES

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ABSTRACT

The study is framed within the context and knowledge that companies that continually achieve product design and development success, habitually work more closely with customers and users. They do this to discover needs and wants in order that these might be translated into new or improved product or service offerings. It is widely recognised that many companies achieve success by reaching-out to customers and users directly in order to tap into what matters most to the people that will purchase and use their products and services: such engagement enables the development of a healthy pipeline of breakthrough products and services. The importance of connecting with customers and users is not a new phenomenon: building-in the voice of the customer is a critical element of well-established tools such as Quality Functional Deployment (QFD) in large organisations. Awareness of this sparked the simple question, 'why, with so much support and clear evidence of the benefits of customer- and user-involvement in identifying and fulfilling needs has the practice not become universally embedded within product design and development activities?'

The main aim of this study is to build upon the work of organisations such as the Design Council and NESTA, and authors such as Herstatt and von Hippell, Cooper and Kleinschmidt and Ulrich and Eppinger. These agencies and researchers have indicated - in numerous studies and publications - that direct contact with customers and end-users is one of the best means of generating information about new product ideas. They also assert that 'experiencing' the use environment of a particular product or function is a prerequisite for generating high quality information.

Many studies provide useful insights into generic best practices and offer evidence to support the assertion that direct contact with customers and end-users is important for large organisations. The research reported below continues in this vein but extends the analysis to examine specifically: (i) the importance (to business success) of fulfilling customer needs, (ii) the extent of customer and user involvement in identifying and fulfilling needs, (iii) the range of activities in which stakeholders and users are typically involved, (iv) the classes of issues discussed in engagement practices, and (v) the issues that contribute to success and failure in product development in SMEs.

The study is important in two key respects. First, because even though organisations such as the Design Council and NESTA have highlighted the positive impact that fulfilling user needs can have on business growth, there remains a mismatch between perceived wisdom and practice. Second, from a research perspective, it builds upon existing theory and provides a level of granularity that both extends understanding and provides novel insights with respect to how the gap between theory (known value) and practice (adoption and use) might be bridged.

The research was undertaken in three key phases. The first involved a series of scoping and context-setting interviews with respondents in selected, innovating SMEs. The second phase involved the development of a sector-based sample of SMEs and the distribution of a comprehensive qualitative-quantitative survey questionnaire. Following data analysis, a third phase witnessed the validation and nuancing of initial results via further engagement with selected innovating SMEs in the safety, general products, and healthcare sectors. Key findings from the study include the following: users and customers are an excellent source of ideas and intelligence in the product development process, however, many companies fail to exploit customers optimally (or at all) as a development resource; identifying user needs is an integral component in the product design process, but many companies lack the skills and knowledge to undertake this work adequately; where customer/user engagement is witnessed, it is frequently at non-optimal phases in the development process and limited in ambit (or undertaken by functions that are poorly-equipped to reap full benefits); and, whilst theory relating to user-involvement is widely recognised in the SME community, this is rarely translated effectively into cutting-edge practice.

The study provides a contribution to new knowledge by focusing on the improvement of front-end product design and development performance via the deployment of user-centred design activities. It unpacks and details the factors that impact on identifying and fulfilling customer needs in front-end product development in UK SME manufacturing companies, and develops a framework that aids in reducing uncertainty and maximising effective practice in the development process. Further, the work maps and analyses state-of-the-art research in the domain and presents an agenda for future investigation designed to stimulate and support improved user-engagement activity and thus improved product development outcomes.

INTRODUCTION

The aim of the introduction is to set out and explain the underlying reasons and thinking behind the study. It will provide a chronology of the (part-time) study, a structured overview of why and how the study was implemented, and stipulate why the study is still relevant today. The objectives are to frame the specific focus of the investigation for the reader, and to provide a clear presentation of the structure of the thesis. The following chapter will act as a context setting section for the study and will concisely discuss the following issues:

- Chronology of the Study
- Context
- Key Players
- Identified Gap
- Contribution
- Focus of the Study
- Review of Relevant Literature and Theory
- Research Questions
- Methodology and Operationalisation
- Data Collection and Analysis
- Findings
- Analysis and Discussion
- Conclusion

Chronology of the Study

The decision to undertake the study was not an easy one to make. It required the balancing of academic and professional practices in order to engage meaningfully with my studies in a part-time mode. I had arrived at a junction in both my academic career and thinking in relation to my personal practice within the field of new product development. My activities were slowly moving away from design based interventions to more research and strategy based activities, requiring me to apply and rethink new product development theories and practices within a user centred design context. The objective of undertaking the PhD was to strengthen my understanding of theory in relation to the core subject areas of user centred design and new product development practices. This would then dovetail with my applied and professional practice based experiences, strengthening my analytical and textual communication skills. In theory, the approach was a good fit. However, at the same time my academic career started to develop resulting in me undertaking new roles and responsibilities and ultimately joining three new institutions during the period of PhD study (involving a transition from Course to Centre Director and then to Associate Dean). In parallel my professional career escalated to the point of establishing a joint business in South Korea and later in China. These unforeseen positive developments posed challenges and opportunities. The ability to translate theory into practice was the key opportunity area: challenges were associated primarily with time pressures. My studies can therefore be described as taking place over three phases, namely (i) scoping, (ii) data collection, and (iii) finalisation. What sustained this process was the realisation that over the period of research - when systematically revisiting the problem to determine the study's pertinence at key points in 2003 and 2008 - the core problem remained relevant. That is, there was a lack of understanding with respect to why companies (in particular SMEs) were not embedding the voice of the customer into their activities. That this problem appeared intractable was perhaps more surprising given that organisations such as the Design Council (2005) and NESTA (2008) had been vigorously highlighting the importance of user-led innovation and its contribution to business and economic growth.

Context

This study is framed within the context and recognition that companies that continually achieve product design and development success, habitually work more closely with customers and users to uncover needs and wants in order to translate them into new or improved product or service offerings. It has been established that they achieve this success by reaching out to their customers and users directly in order to tap into what matters most to the people who will purchase and use their products and services, enabling the development of a healthy pipeline of breakthrough products and services (Eisenberg, 2011). The importance of connecting with customers and users is not a new phenomenon. Cooper and Kleinschmidt (1994) established that building-in the voice of the customer is one of the crucial factors in getting new products to market more quickly (developing products and services that fulfil user needs). Building-in the voice of the customer is a critical element of well-established tools such quality functional deployment (QFD) in large organisations. The awareness of this knowledge sparked the simple question, why, with so much support and clear evidence of the benefits of customer and user involvement in identifying and fulfilling needs, has it not become universally embedded within product design and development practices?

The above question indicates the importance of this study. Despite decades of high quality research (Herstatt, von Hippell, Cooper, Kleinschmidt and Ulrich), numerous examples of commercial success (e.g., the 1989 launch of the Mazda MX5) and the emergence of global champions (Tim Brown of IDEO and A.G. Lafley formerly of Procter and Gamble) there is still the need for a study such as this one.

Key Players

The main aim of this study is to build upon the work of key organisations such as the Design Council and NESTA, and authors such as Herstatt and von Hippell, Cooper and Kleinschmidt and Ulrich and Eppinger. These commentators, in numerous studies and publications, have identified that direct contact with customers and end-users is one of the best sources of information about new product ideas. They also assert that experiencing the use environment of a particular product, function or task is a prerequisite for generating high quality information.

Identified Gap

Many studies provide useful insights into generic best practices and offer support for why direct contact with customers and end users is important, particularly in large organisations (Eisenberg (2011), Barczak et al. (2009)). What has not been undertaken, however is a detailed and focused study with respect to what companies actually do in practice and what are the barriers to achieving success, especially in small medium sized (SME) companies. Therefore the objective of this study is to bridge this gap in current knowledge by examining and understanding what actual involvement, activities and methods are being adopted, and what factors contribute to success and failure in relation to UK SME manufacturing companies. More specifically, this study aims to examine: (i) the importance of fulfilling customer needs to business success, (ii) levels of customer and user involvement in identifying and fulfilling needs, (iii) the range of activities that stakeholders and users are typically involved in, (iv) the type and nature of issues discussed in engagement practices and (v) what issues contribute to success and failure in SMEs.

This study is important, firstly because even though organisations such as the Design Council and NESTA have highlighted the positive impact that fulfilling user needs has on business growth there is still a mismatch between perceived wisdom and practice; secondly from a research perspective it builds upon existing research and will provide a level of granularity that will contribute new knowledge and help identify new insights of how to bridge the gap between theory (known value) and practice (adoption and use).

Beyond the above, the notion of uncertainty has emerged as a significant factor that impact on new product development practices creating indecision and hesitation for many organisations, resulting at best in increased development times and at worst in missed opportunities. Cost has been identified as a core area of uncertainty but it is currently unclear what other factors are impacting on adoption and use of user centred methods, particularly in UK SME companies. The intention is to identify the underlying reasons that contribute to creating uncertainty in SME manufacturing companies (i.e., the inability to involve users effectively) when they trying to engage users within their front-end product design and development activities.

Contribution

The study will address these issues and make a contribution to new knowledge by focusing on understanding how to improve front-end product design and development performance in SMEs through user centred design activities (see Figure 1). It aims to understand the factors that impact on identifying and fulfilling customer needs in front-end product development (see Figure 2) in UK SME manufacturing companies and develop a framework for reducing uncertainty. In doing so it draws upon the pioneering work of Ulrich and Eppinger (1995) (see figure 2).

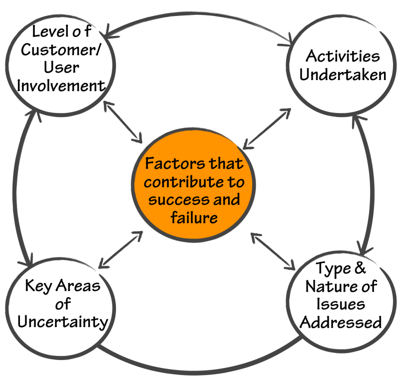

Figure 1: Project Focus

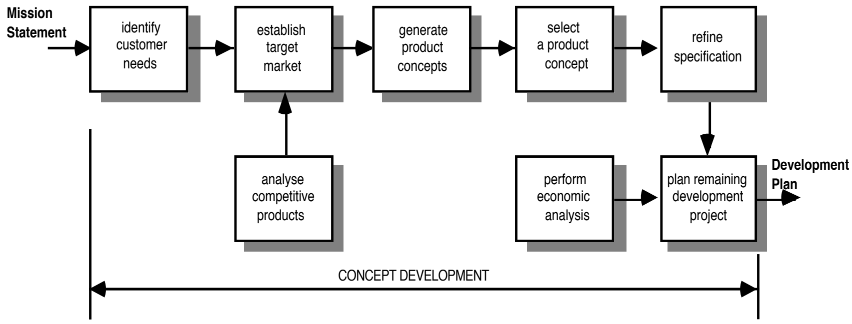

Figure 2: Front-end Product Design and Development Activities –
Concept Development Stage, Ulrich and Eppinger (1995) p.35

Focus

The study specifically focuses on front-end product design and development activities and adopts Ulrich and Eppinger's (1995) concept development stage (CDS) as a basis for its framework (see Figure 2). The essential activities explored, in relation to the concept development stage, relate to the process of information acquisition and transformation, the generation of product design requirements, the development of product design concepts, the testing and re-testing of product design ideas. The study takes into account the range of potential *stakeholders* indicated in figure 3; with particular reference to the concept development stage illustrated in figure 3 below.

It concentrates on investigating how product design and development performance in SME Manufacturing companies could be improved through the deployment of user centred design activities in order to reduce uncertainty in front-end activities. Within the context of front-end activities, uncertainty relates to the inability to identify and collect actual user/customer needs and the incapacity to establish new target markets that fosters indecision, hesitation and erodes confidence in people and teams.

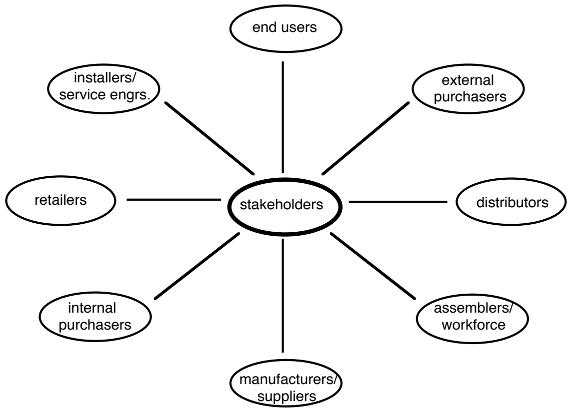

Figure 3: Potential Stakeholders within the Front-end Product Design & Development Process

At the heart of the study is a multi-theme literature review that focuses on (i) user involvement, (ii) new product development practice and design practice issues. The multi-theme review of theory and commentary has been instrumental in exposing the main gaps in knowledge and principle areas of uncertainty (Booth et al (2004) cited in Robson's (2011)). It has helped to identify patterns in findings from multiple sources and from this understanding and emergent conceptualisation, the focus and the primary questions and measures for study have been established (see Table 1).

Principle Question Areas and Measures	Key CDS Activities
A: Level of Customer Involvement in SME Practices Measures: Importance, Frequency, Nature of Involvement **B: Activities Undertaken with Stakeholders by SMEs** Measures: Frequency, Who Undertakes Activities, Responsibilities **C: Types & Nature of Issues Addressed with Stakeholders by SMEs** Measures: Who, Frequency, Information Sought, Nature of Processes, Quality **D: Key Areas of Uncertainty that SMEs Experience** Measures: Levels of Uncertainty, Levels of Success and Failure	**1: Identification & Collection of User Needs** **2: Establishing Target Markets** **3: Evaluation of Competing Products** **4: Generation of Product Design Requirements / Specifications** **5: Generation & Selection of Product Design Concepts** **6: Testing & Prototyping of New Product Ideas**

Table 1: Core Questions and Activities

In order to drive the study, a robust exploratory project framework has been developed. This breaks downs the CDS into six key activities, derived from Ulrich and Eppingers (1995) front-end phases, that the study focuses on. It then relates these to the four principle question areas of the investigation (see Table 1) originating from the emergent literature review themes. Each question area is explored in relation to the six activities and investigates four key questions areas stemming from literature review best practices/issues (see Figure 4).

Building upon the exploratory project framework. It enabled the defining of the relationships between the emerging concepts, and the establishment the specific concepts that study would focus on measuring and testing. Utilising deductive reasoning to further the investigation, four interrelated key concepts were identified and have helped to form the basis of core question areas for the study (see Figure 4).

Review of Theory a Commentary

The study adopted a multi-theme model of investigation. The underlying reason for adopting a multi-theme literature review is based on (i) the importance of users to design through activities such as co-creation and (ii) design to CDS activities due to design-driven innovation and design-led businesses. This approach was deemed to be relevant model of investigation, as it focuses on exposing the main gaps in knowledge and principle areas of uncertainty, identifying patterns in findings from multiple sources in the same area and finding appropriate research methods (Booth et al (2004) cited by Robson's (2011)). The study adopts Hubbard's definitions of uncertainty and risk, with uncertainty relating to 'the lack of complete certainty, that is, the existence of more than one possibility' (2010: 763-764). In addition he also defines risk as a state of uncertainty, where some possibilities involve a loss, or other undesirable outcomes.

The aim of the literature review chapter is generate an in depth understanding of the factors that impact on identifying and fulfilling customer needs in front-end product design and development activities. To achieve this goal, the literature review engages three main domains:

- Factors Affecting User Involvement
- Factors Affecting New Product Development Practices
- Factors Affecting Design Practices

The rationale for adopting this multi-trajectory approach is the strong connection between user involvement and design practice; the importance of user involvement within the new product development practices (NPD) and the traditional interrelationship between design and NPD.

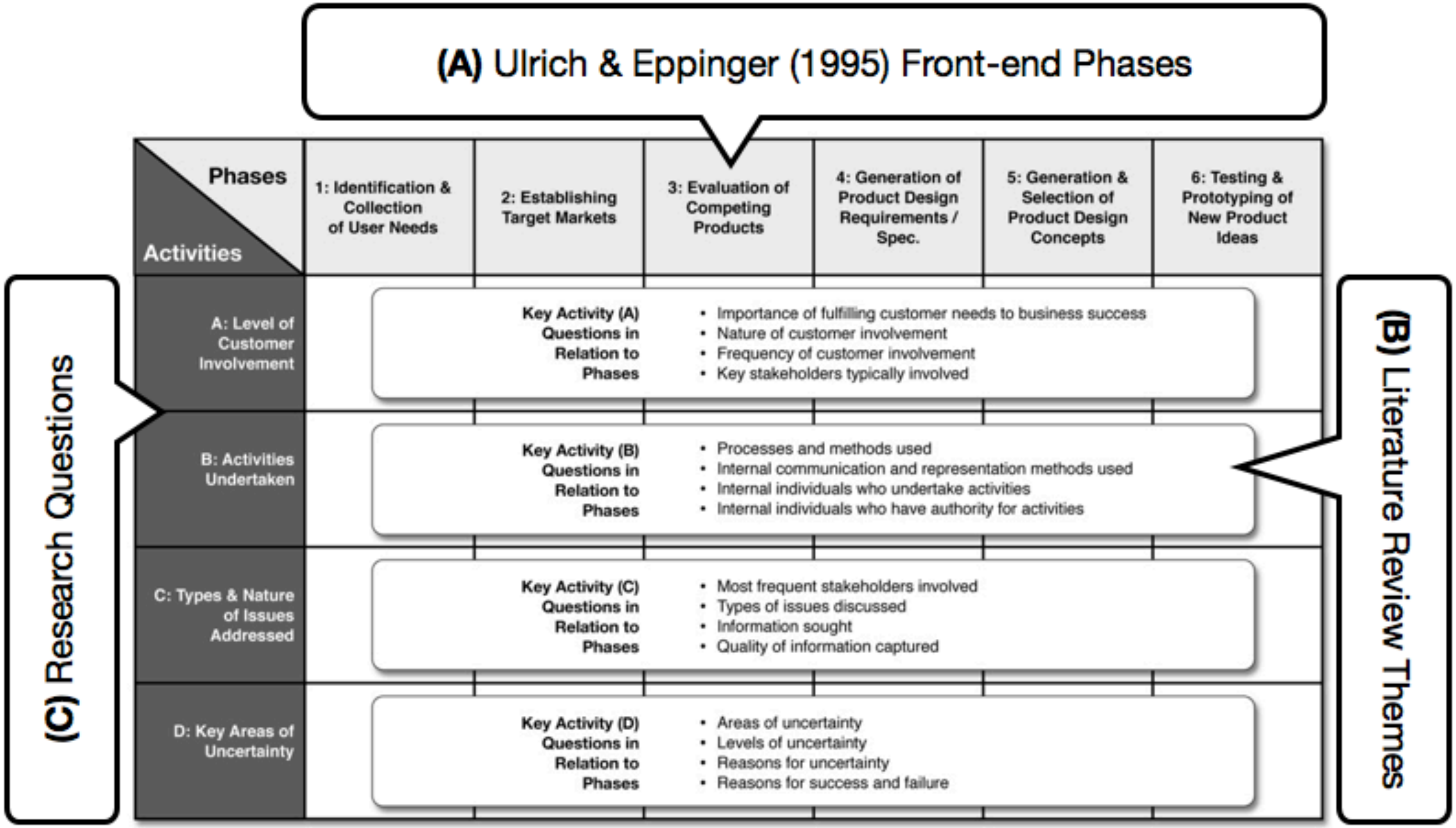

Figure 4: PhD Framework

Each section of the review explores a series of emergent themes derived from multiple sources and ends with a summary of the emergent issues.

Research Questions

Critical analysis of the emergent themes from the literature review domains (user involvement, new product development practices and design practices) enabled the identification of a series of research questions. This process was central in helping to focus attention onto the central questions and related sub-issues:

(RQ1) What is the Nature and Frequency of Customer Involvement in SME CDS Practices?

Sub-issues explored to address research question:

- Importance of fulfilling customer needs to SME business success
- Nature of customer involvement in the key CDS activities
- Frequency of customer involvement in the key CDS activities
- Key Stakeholders typically involved in the key CDS activities

(RQ2) What Processes and Methods do SMEs Typically Use to Collect CDS Information from Stakeholders?

Sub-issues explored to address research question:

- Processes and methods typically used by the SME to capture information
- Communication and representation methods used internally by SMEs
- Who typically undertakes the information capture activities within the SMEs (role and function)
- Who Typically has responsibility and decision-making power regarding information capture activities

(RQ3) What Issues do SMEs Address with Stakeholders in order to Identify Their Needs in the CDS Process?

Sub-issues explored to address research question:

- Stakeholders most frequently involved in establishing key CDS issues
- Types of issues discussed with stakeholders within key CDS activities
- Information sought within key CDS activities
- Quality of the information captured within key CDS activities

(RQ4) What are the Key Areas of Uncertainty that SMEs Experience within the CDS?*

*Uncertainty can be attributed to factors such as a lack of certainty, knowledge, expertise, experience and or confidence.

Sub-issues explored to address research question:

- Level of uncertainty SMEs experience within the key CDS activities
- Reasons for uncertainty SMEs experience within the key CDS activities
- Levels of uncertainty SMEs experience within the key CDS issues
- Reasons for uncertainty that SMEs experience when discussing key CDS issues
- Levels of success & failure that SMEs achieve when undertaking key CDS activities
- Reasons for success/failure that SMEs achieve when undertaking key CDS activities

Data Collection and Analysis

The empirical study was built on a self-completion sample survey method. Disadvantages, according to Robson (2011) of self-administered sample surveys are that they typically generate low response rates. However, he suggests that the advantages are that such surveys encourage frankness when sensitive areas are being explored. This offsets the typical disadvantages of interview surveys were data maybe affected by the characteristics of the interviewer and the interaction between the respondent and the researcher (Robson, 2011).

A target sample of 120 companies was established, with 40 companies per three categories: (1) health related products; (2) safety related products; and (3) general. The SMEs were selected from the an initial data base of companies who had engaged in the Design Council's 'Design in Demand' program and was cross referenced with Kompass business database in order to determine that they where classified as SMEs. Companies were approached in order to identify willing participants and a condition of them taking part was the wish of the participants to remain anonymous due to in depth nature of the study. The sample focused on SMEs that had: (1) a turnover of greater than £500K to avoid start-up companies; (2) a minimum of 10 employees to ensure the need for some forms of processes and structures within their business activities; and (3) a design function within the business to undertake new product development. A 13% success rate was achieved from 120 target companies – 15 respondents (40% health related products; (27%) safety related products; and (33%) general.

Prior to developing the survey document, a series of scoping interviews where undertaken to evaluate specific characteristics and needs of SME's in terms of achieving product success through CDS development. The scoping interviews were crucial in helping to structure concepts, and in improving language and relevancy of the ordering and nature of the questions. The survey document incorporated a triangulation strategy (cross-referencing quantitative and qualitative issues and questions) in order to identify and determine inconsistency between perceived importance and actual day-to-day practices.

A descriptive approach was selected regarding the analyse of the data. This is because descriptive statistics aim to summarise a sample, rather than use the data to learn about the population (Field, 2009). The adoption of this approach supported the central theme of the study of being able to describe what SMEs are actually doing in practice, regarding user involvement.

Thematic coding analysis, as described by Robson (2011) and Liamputtong and Ezzy (2005), was undertaken to summarise key emerging themes from a large amount of qualitative data. In the main findings section a summary cross-tabulation method has been used to generate concise and uncomplicated summaries.

Findings

The findings chapter will introduce and discuss the results derived from the sample survey. The chapter comprises of four key sections that address the central research questions and hypotheses of the study. Each section will summarise the key findings; discuss emergent themes from the analysed responses', present quantitative and qualitative data were appropriate; and address the related research questions.

Discussion

The purpose of this chapter is to discuss in more detail the emergent themes from the results and to discuss the extent to which and how they are consistent with previously published knowledge on the topic. The discussion will suggest that the SME sample see the importance of customer involvement to the achievement of business success in front-end activities, which supports the activities of the Design Council and NESTA to raise the importance of user-led innovation to business success. However, it will suggest that the sample companies typically focus more on the rear-end related activities (such as selection, testing and prototyping of selected product concepts) because they experience uncertainty in the identification of user needs and in establishing new target markets. This uncertainty often is driven by a lack of certainty (new market and or customer needs), knowledge (technology and or market), expertise (research skills), experience (infrequent number of projects undertaken) and or confidence (lack of resources). These activities are typically undertaken in an unstructured and informal manner that leads to uncertainty.

Conclusion

The conclusion will return to the research questions and highlight the ways in which related findings assist in contributing to the closing of the gap in current knowledge (i.e., what do SMEs actually do in practice re: user involvement in CDS processes). The conclusion will also allude to the messages, both practical and theoretical, that can be distilled from the findings of the study. The section will close with a discussion of (a) the limitations of the study, and (b) an outline of further research opportunities.

Literature Review

The aim of the literature review chapter is generate an in depth understanding of the factors that impact on the identification and fulfilment customer needs in front-end product design and development activities. In order to achieve that goal, the literature review adopts a multi-trajectory approach that explores three key areas:

- Factors Affecting User Involvement
- Factors Affecting New Product Development Practices
- Factors Affecting Design Practices

The rationale for adopting this approach relates to the strong connection between user involvement and design practice; the importance of user involvement within the new product development (NPD) practices and the traditional interrelationship between design and NPD. The literature review comprises of three sections. Each section explores a series of emergent themes derived from multiple sources and closes with an extended and analytical summary of the emergent issues. The focus of section one is the provision of an in depth review of the factors affecting user involvement. The section sub-divides the findings of the literature review into three themes that focus consecutively on articulating the need for greater user involvement, the scope and nature of user centred tools & methods; and describing the role of the product designer. The second section explores the factors that affect new product development practices . The NPD literature review discusses issues shaping the 'fuzzy front-end'; the importance of the voice of the customer within NPD practices; and he changing role of design within NPD activities. It closes by outlining the current trends and drivers of success within NPD practices and activities. The final section looks at the factors affecting design practices. Several themes are discussed. Firstly it serves highlight the current confusion in the lack of common definitions for design and innovation; it examines the concept of the 'value' of design; explores design and development practice issues; investigates design-driven innovation strategies; and closes by describing the emerging new relationships for design such a brand driven innovation.

The chapter concludes by summarising arrange key points that have influenced the focus of the study. Here are also stated the key questions that will be explored in the focal study of the project.

Factors Affecting User Involvement

Introduction

This section is designed to examine emergent trajectories and themes, key commentators (authors) and journals that have contributed to the subject area and development of the discipline has provided the study with a thorough grounding and platform with respect to the field of the user involvement literature. The following sections explores three identified trajectories:

A. Need for Greater User Involvement
B. User Centred Tools & Methods
C. The Role of the Product Designer

The section concludes by summarising the core issues within the examined fields.

1 Need for Greater User Involvement

Voice of the Customer

The best companies often work closely with their customers to uncover needs and wants that can be translated into new or improved product or service offerings in order to develop a healthy pipeline of breakthrough products and services that will provide robust and steady profits. To achieve this, companies often reach out to their customers directly in order to tap into what matters most to the people who will purchase their products and services. (Eisenberg, 2011).

Cooper and Kleinschmidt (1994) found that *building in* the voice of the customer is one of the crucial factors in getting new products to market more quickly than traditional approaches that do not adopt this approach. However this finding must be seen within the context that although lead times for introducing new products to market are reducing, seventy-five percent of all new products introduced fail and many consumer products also fail to achieve their objectives in the market place (Power (1991), Chay (1989), DTI (1991)). A significant number of studies have identified that poor market research combined with a lack of thoroughness in identifying real needs are key factors associated with product failure (Hopkins (1981), Berry (1981), Cooper & Kleinschmidt (1987), Craig & Hart (1992)). This then raises the questions:

(a) are companies spending sufficient time and resources understanding the needs of their users?
(b) are they utilising that information effectively?

Historically, European firms have been identified as being less involved with their customers than US or Japanese companies (Robert,1995). This information was established from a global benchmarking study of 244 companies that account for approximately 80 percent of R&D expenditure in Europe, Japan and the United States (Robert,1995).

User Needs and Design Function

Walsh *et al* (1992) indicate that the relationship between the role of design and the use of design and that of the market sector affects the design function and emphasis. They suggest that the correct analysis and interpretation of market needs is critical to design success. Crandell (2011) also points out the importance of keeping in step with organisational business strategy, suggesting to focus on product development projects that align with both market needs and the company's overall business strategy. Struggling to satisfy customer desires is only beneficial when it advances your company's longer-range objectives.

The problem then arises that conventional market research methods appear not to work well in the instance of many industrial goods and services, yet an accurate understanding of *user needs* is essential for successful product innovation (Herstatt & von Hippell (1992)). In addition it has been established that many companies experience uncertainty when attempting to identify user needs (Souder and Moenaert (1992)). Symons (1988s) adds to the debate by arguing that market research must attempt to learn the reasons *why* customers may be drawn to purchase a new product and that field tests should attempt to examine the physical characteristics of a product. Veryer (1993) supports this argument by indicating that although good product design is increasingly being recognised by marketing practitioners and consumer researchers as being an important determinant of consumer behaviour, there has been relatively little investigation of the *influence of aesthetic aspects* of products on the preferences or evaluations formed by the perceivers of the products.

In addition, several early studies have identified a number of generic issues relating to market research. Rice (1991) established, via survey method, that only 25% of executives within electronic companies (US) regarded surveys and market research as useful. Page and Rosenbaum (1992) observed that empirical research studies (around 1992) of the new product development process indicated that little market research is done in the early stages of the process to determine the degree of buyer’s interest in the new product idea.

A number of specific issues have also emerged. Rosenau (1992) found that problems arise whenever a company bases a product specification on the combination of the best single features observed in available competitive products. The new product’s design is therefore driven by competition and not derived from unique market insight. An important issue to emerge, via a survey undertaken by Yeaple (1992), was that the majority of the product development engineers and engineering managers surveyed reported that they only *speak with customers* either once or twice a year or not at all about product design related issues.

Customer Driven Strategies

Many companies have attempted to develop *customer-driven strategies* requiring them to identify what customers want. This is driven by the success of organisations such as IDEO and the advice of respected organisations such as NESTA (2008), DTI (2005) and the Design Council (2005). Simonson (1993) found, through his analysis of contemporary studies, that there is evidence to suggest that *customers' wants* are often fuzzy, unstable and susceptible to influence from a variety of seemingly irrelevant factors.

More specifically Mathur (1988) indicates that when attempting to develop *customer-orientated strategies* it is important to carefully select the *level of support* in relation to chosen needs of the intended target customer. This relates to a number of issues such as the level of expertise the users have in terms of communicating their knowledge or expertise, for example the difference between utilising professional sports people as *lead users* versus casual amateurs; the ability to communicate to the *users* the process to be undertaken and their role within the process; and the ability of a company to provide the necessary internal support required to achieve the specific project goals. LePlante (1991) supports this notion by arguing that, although the empowerment of end users has many advantages, more sophisticated users require more support than beginners. The principal factors associated with successful *end-user programmes* included developing credibility and managing the expectations of the end-users involved, (LePlante, 1991). Simonson (1993) observed that the choices that customers make could be systematically affected by manipulating the set of alternatives under consideration, the manner in which alternatives are evaluated and the description of alternatives. He goes onto suggest that companies need to make more careful use of current knowledge about *the psychology of customer choice* in the development of a product. Anderson (1987) has also found that there is a significant effect on the *purchase preference judgements* of customers dependent on the alternative ways of representing new product ideas. The literature indicates a trend that the more realistic the representation of the product idea is, the more successful the process is in achieving good quality information. This then suggests a tangible link between the notion of *user centred design* and the product designer.

Lead Users

Magnusson (2003) indicates that collaboration between suppliers and users can lead to a mutual understanding of the users' needs and wishes, as well as an understanding of the technological opportunities (Anderson and Crocca, 1993; Sinkula, 1994; Veryzer, 1998; Hennestad, 1999). It has also been recognised that development times can be shortened if continuous acceptance testing is used during development (Gupta and Wilemon, 1990; Iansiti and MacCormack, 1997). Users can come up with suggestions for improvements during development (Norling, 1993; Prahalad and Ramaswamy, 2000). However, users are not normally trusted to play a part in the initial generation of new product ideas. Typically Users are contacted after the company has developed a new concept for a product or service in order to evaluate these, e.g. focus groups (McQuarrie and McIntyre, 1986).

Some suggest that users do not have sufficient technical knowledge to produce innovations (Christensen and Bower, 1996), or that they cannot articulate their needs (Leonard and Rayport, 1997). Wikstrom (1995) is of the opinion that intensive interaction with potential customers is a likely source of generating new ideas and new ways of doing business.

There are several usability methods that are suitable in the product-development context (e.g. ISO/TR 16982, 2002). According to a survey of user-centred design practitioners, usability testing and other late methods are the most widely used (Vredenburg et al. 2002). However, user involvement is most efficient and influential in the early stages of product development, as the costs involved in making changes increase as the development continues (cf. Ehrlich and Rohn 1994, Noyes et al. 1996). In addition to testing and improving an existing design we need methods for understanding user needs and creating the designs (cf. Wixon et al. 1994).

Much research has emphasized improving current new product concept techniques, for example, through mental analogies (Dahl and Moreau 2002), visual depiction and animation (Dahan and Srinivasan 2000), Web based testing (Dahan and Hauser 2002), and conjoint analysis (Green, Krieger, and Vavra 1997). Bitner et al. (2000) also recommend the close involvement of customers in the design process of technology-based services. However, little work has focused on trait-based approaches that specify which consumers are the "right" ones to use in the new product development process, particularly in the consumer goods industry (Hoffman, Kopalle and Novak, 2010).

Von Hippel has illustrated that certain types of users, so-called lead users, have invented the majority of products in certain industries (von Hippel, 1988). Lead users are expected to have unique features, which von Hippel (1988, p. 107) defines thus:

Lead users face needs that will be general in a marketplace, but they face them months or years before the bulk of that marketplace encounters them, and Lead users are positioned to benefit significantly by obtaining a solution to those needs.

Von Hippel's studies of lead users are from industrial markets and do not include consumers. It has been claimed that lead users have a propensity to come up with more radical and useful innovations than those suggested by company innovators (e.g., Morrison, Roberts, and von Hippel, 2000; von Hippel, 1986). The ability of these users to be effective innovators has been ascribed to a combination of adequate technological knowledge and superior knowledge of the user domain — so-called 'use experience' (Luthje, 2004). Lead users have a conscious awareness of their domain-specific needs, are motivated to innovate to satisfy those needs, and experience those needs earlier than others in the market (Roberts, and Von Hippel 2000, Lilien et al. 2002;).

A key criticism of von Hippel's lead user concept has been the difficulty of identifying lead users beforehand. A point of conjecture is that it might be even harder to find lead users on consumer markets. According to Rogers' theory of innovation diffusion, von Hippel's lead

users would only represent approximately 2.5 per cent of the total number of customers (Rogers, 1995; von Hippel et al., 1999).
Mullins and Sutherland (1998) have investigated best practices for new product and service development. “Best practices” identified related to involving users in idea generation, and the use of mock-ups and prototypes to understand customer usage and benefits.

Therefore, direct contact with customers and end users has been identified as one of the best sources of information about new product ideas and that experiencing the *use environment* of a particular product, function or task is a prerequisite for generating high quality information (Yeaple (1992), Herstatt & von Hippell (1992), Ulrich and Eppinger (1995)). However, Hubel and Lusson (1984) suggest that the design process relies too heavily on the production of ideas based on assumptions generated or verified by the problem setting process *guided by* business and manufacturing parameters.

Schreier and Prugl (2008) articulate that lead users are found to generate commercially attractive user innovations and have been shown to be a highly promising source of innovation for new product development tasks. In a similar vein, Gruner and Homburg (2000), for example, found that firms collaborating with customers who exhibit lead-user characteristics report an increased rate of new product success. Despite these encouraging findings, there is generally still a limited understanding of who lead users are and, even more importantly, why they are (or become) leading edge in a given field. Schreier and Prugl (2008) also state that, identifying users ‘‘equipped’’ with innovative personalities and strong field expertise, will be those at the leading edge of the market who will challenge the status quo and shape the needs of the future. In turn, they will be among the first to adopt new products upon market introduction. See table 2.

However, it has been identified by multiple observers that one of the major challenges in applying the lead-user method has been the efficient and reliable identification of leading-edge users (Olson and Bakke, 2001; Lilien et al., 2002; Luthje and Herstatt, 2004). This problem appears most acute in consumer goods fields where overall user populations appear to be ‘‘unmanageably’’ large (i.e., several hundred thousand consumers or more).

Product Field	Method	Key Findings (Related to Lead-User Theory)	Source
PC-CAD Software	• Sample: PC-CAD users ($n = 136$) • Measurement: 7 items for lead userness, including the question of whether users innovated (23%) or not • Analysis: cluster analysis • In addition, 5 lead users jointly developed an improved PC-CAD system, which was then evaluated by 71 PC-CAD users compared with respondents' current systems and the best commercially available systems	• 87% of the lead-user cluster had already innovated (as opposed to 1% of the nonlead-user cluster) • The concept developed by lead users was significantly preferred over competing PC-CAD systems	Urban and von Hippel (1988)
Library Information Systems	• Sample: Australian libraries ($n = 102$) • Measurement: 7 items for lead userness ("leading-edge status"); user innovators (26%) described their innovations, which were then evaluated by 2 experts using 2 items for commercial attractiveness • Analysis: logit regression	• Lead userness explains likelihood of user innovation • 70% of innovations provided functionality improvements of at least "medium" importance to commercial vendors	Morrison et al. (2000)
Surgery at University Clinics	• German surgeons ($n = 262$) • Measurement: 6 items for lead userness; user innovators (22%) were asked whether their innovations were or soon would be commercialized • Analysis: logit regression	• Lead userness explains likelihood of user innovation • 48% of innovations were or soon would be marketed by manufacturers of medical equipment	Lüthje (2003)
Canyoning, Boardercross, Handicapped Cycling, and Sailplaning	• Members of German communities for the respective sports ($n = 197$) • Measurement: 7 items for lead userness; user innovators (32%) described and rated their innovations in terms of newness and market potential and indicated whether their innovations were or soon would be commercialized • Analysis: t-tests	• Innovators demonstrated higher lead userness than noninnovators • 15% of innovations were considered to be a completely new product • 24% of innovations were considered to have high market potential • 23% of innovations were or soon would be produced for sale by manufacturers	Franke and Shah (2003)
Web Server Software	• Sample: Apache webmasters ($n = 138$) • Measurement: 2 items for lead userness; user innovators (23%) described their innovations, which were then evaluated by the users themselves and 2 experts using 2 items for commercial attractiveness • Analysis: logit and OLS regressions	• Lead userness explains likelihood of user innovation (total sample) • Lead userness explains likelihood of attractive user innovation (total sample) • Being ahead of trend explains attractiveness of user innovation (user innovator sample)	Franke and von Hippel (2003)
Consumer Outdoor Products	• Sample: Customers of two outdoor product manufacturers ($n = 153$) • Measurement: 2 items for lead userness ("innovation-related core benefit"); user innovators: 37%	• Lead userness explains likelihood of user innovation	Lüthje (2004)
Kite Surfing	• Sample: European kite surfers ($n = 414$) • Measurement: 9 items for lead userness; user innovators (31%) described their innovations, which were then evaluated by 6 experts using 6 items for commercial attractiveness • Analysis: logit and OLS regressions	• Lead userness explains likelihood of user innovation (total sample) • Lead userness explains likelihood of attractive user innovation (total sample) • Being ahead of trend explains likelihood of attractive user innovation (user innovator sample) • Being ahead of trend explains attractiveness of user innovation (user innovator sample)	Franke et al. (2006)

Table: 2: Evidence of Innovation by Lead Users, Schreier and Prugl (2008)

Defining Customer Needs

Diangelo and Petrun (1995) suggest that an accurate *definition and assessment* of customer needs and wants forms the basis for product offerings and that the emphasis on product usability and the end-user interface is continuing to increase as computer products are more widely used; Kaulio (1995) suggests this is due to the increasing complexity of 'man-machine interfaces'. Akrich (1995) specifically suggests for the reassessment of the notion of innovation in order to adequately recognise the complexity of the relationship between the innovative product concept and its end-user, and that developing new innovative products requires more attention to be paid to the different representations of what it is to be a user and how a product can be developed. This then raises the question: to what extent is usability testing being used in *non-user-interface* type situations?

Ergonomists and applied psychologists have also raised the issue of why so many products still fail despite the widespread use of market and usability testing (Sanders 1994). Slappendel (1994) has identified the changing nature and use of ergonomics within the design process via comparative case analysis of the use of specialist ergonomics knowledge bases in six New Zealand organisations. She found that the conceptual emphasis of the study shifted from the application and use of generalised theories to an examination of the processes by which a situationally specific ergonomics capability could be developed within each organisation. This point is paralleled in the experience and use of design, where generic tools and methods are deployed but are dependent on such issues as the level of expertise the company possesses, the availability of resources and degree of competition within the core markets, therefore requiring the development of a situationally specific design process relative to the company's needs and capabilities. However this point is not widely recognised.

The need to understand 'user needs' more thoroughly is supported by observations that few companies understand that *product definitions* will change during the product development process and most have no mechanisms for managing change (Bacon *et al*, 1994).

Marzano (2005) highlights that R&D in manufacturing has traditionally focussed on technological and other fundamental issues to generate benefits. He suggests that the traditional R&D processes have been driven by the assumption that consumers would automatically value technological breakthrough, but suggests that breakthroughs only become breakthroughs when consumers place a high value on technology. In order to meet the needs of the customers, companies require technical competence, integration competence and market/business knowledge competence (Shepherd and Ahmed, 2000). Market competence requires understanding the customers' needs and wants (Lagrosen, 2001). Marzano (2005) identifies two essential questions: (1) which product factors lead to customer satisfaction?; and (2) which lead to dissatisfaction?

Evidence shows that when customers are satisfied they are generally loyal and provide a basis for sustainable cash (Matzler et al., 1996). Despite this knowledge and the efforts of companies, many new product development projects fail and result in products that do not meet the expectations of customers (Matzler and Hinterhuber, 1998). Successful new product development requires in-depth understanding of the customers, their situation, their needs and their wants (Lagrosen, 2001).

Customer Focussed NPD

New product development best practice analysis has identified that the process benefits from cross-functional collaboration involving the marketing, design and production functions (Mello, 2001). Although cross-functional teams bring huge benefits, the process of building effective teams is difficult due to cultural and organisational barriers (Condit, 1994). Analyses of effective new product development practices have also identified that introducing representatives from external organisations, notably consultants and customers enhance performance (Howley, 2002; Pitta et al., 1996).

In addition to best practice NPD factors, a number of new dimensions have also started to emerge. Kumar et al (2003) suggest that no company can safely assume there will be a viable foreign market for an existing product, and any company seeking to expand globally needs to ask if its offerings are culturally and socially appropriate for its target market. Many more offerings will succeed only if they make critical accommodations to the behaviour, beliefs and aspirations of local culture. Kumar et al (2003) suggest that aligned to understanding new cultures doing it quickly is a key factor.

Strong (1996) also suggests for the growing importance of ethical consumer. He states that the ethical consumer "adheres" to social and environmental principles, considering adhesion as a measure of the adequacy between the consumer's values and the principles underlying the product, defining ethical product adhesion as the extent to which consumers buy ethical products because of their underlying ethical principles. Blili (2010) too expresses the rise of ethical consumerism shows that consumers, suggesting that they are increasingly willing to integrate ethics in their product purchase decision. Blili (2010) defines "ethical" products, as products that exhibit one or several social or environmental principles, which might affect consumer purchase decision. However, when dealing with ethical purchases, there is a gap between consumer buying intentions and effective purchase (De Pelsmacker et al., 2005; Strong, 1996).

Laurent and Kapferer (1985), define five "facets" or "antecedents" of consumer involvement based on the review of previous research and practices, hence a multi-dimensional construct. They propose five variables that help build the Consumer Involvement Profile (CIP): (1) hedonic value; (2) sign value; (3) risk probability; (4) risk impact; and (5) importance.

O'Cass (2001), previously, identified the change from technical to value driven innovation by stating that "an object will be more involving if it is strongly related to a consumer's values". Buur and Matthews (2008) support the notion that the intrinsic value of user participation in corporate innovation processes is now widely appreciated with an increasing number of corporations engage with users in *co-innovation* of products and services. User-driven innovation has come of age, at least in academic and research circles, and in some governmental funding bodies (Buur and Matthews, 2008). Users are widely acknowledged as a valuable source of creativity and knowledge in the development of new products, especially in the so-called "fuzzy front-end" (Wheelwright and Clark, 1992) of innovation processes. Ramaswamy and Gouillart (2010) state that virtually all companies' worry about their customers' experiences with their products and services. People are inherently creative and want to shape their own experiences. They compare traditional versus co-creation strategies advocating value, goals, focus and advantages of each approach (see table 3).

STRATEGY	**VALUE**	**GOALS**	**KEY FOCUS**	**ADVANTAGES**
TRADITIONAL STRATEGY	Creates value by delivering defined customer experience to targeted customer set	Establishes strategic goals at the outset and doesn't significantly change them	Focuses on the interests of the firm: that is, how the firm can maximize its share of the created value relative to the shares of its industry competitors and the other members of its value chain	Achieves advantage through realizing economies of scale before competitors do and making big, bold moves (such as acquisitions and investments in proprietary assets)
CO CREATIVE STRATEGY	Creates value by constantly enhancing experiences for all stakeholders	Uses the initial strategic goal as a starting point and lets the full strategy emerge over time	Focuses on the interests of all stakeholders and how the ecosystem can maximize the size of the pie maximising the share of value captured by the firm is secondary	Achieves advantage through the increased engagement of stakeholders and by continually building new interactions and experiences, which lead to higher productivity, higher creativity, and lower costs and risks

Table 3: Adapted by Author from Ramaswamy and Gouillart (2010)

However, Buur and Matthews (2008) suggest that industry has been slow to adopt user-centred approaches to product development and innovation. They believe this is because of entrenched development processes in companies retain a traditional structure that inhibits the adoption of user-centred methods of innovation.

Marzano (2005) indicates that the traditional R&D processes have been driven by the assumption that consumer would automatically value technological breakthrough, but suggests that breakthroughs only become breakthroughs when consumers place a high value on it (technology). He states that, “ Instead of thinking about companies in terms of business units, we need to think of them as a portfolio of competences, and then consider how we can combine these competences in ways not limited by traditional business-unit boundaries. And we also have to consider whether, to give our market what it wants, we need new competences.” He suggests a framework structure, the competences and the processes used to delivery new value in Philips (see table 4).

Framework Required:	**Competences Required:**	**Processes Required:**
Key challenge is identifying what people see as new value and that consumer perception of new value is coloured by their situation in time and space. In order to identify and develop new value Philips explore three interrelated parameters: (1) **Our market** - people (understanding the wider context of use, behaviour and hidden benefits), (2) **Ourselves** - understanding our portfolio of competences and where the company can acquire new competences either internally or through partnerships with other external organisations, and (3) **Customer Interface** - where and how the organisation meets and deals with consumers (user touch points).	(1) **Understanding people** through social science methodologies and insights that can be used to generate hypotheses, directions and strategies about what might constitute desirable future qualities of life for people in particular situations; (2) **Innovative Integration** of multi-disciplinary expertise and capabilities (engineers, marketers, strategists and designers) who come together to develop new solutions for products, systems and services through going beyond traditional design competences to include: sociological skills; an understanding of technological trends, media design, and business strategies, models and processes; as well as psychology and ergonomics; (3) Design articulation through the application of traditional design based skills into clearly defined concepts.	(1) **Combining research findings** through use of a High Design Strategic Futures process brings together multiple interrelated insights from social, cultural and visual trends relevant to a particular target group and map these against technological trends from internal and external sources; (2) **Avoiding historical bias** (avoiding basing future on what we know of the past) through use of an **“axiom”** - that a major driver in human development is the ambition to do everything, be everywhere, and know everything - with minimum effort, building up a **“dynamic picture”** of a situation, with all its tensions and interactions; (3) **Creating scenarios and visualisations** through generation of desirable, realistic future situations and experiences and define the roadmaps needed to take the company there, specifying what individuals might want to do in particular circumstances, and how future products or services might help them; and (4) **Filtering and validating scenarios** through two phase process of review and filtering via a panel of international experts and then the communication of the most promising scenarios/ideas to selected audiences through exhibitions, on-line media. The purpose is to provide useful feedback and to plant in people’s minds **“memories of the future”** (Ingvar (1985)). Marzano (2005) indicates that these memories of the future potentially lead to new aspirations and desires.

Table 4: Framework, competences and processes requirement, Adapted from Marzano (2005)

In addition Marzano (2005) also indicates that new partnerships and networks are important in helping companies to meet consumers through new channel, where the focus can be placed less on function and more on lifestyle, sensory or aesthetic experiences, and personal comfort/wellbeing - intangible values that are increasingly important to consumers. Underpinned by the use of on-line concept testing, production on demand, registering customisation requirements, co-design, and on-line communities.

2 User Centred Tools & Methods

Information Capture Methods

Approaches to the development of information capture methods (in apparent response to the failure of existing market research practices) for integrating and developing the role of the user within the product design process have been addressed from a number of different perspectives, such as quality management, marketing and human factors engineering. Key players to emerge within the requirements engineering process have been Hauser, Clausing (1988) and Griffin (1992) (Quality Function Deployment); Urban, Hersatt and von Hippel (19988) (Lead User Method); Page and Rosenbaum (Beta Testing); and Nagamachi (2008) (Kansei Engineering).

In product development, Quality Function Deployment (QFD) is the dominating approach. quality function deployment (QFD). QFD is a structure product development process for designing and improving products and services by listening to voice of the customer. However, it has been criticised for being imprecise regarding the up-stream activities of data collection. Other criticisms concern the involvement of customers only in the early phases of the design process instead of utilising an interactive dialogue with customers during the whole process. In addition practitioners have perceived QFD to be bureaucratic, hard -work and inflexible (Kaulio 1995). From the area of innovation research the Lead User Method has emerged which has strong similarities with Consumer Idealised Design – a stakeholder driven process.

Kansei is a Japanese term that implies psychological feeling and needs in mind. Nagamachi introduced Kansei engineering around 1970 at Hiroshima University as a customer-oriented product development method in order to realize products' best fit to customer needs (Rise, 2013). Kansei engineering (KE) uses a unique ergonomic technology to produce a new product which fits to consumers' feelings and demands. It is a consumer-oriented product development method based on the consumer mind. It utilises psychological methods to grasp the customer's feelings (hierarchy of values), and the data obtained by this method are analysed using multivariate statistical analyses that are transferred to the design domain (design specifications).

In summarising the methods used for information capture several key methods have been identified, the areas they are applied to and their level of user involvement *(see table5)*.

Degrees of User Involvement

Kaulio (1995) suggests that when attempting to compare existing methods and tools it is important to determine their degree of user involvement and recommends Eason's (1992) categories of *'design for', 'design with'* and *'design by'* as a possible metric. Applied to the area of product design the different categories could be defined as:

Methods & Sources	Areas Applied To	Level of User Involvement
Quality Function Deployment **(QFD)** • Akao(1990) • Hauser + Clausing (1988) • Bossett (1991) • Griffin and Hauser, (1993)	mechanical, software, construction, service engineering	*Design for*
User-orientated Product Development **(UPD)** • Dahlman (1983)(1986) • Karlsson (1992) • Rosenblad-Wallin (1988) (1985)	products with man-machine interface problems	*Design with*
Concept testing **(CT)** • Dolan and Matthew's (1993)	consumer products, packaging and industrial products	*Design with*
Beta testing **(BT)** • Page and Rosenbaum (1992)	computer systems, software and consumer goods	*Design with*
Lead User Method **(LUM)** • Herstatt & von Hippel (1992), • von Hippel (1988) • Urban and von Hippel (1988)	industrial buyers, both high-tech and low-tech	*Design by*
Consumer Idealised Design **(CID)** • Cicanntelli & Magidson (1993)	consumer durables	*Design by*
Participative Ergonomics **(PE)** • Noro & Imada (1991)	industrial ergonomics and architecture	*Design by*

Table 5: Information Capture Methods and the Level of User Involvement, Adapted from Kaulio (1995).

- *Design for* - denotes a product design process focusing on the user, but only utilising data on user preferences, needs and requirements.

- *Design with* - denotes a product design process, focusing on the user, utilising data on user preferences, needs and requirements and also displaying different solutions, concepts for the users, so they can select or reject and react to different proposed solutions.

- *Design by* - denotes the participatory stage of user involvement, in which user actually takes part in design work.

An issue to emerge from reviewing *information capture methods* was that the literature frequently failed to indicate the quality of information captured by the relevant methods, but did however indicate the type and function of the tools used. Kaulio *et al* (1995) have categorised the tools into two distinct areas: methods for analysis (see table 6) and methods for representing ideas / solutions (see table 7). Eason (1992) suggest that within the notion of *user information capture and analysis* three types of information are captured: *user tasks*, which identifies tasks the users carry out in the course of their work, *user characteristics* - which identifies personal attributes such as skills or handicaps, and *context of use* - which identifies the physical and organisational characteristics. However the criticism of this notion is that it is predominately orientated to task analysis.

Once establishing the existence and nature of appropriate information capture methods, it poses the question when and where within the product design and development process are they used? Table 5 indicates the relationship between existing information capture methods and the product design process. The research indicates that tools and methods currently exist which can aid the introduction of the user within the early stages of the product design process (development of specifications and concept generation/ evaluation), although there is currently little understanding of the wide spread use of these techniques within industry. However the findings do indicate that little market research is undertaken in the early stages of the process - identifying user needs (Page and Rosenbaum, 1992) and there is little or no indication of who carries out these tasks.

Understanding Consumers

Kumar et al (2003) indicate that companies that attempt to understand consumers in two key ways: (1) **Product-focussed research** - typically involving user surveys, focus groups, interviews, home visits, and usability tests to ask customers about existing or prototypical products and services. They suggest the strengths to be that they lead to specific insights and provide early feedback on prototypes, but the weaknesses are that these techniques do not often lead to large-scale improvements and the discoveries are limited by the participant's current expectations. (2) **Culture-focussed research** - typically focuses on looking at general patterns of daily life (value systems, social structures and relationship networks). The strengths of culture-focussed research are that it provides deep insights into behaviours, beliefs and goals, which can in turn be used in product planning and company positioning activities. They suggest that the weaknesses relate to inability to develop specific enough insights to help development teams improve the offerings they are trying to create.

Kumar et al (2003) propose **activity-based research** method to address the above weaknesses that focuses on people's activities when they are using a specific product or company service a company wants to develop. They are suggesting a 360 degree observational based research technique that would examine for example all the activities of say family cooking, eating and drinking habits in the home (meal planning, shopping, preparation, serving, eating and clean up activities). The main innovation is the use of POEMS (people, objects, environments, messages and services) framework tool for recording observation that has four frameworks dealing with brand, strategy, and user experience and user interaction. The tool has six key phases: (1) data gathering (observational), (2) data tagging, (3) data screening, (4) data clustering, (5) data analysis and (6) data pattern recognition.

Seen in conjunction with table 5, table 6 provides an overview by Kaulio (1995) of the relationship between a range of the key information capture tools and the key product development phases. Tables 6 and 7 attempt to drill down into the specific tools for analysis (see table 6) and for representation (see table 7). Hugh Aldersey-Williams et al. (1999) provide a useful overview of user research tools (see table 9).

Analysis Tools	Function
Stakeholder Maps	Identifying requirement sources
Affinity Diagrams (KJ - methods)	Structuring large amounts of data, by a bottom up strategy
Tree Diagrams	Structuring data in hierarchies
Paretto Diagrams	Prioritising data on basis of frequency
Stratification	Structuring data on the basis of a common denominator or factor
Matrix Diagrams	Relating two or more kinds of data to each other
Position Maps	Illustrating a product's position (i.e. customers perception) in the market place
Perception Maps (Competitor benchmarking in QFD)	Assessing individual properties of competing products
Surveys / questionnaires	Assessing a range of alternatives when the product type is known to those being surveyed
Focus group discussions	Exploring common perceptions of requirements and reacting to product concepts
Interviews	Exploring purposes, anxieties and for cost/benefit issues
Task analysis	Studying user doing specific tasks
Ethnomethodological studies	Studying users in their cultural context, and understanding interpersonal behaviour (use of video)
Usability trials	Testing early prototypes
Scenarios and role playing	Exploring new product situations

Table 6: Analysis Tools, Adapted from Kaulio, Karlsson, Rydebrink, Dahlman & Hallgren (1995)

Representation Tools	Example	Focus
2-D / 3-D Visual Representations	Sketches, drawings, images and CAD models	Aesthetics, form embodiment, configuration, interfaces etc.
3-D Physical Models	3-D embodied scale or appearance models in different degrees of readiness	Representing / testing visual appearance, man-machine interface, etc.
Mock-Ups	Functionally working but often not complete product	Testing specific functions or features
Prototypes	First example(s) of the 'complete' working product or principle	Testing specific functions or features
Pilot / O-serie	Pre-production series products	Testing the product's relation and fit to the production process

Table 7: Representation Tools, Adapted from Kaulio, Karlsson, Rydebrink, Dahlman & Hallgren (1995),

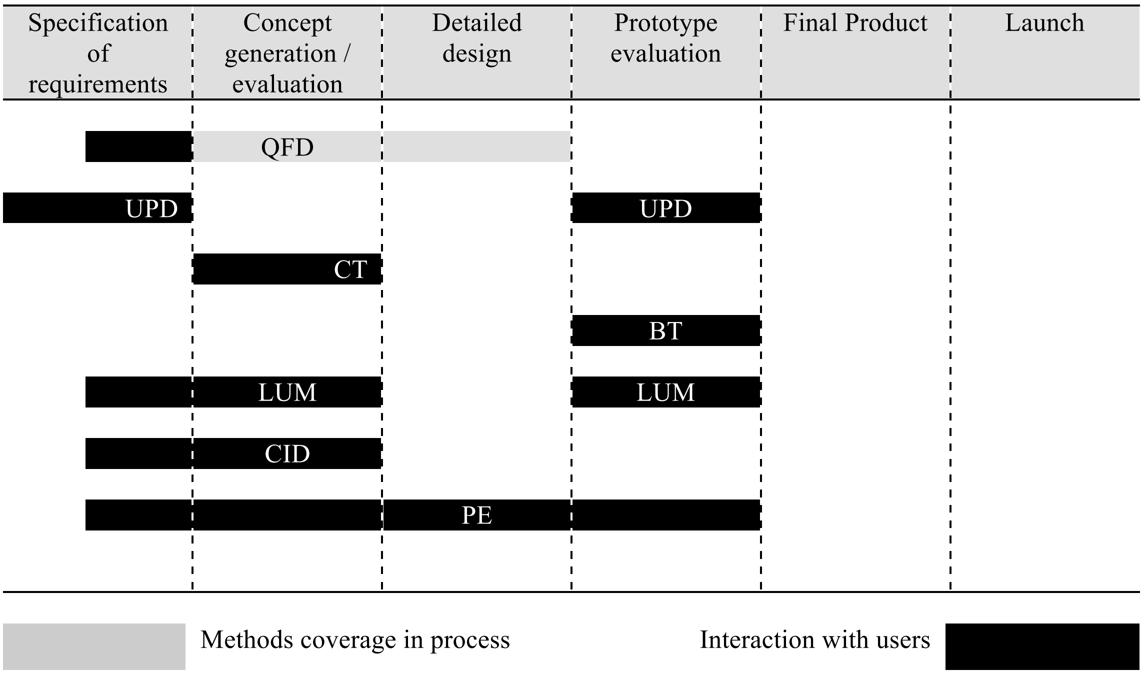

Table 8: Information Capture Methods and their Relationship to the Product Design Process, Adapted from Kaulio (1995).

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Method and Focus	**Design Centred**	**User Centred**	**Visual Qualities**	**Functional Qualities**
Scenarios: Constructing stories can help design teams propose new design concepts from an understanding of people's present experiences		X		
Role Play: Role play can help designers imagine new design approaches and communicate design intentions	X			
Explore, represent, Share: Involves exploring ideas, representing them and sharing them in a facilitated group setting can increase awareness and release creativity	X			
Opinion Polls: Involves representative samples of people are asked a set of questions in order to gain a reliable measure of the views of an entire population		X		
Immersive Experience: Researchers may "immerse" themselves in the user experience in order to gain deeper insights into actual life circumstances.	X	X		
Lead User: Involves consumers with a passionate interest in a given product single themselves out and may be used to explore future developments of the product.		X		X
Rapid Prototyping: Making of realistic models of product concepts quickly from CAD data that can be evaluated by users and clients	X	X		X

Method and Focus	Design Centred	User Centred	Visual Qualities	Functional Qualities
Usability Testing: Involves observing and questioning sample users as they use past or planned products in typical daily situations		X		X
Rapid Ethnography: Designers can adapt a range of research methods to commercial needs by acceptably trading scientific accuracy for speed of results.	X	X	X	X
Longitudinal Analysis: Involves the repeated assessments of the same people in order to describe physical and mental development in childhood, adolescence and ageing.		X		X
Shadowing: Involves sustained user observation over days, giving deep insights that stem from involvement in activities rather than passive observations.		X		X
Direct Observation: Involves observing people interacting with devices that gives data on errors and performance time, and insight into the ease or difficulty of tasks.		X		X
Individual Interviews: Involves one-to-one interviews that provide information about individual actions and motivations that cannot be obtained through group discussions		X	X	
Focus Groups: Involve a forum of selected people controlled by an impartial moderator to give feedback to design ideas.	X	X	X	X
Conjoint Techniques: Enables researchers to establish how much consumers value features of a product or service	X	X	X	X

Table 9. Adapted from The Methods lab: User Research for Design, Edited by Hugh Aldersey-Williams, John Bound and Roger Coleman (1999), Design for Ageing Network, Presence Conference.

This then raises a number of issues, some which are open ended and others that are more context specific:

(a) are companies and designers utilising some form of structured process and methods to identifying user needs?
(b) are companies and designers successfully utilising the data / information generated?
(c) and if companies and designers do use the information correctly how many users do they contact?

In comparing different methods for user involvement Kaulio (1998) proposes a framework based on two dimensions:

(1) The longitudinal dimension, which includes the points of interaction between customers and the design process;
(2) The lateral dimension, which captures the depth of customer involvement in the design process.

Nissan and Lieshout (1995) categorise the most popular tools for new product development according to their purpose in four groups as follows:

(1) **Idea generation**	Creative tools such as brainstorming, synectics and morphological analysis and non-creative tools such as focus groups, surveys, observation, Delphi method, scenario, expert opinion and product life cycle;
(2) **Product optimisation**	Conjoint analysis, quality function deployment, concept testing, prototype testing and pilot plant/in-home use test;
(3)**Marketing Mix Optimisation**	Simulated test marketing, mini-market, limited prediction, including computer prediction models, diffusion models, and economic models such as return on investment - analysis and pay-back time;
(4) **Prediction**	Computer prediction models, diffusion models, and economic models, such as return on investment – analysis and pay-back time

Although many formal tools for product development have been designed, the awareness and usage of them is generally surprisingly infrequent (Hanna et al., 1995; Nijssen and Lieshout, 1995). Nonetheless, Nijssen and Lieshout (1995) have found that use of formal tools is correlated with higher profitability. The use of formal tools for customer involvement is mainly found in the large companies. The only formal tool that is used by the small companies is prototype testing (Ulrich and Eppinger, 2000).

The main reason referred to for not using additional tools for customer involvement is the cost factor. The number of customers is also cited as a problem. Interestingly, some companies claim that they have too few customers for formal tools to be appropriate whereas other companies allege that they have too many customers for formal tools to be feasible. The level of customer involvement was found to vary. Earlier research shows that customer involvement increases the likelihood of new product success. Research shows that the use of formal methods for customer involvement is rather infrequent (Hanna et al., 1995; Nijssen and Lieshout, 1995). This suggests that manager knowledge of the available methods is rather limited.

User Centred Design Methods

Buur and Matthews (2008) highlight three of these strands of user centred design methods: (1) lead-user approach, (2) participatory design and (3) design anthropology. They support the notion that the "lead-user" model (von Hippel, 1986 - 2001) and its variants has gained much prominence underpinned by a developed theory and methods (e.g., Franke *et al.*, 2006) whereby companies can find and exploit innovative initiatives developed by users — in a sense, outsourcing design and development and obviating traditional market research. Finding the "right" users is clearly the key problem in this approach.

Button (2000) suggests that the ethnographic tradition of social investigation has been developed mainly within the human science disciplines of anthropology and sociology. Specifically highlighting its contributions to social investigation has been the demonstration that culture can be viewed from 'inside' its arrangements and relationships. The disciplinary background of those undertaking the studies has widened beyond anthropology and sociology and is often used as substitute for fieldwork (Button 2000). This emphasis on emersion inside the typical users own world is common to user centre design methods.

Eisenberg (2011) suggests that the lead-user research method goes a step further, looking not only to the typical customer, but also to those users whose needs and preferences lead the market. What is important to note is that Eisenberg (2011) makes an important distinction that the term "user" does not necessarily imply an individual. Rather, a lead user can be an individual, a group, or a company. His work highlights four key differences between lead-user research projects and standard market research efforts:

- Focus on the needs of leading-edge users, not routine users;
- Seek not only needs data but innovations—user developed solutions to leading-edge needs—from users;
- Seek needs and solutions in adjacent markets and non-obvious, analogous markets, in addition to target markets;
- Employ a cross-disciplinary team, bringing in perspectives from various parts of the organisation.

In addition, his work provides a useful historical backdrop to the development of the lead-user method, stating that it was Sonnack, from 3M, who was seeking to find a way to generate customer-focused product concepts that went beyond incremental product improvements. Her answer was the lead-user research method, which she developed with Joan Churchill, a Minnesota-based organisational psychologist, and von Hippel.

Eisenberg (2011) suggests that many companies aspire to be user centered, but not all succeed. It takes enormous courage to break out of established product labs and open one's eyes and ears to where users are taking you. That courage can be rewarded with breakthrough innovation. "Successful implementation of the method requires appropriate management support, careful team selection, and sufficient time to allow insights to develop", (Eisenberg, 2011). He highlights four key challenges associated with the Lead-User Research Method:

- Finding the right people: Reaching the real lead users and lead-use experts.
- Getting the right people to answer the e-mail or phone call.
- Remaining open-minded about problems and solutions
- Allocating enough time for the process.

In addition to the lead-user method, a number of other key methods have emerged. Participatory design is a Scandinavian legacy originating out of Kristen Nygaard's pioneering work in the 1970s (see Ehn and Kyng, 1987; Schuler and Namioka, 1993). "Participatory design" has become a label for design and development processes in which end-users were invited to participate and contribute, not simply as critics and evaluators of product and system concepts, but as co-designers. Participatory design has developed a host of methods to engage stakeholders in co-design activities throughout innovation processes (e.g., Ehn and Kyng, 1991; Buur and Bagger, 1999; Holmquist, 2004), and to ensure that "ordinary" users are able to make important contributions to products and services. According to Buur and Matthews (2008) a hallmark of participatory design is that methods development is a characteristic of work in the field. They suggest that participatory design projects are typically not the re-application of a (or "the") participatory design method to a new business context or product domain, but are instead engagements in methods development themselves. The methods developed are tailored to the particularities of the project- specific contexts: organisational, managerial, market, use, supply and production.
Buur and Matthews (2008) suggest that the application of anthropology to design and development practices is an appropriate means of providing comprehensive understandings

of users, when the anthropological requirement is to work and live with the people being studied for extended periods of time. They suggest that design anthropology has become a practice that selectively applies anthropological theory to challenge existing conceptualisations of products, services, technology, users and use (Suchman, 1987; Blomberg *et al.*, 1993; Anderson, 1994; Crabtree, 2003; Nafus and Anderson, 2006). Burr and Matthews also suggest that the value of anthropology to design and development has much to do with how it is able to radically recontextualise and portray the 'familiar' as 'strange'. They advance the case that understanding an exotic foreign mind-set is very useful in breaking down our own preconceptions and helps us (designers and product developers) to view our own natural assumptions and practices in a new light (i.e., to reconceptualise). Buur and Matthews (2008) suggest that anthropology draws novel conceptual boundaries that enable us to glimpse how other cultures and people might view the world; in doing so, it throws our taken-for-granted, unarticulated conceptual distinctions into sharp relief. They cite an interaction analysis example that augments a traditional anthropology's holistic focus, which considers societal and political issues underpinned by a detailed analytic orientation to the organisation of user practices (e.g., Heath and Luff, 1991; Button and Sharrock, 1998). This view is supported by Suchman's (1987) now classic study that illustrates the extent to which the users assumptions impact on their interpretive behaviour.

Buur and Matthews (2008) advance the view that design anthropology provides the most comprehensive understandings of users and contexts of use, and brings a theoretical orientation that enables businesses to expose tacit assumptions embedded in organisational processes and to re-perceive their role in the market. There is not always a short-term commercial gain from its use, and even its long-term organisational benefits can sometimes be obscure, particularly if viewed solely in terms of economic metrics. Clarke (2011) promotes an additional strand of user centred design that focuses on the use anthropology as a means of eliciting the meaning and value of interactions, rather than purely functional issues. She argues that understanding user-experiences from a design anthropology perspective helps to (1) harness insights and (2) shape future visions. Design anthropology has been widely adopted by leading multinational companies such as Intel and leading design innovation companies such as IDEO. The central theme of thesis will explore and determine whether SMEs are also adopting and using these types of approaches, and if not why not?

Not all innovation can be generated through lead users, particularly when the innovation is not purely technological based, but one about achieving by better matching the technology to people participatory design excels (Bergman and Haitani, 2000). When comparing participatory design and design anthropology, it is suggested that they can take a narrower and technological view of innovation than that of the lead-user approach (Buur and Matthews, 2008).

However the advantages of participatory design are that it has the ability to introduce novel user-driven practices to organisations that have traditional ways of working. The deployment of participatory design is itself, often operates as an exercise in organisational change, bringing a strong design competence to bear on use and user issues, something that forms a valuable complement to design anthropology (Buur and Matthews, 2008).

When comparing the three user centred design methods Buur and Matthew (2008) make the following observations: (1) that the lead-user method has a strong orientation to market opportunities for successful innovation. It also possesses a better understanding of, and due emphasis on, the conditions of user innovation — namely the users who experience needs in excess of the bulk of the market, who have the personal skills to modify products themselves, and who stand to gain significantly from product developments are best placed to develop innovations that have a future market appeal; (2) that the design anthropology method offers a societal (as opposed to a market) orientation, which may be more difficult to translate into market potential; though it can and does have less tangible (but no less real) contributions to organisations. Being observational and participatory in the nature of its methods, it also tends more towards understanding users' actual practices and processes of innovation, in addition to the social and organisational conditions of innovation and use; and (3) that participatory design methods have a strong tradition in interventionist methods of engagement (action research based), and an active involvement with users in development practices gives it a unique purchase on the real-time process of user-centred innovation (cross-disciplinary and co-design approach). They suggest that is has two objectives: (a) to generate *knowledge* about users/customers in a format that inspires company employees to reflect on product, producer role and company identity; and (b) to generate *business opportunities* that relate to a market in the form of product/services concepts with considerations of use, interaction, technology, appearance, business model etc. See figure 5.

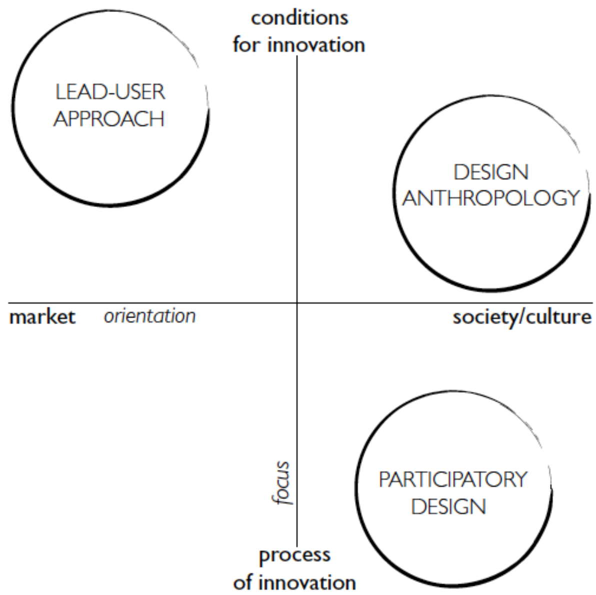


Figure: 5: Three contemporary approaches to user-driven innovation mapped according to their main focus and orientation, Buur and Matthews (2008)

Participatory design has evolved into co-creation strategies. Ramaswamy and Gouillart (2010) highlight four core principles of co-creation:

- Stakeholders won't wholeheartedly participate in customer co-creation unless it produces value for them, too;
- The best way to co-create value is to focus on the experiences of all stakeholders;
- Stakeholders must be able to interact directly with one another;
- Companies should provide platforms that allow stakeholders to interact and share their experiences.

Co-creation has the potential to change the way companies think about operations and strategy. In conventional approaches, activities and processes are the two building blocks of business design (Ramaswamy and Gouillart, 2010). Reengineering focuses predominantly on identifying "pain points" that cause inefficiencies in the system, which are bounded and incremental.

Co-creation is also impacting on service-based innovation. Payne et al (2009) suggest that a service-dominant logic of exchange is likely to be more integrative than a goods-dominant logic (Vargo and Morgan, 2005). Central to this perspective is their foundational proposition relating to co-creation that involves customer's active involvement and interaction with their supplier in every aspect, from product design to product consumption. Their commentary is influenced by Prahalad's (2004) view that the customer as "always being a co-creator of value" where "the brand becomes the experience", they also cite de Chernatony's (2006) contemporary experiential definition of a brand as being especially relevant: "A brand can be regarded as a cluster of functional and emotional values, which promises a unique and welcome experience". Payne et al (2009) cite Grönroos (2000), Prahalad and Ramaswamy (2000) and Vargo and Lusch (2004) who suggest that value is embedded in the co-creation process between the customer and the supplier, and where the customer shifts from being a passive audience to an active player. Participatory design (known before as cooperative design) is an approach to design attempting to actively involve all stakeholders (e.g. employees, partners, customers, citizens, end users) in the design process in order to help ensure the product designed meets their needs and is usable.

User centred design approaches have evolved over time from cooperative through to participatory and have been further developed, moving from individual to stakeholder and then to community levels. The transition has been accelerated by new and emerging design practices such as socially responsible design, which have adopted both co-creation and participatory methods (Thorpe and Gamman, 2011).

Sampling – How Many Users Should Be Involved?

Griffin and Hauser (1993) have explored the question of how many users should be sampled in order to reveal most of the user needs. In one study, they estimated that 90 percent of the users needs for picnic coolers were revealed in 30 interviews. In another study, they estimated that 98 percent of the user needs for a piece of office equipment were revealed after 25 hours of data collection in both focus groups and interviews. Griffin and Hauser (1993) suggest, as a practical guideline for most products, that conducting 10 interviews is probably inadequate and 50 interviews are probably too many. However, interviews can be conducted sequentially and the process can be terminated when no new needs are revealed (cited Ulrich and Eppinger 1995, p.39).

Tool Kits

Franke and Piller (2004) suggest that the advent of the Internet has facilitated new forms of producer-customer interaction in product development (Sharma and Sheth, 2004). They suggest that on-line toolkits offer an interesting interaction platform for user innovation and design (Thomke and von Hippel, 2002; von Hippel, 2001), or user design (Dahan and Hauser, 2002). They suggest that both ideas are based on the proven ability of customers to design their own products (von Hippel, 1988). They indicate that the toolkit design interface enables trial-and-error experimentation and gives simulated feed- back on the outcome. They suggest their relevance is due to their ability to enable users to learn their preferences iteratively until the optimum product design is achieved citing von Hippel and Katz (2002). Quoting von Hippel (2001) defines toolkits for user innovation as a technology that (1) allows users to design a novel product by trial-and-error experimentation and (2) delivers immediate (simulated) feedback on the potential outcome of their design ideas. Franke and Piller (2004) suggest that in addition to employing toolkits as a means of individualizing products, manufacturers should consider using toolkits as a new market research method in order to introduce promising new standard products or product designs. A key area of uncertainty is when shifting preference information from the customer to the manufacturer. Such information is known to be difficult to encode, to transfer, and to decode (Cooper, 1979; Dougherty, 1990; Leonard-Barton, 1995; Poolton and Barclay, 1998).

Challenges

Marzano (2005) suggests that one of the key challenges for an organization is the ability to identifying what people see as new value, advocating that consumer perception of new value is coloured by their situation in time and space (context). In order to identify and develop new value, Marzano (2005) outlines how Philips explores three interrelated parameters: (1) *Our market* - people (understanding the wider context of use, behaviour and hidden benefits), (2) *Ourselves* - understanding our portfolio of competences and where the company can acquire new competences either internally or through partnerships with other external organisations., and (3) ***Customer Interface*** - where and how the organisation meets and deals with consumers (user touch points). He also draws attention to the critical competences required:

(1) **Understanding people** through social science methodologies and insights that can be used to generate hypotheses, directions and strategies about what might constitute desirable

future qualities of life for people in particular situations;

(2) **Innovative Integration** of multi-disciplinary expertise and capabilities (engineers, marketers, strategists and designers) who come together to develop new solutions for products, systems and services (convergent innovation – Essingler 2009) through going beyond traditional design competences to include: sociological skills; an understanding of technological trends, media design, and business strategies, models and processes; as well as psychology and ergonomics;

(3) **Design articulation** through the application of traditional design based skills into clearly defined concepts.

Competences alone will not deliver success. Marzano (2005) emphasizes the core parameters that influence the **process** of delivering success:

(1) **Combining research findings** through use of a 'High Design Strategic Futures' process brings together multiple interrelated insights from social, cultural and visual trends relevant to a particular target group and map these against technological trends from internal and external sources;

(2) **Avoiding historical bias** (avoiding basing future on what we know of the past) through use of an **"axiom"** - that a major driver in human development is the ambition to do everything, be everywhere, and know everything - with minimum effort (goals/question - pattern recognition criteria), building up a **"dynamic picture"** of a situation, with all its tensions and interactions;

(3) **Creating scenarios and visualisations** through generation of desirable, realistic future situations and experiences and define the roadmaps needed to take the company there, specifying what individuals might want to do in particular circumstances, and how future products or services might help them; and

(4) **Filtering and validating scenarios** through two phase process of review and filtering via a panel of international experts (thought leadership forum) and then the communication of the most promising scenarios/ideas to selected audiences through exhibitions, on-line

media. The purpose is to provide useful feedback and to plant in people's minds **"memories of the future"** (Ingvar (1985)). Marzano (2005) indicates that these memories of the future potentially lead to new aspirations and desires.

It is clear that the design research community nowadays recognizes collaboration and communication problems during design in multidisciplinary teams (e.g. Cross and Clayburn Cross, 1995; Bucciarelli, 1996, 2002; Badke-Schaub and Frankenberger, 1999; Badke-Schaub et al., 2007).c

Kleinsmann et al. (2008) suggest that "co-design" is the process in which actors from different disciplines share their knowledge about both the design process and the design content. They do that in order to create shared understanding on both aspects, to be able to integrate and explore their knowledge and to achieve the larger common objective: the new product to be designed. Knowledge creation and integration are the goal of the co-design process. Creating shared understanding between actors from different disciplines is difficult, because these actors have different backgrounds, interests and perspectives on the new design (Bond and Ricci, 1992; Dougherty, 1992). A key objective strived for is to achieve shared understanding. Kleinsmann etal. (2008), defines shared understanding as the similarity in the individual perceptions of actors about either how the design content is conceptualized (content) or how the transactive memory system works (process). Kleinsmann etal. (2008) outline the factors that influence the creation of a shared understanding between different actors from different disciplines (see table 10).

Factors on the actor level	Factors on the project level	Factors on the company level
The ability of the actor to make a transition of knowledge	The efficiency of information processing	The organization of resources
The applicable experience of the actor	The quality of project documentation	The organization of the design team
The empathy of the actor about the interest of a task	The rigor of project planning	The allocation of tasks and responsibilities
The view of the actor on the design task	The controllability of product quality	The availability of specialized knowledge within the company
The equality of the language used between the actors	The division of labor	
The skills of the actor to process knowledge	The degrees of freedom within the design task	
The applicable knowledge of the actor	The controllability of project budget	
The knowledge of the actor about the task to be performed	The controllability of design changes	
The view of an actor on the process to follow		
The view of an actor on the knowledge to be shared		
The prospect of the actor on the task of the other actors		
The ability of actors to make use of different communication methods		

Table 10: factors Affecting Shared Understanding (Kleinsmann,M and Valkenburg, R 2008)

Redstrom (2008) suggests the emergence of two potential paradoxes. First, he suggests that by referring to ‘users’ during the design process, there is an implicit assumption that there are already users of things not yet designed, thus obscuring the complexity of what actually happens as someone starts using a thing and as someone becomes a user. Second, there are emerging tendencies towards more open-ended design approaches that appear to be focussing more on the notions of appropriation, reconfigurability and customisation - these involve extensive user participation. He is therefore questioning ‘what is a user’ and ‘what constitutes design for or with or by users’. He is also highlighting the transition from generic user centred design to more participatory methods. He implies that the role of design is changing from *ad-hoc* to more systematic approaches. This notion is supported by the citation by Redstorm (2008) of Sengers and Gaver who assert that, ‘if we take supporting multiple interpretations as a central goal, design shifts from deciding on and communicating an interpretation to supporting and intervening in the processes of designer, system, user, and community meaning-making.’

3 The Role of the Product Designer

Importance of Design

Product design is acknowledged as an important marketing variable (e.g. Dumaine, 1991; Kotler, 2003; Lorenz, 1986; Roy, 1994; Pilditch, 1976; Thackara, 1997; Yamamoto and Lambert, 1994). To be successful in today's increasingly competitive marketplace, the appearance of new products has to match the preferences of consumers: consumers must like the looks of a product.

Consumer researchers have made important advances into understanding the cognitive and emotional reactions of consumers to product design and appearance (e.g. Bloch, 1995; Creusen and Schoormans, 2005; Crilly et al., 2004; Veryzer and Hutchinson, 1998). In fast-moving consumer products sectors, the ability to drawing attention to and easily categorise cognitive and emotional reactions of consumers to product appearance or package have become more and more important (Garber et al., 2000).

The perceived purpose of the product design process (from a marketing and manufacturing perspective) is to *achieve change or implement improvements* based on the designer *visualising* something that does not already exist, manipulating and representing that idea through sketching and modelling. The product design process seeks to respond to inventions and innovations, generating alternative best practice solutions and configurations and modifying and improving existing products (Walsh *et al* 1992). However the design process often leads to the introduction of products that do not meet user expectations, which poses the question why?

The mission of industrial design has traditionally been to support engineering and marketing by improving the look and feel of a product. March (1994) indicates that *user-centred design* goes beyond that of usability testing to encompass the cognitive aspects of using a product, such as how logical and natural a product is to use and how people feel about using it. This supports an apparent trend in Human Factors Engineering of attempting to address how to encourage designers to adopt and develop the role of the user within the product development process (Wilcox 1994, Ungari 1994, Miller *et al* 1994). Ulrich and Eppinger (1995) suggest that *user needs* are an integral part of the product design and development process, and that the information generated is closely related to concept generation, concept selection, competitive benchmarking and establishing product specifications.

The management of designers and the design process controls a crucial element in the efficiency and effectiveness of product realisation. This view is supported by the 'Value of Design" initiatives by the Design Council (2005) that demonstrates the business success that can be achieved by design-led innovation. However Roy (1990) suggests that many managers (the problem setters) are not aware of the role of design and that some managers are hardly aware that design decisions are made and who is responsible for them. Companies typically distinguish the role of the *design engineer*, treated as a professional, from that of *designer,* treated as worker who creates the detail design, (Fleischer and Liker, 1992). Fleischer and Liker (1992) suggest that managers should treat *designers* more as professionals and less as workers. They also suggest that the designers should have greater responsibility for linking with external groups. Walsh and Roy (1985) suggest that the designer should be given more *responsibility* for assembling the necessary information required to undertake the design process. An additional point to be raised in connection with this argument is that the designer should also be given the *authority* for undertaking this process. However what is not clear in the majority of studies is *who* collects the information, and therefore a better understanding of who typically collects user information would enable a greater insight into how to develop the *requirements engineering* process.

Bailetti and Livtva (1995) have identified an apparent weakness in the designer's ability to transform *user requirements* and suggest that there is a need to develop a better understanding of the process by which designers *transform information* into the final product design specification in order to achieve greater success. If this issue can be explored and rectified it could provide a significant step forward in achieving a more *user centred* approach to product design practices. Ciccicantelli and Magidson (1993) also suggest that design methodologies could be greatly enhanced by focusing more attention on understanding consumer needs and behaviour, especially in the initial stages of product development (see figure 1). Jonas (1993) puts forward the notion that there has been an evolution in the conception of the designer resulting in an increased emphasis being placed upon the *end-user* as part of the design process, although little evidence is provided of how this change has been measured and against what. He further indicates that there is a necessity for an *analysis of need* and to incorporate the *human-product relationship* in the design of products. Despite the lack of evidence of the amount of change that has taken place, the key factor is the importance that Jonas places on the concept of *human - product relationship* and its relevance to the product design and development process.

van Veggel (2005) suggests that in order to develop products that are easy and intuitive in their use, and that are useful and easily integrated in existing practices, designers need to know who the users of these products are going to be, what they think, what they do, and how they might use these new products. To fill in the gap in understanding, users of new products and designers have turned to the sciences. Psychologists, who primarily approach humans as individuals, have developed their understanding by performing tests in controlled environments such as labs. Sociologists, particularly in quantitative or statistical sociology, have helped designers to understand the people targeted in product development activities can be defined as living in both social and cultural contexts.

Addressing the Limitations of Design Research

However, for many design projects, the use of this research is limited because surveys consist of questions on characteristics, behaviours, and attitudes that are based on presumptions on what these characteristics, behaviours, and attitudes are. Van Veggel (2005) suggests that design, through seeing limitation in other social sciences, has turned to anthropology, and to the method of ethnographic research in order to fulfil users' needs by appealing to users' desires, designers need to question their own presumptions and to think and act as a user, and then to translate these needs and desires into the medium that he or she, as a designer, dominates (van Veggel, 2005).

It is suggested that the advantages of ethnographic research are that one single person, using simple tools such as pen and paper, or more updated but still simple ones such as a video camera can implement it (van Veggel, 2005). He also suggests that designers approach ethnography for the practical reasons of gaining a rich and deep understanding of users that can be easily integrated into design projects, and yet quick and relatively inexpensive to obtain. Within this context, he indicates three key phases: (1) **formulation** of the initial research questions driven by preconceptions, attempting to articulate in terms of goals and research methods; (2) **user contact with participants**. He suggests that designers/ethnographers "learn through doing" (action learning approach), arguing that it at this point the researcher formulates the actual questions after speaking with and observing the participants. This then enables the researcher to participate as closely as possible in the regular lives of the research subjects; and (3) **Interpretation of data**.

Product Design Models and Practices

Many product design models encourage the development of a multiplicity of concepts but fail to indicate or identify any distinct links between primary information sources – the customers and users (Bolton and Williams, 1995). Emphasis on rapid idea generations means that far too frequently ideas are generated remotely for the needs of the user (Bolton and Williams 1995). A factor that may contribute to this issue could be the use of unstructured processes by designers. Craig et al (2000) imply that most design offices engage in unstructured collaboration. They suggest that collaboration without shared goals—unstructured collaboration - minimally requires an open exchange of ideas and issues between participants.

The general emphasis within many product design models (Pugh 1982, March 1984, French 1985, Cross 1988, Pahl and Beitz 1988, Holt 1990) is on achieving performance specifications. Parameters are usually derived from the definition of the problem and encourage the generation of multiple alternative concepts by building up best sub-solutions. Within the array of descriptive and prescriptive product design models, key components of the processes and models act as appropriate tools when dealing with specific issues, such as establishing design specifications, but there exists a lack of linkage with user needs as suggested by Ulrich and Eppinger (1995). Goodman-Deane et al (2010) support this theme by arguing that many of the methods for understanding users have had limited uptake in design practice, citing the work of Cardoso *et al*. (2005). They suggest that there are various possible reasons for this, but an important underlying factor appears to be a poor fit between many of these methods and the ways in which designers think and work (Cardello 2005).

Redstrom (2006) indicates that design used to be a matter of physical form, its subject the material object, it now increasingly seems to be about the user and her experiences. Particularly in the design of electronic appliances, interactive systems and computational things, there has been an increased interest in 'experience design' and in designing the 'user experience'. As Thackara (1988) has articulated it is the development of design discourses 'beyond the object' (shift from task to experience based design).

Redstrom (2006) suggests that the increased interest in users and their experiences must, however, also be understood in the light of designs failing to get approval by users and situations where the intended use of designs does not translate into actual used and how the design community has responded to this, attributed to an insufficient knowledge about people and their behaviours.

Redstrom (2006) states that due to this phenomenon that a range of methods for studying users, testing prototypes, involving potential users in the design process, etc., has been developed within the general area of user centred design. With respect to this, the interest in experiences is an attempt to broaden the knowledge about use and users as a response to established ideas about usability and utility being overly constrained (Hassenzahl et al., 2001; Preece et al., 2002).

Participatory design has emerged in order to reduce the distance between designers and users, changing (some of) the people who might be 'users' to also become 'designers' (Redstorm 2006). Redstorm (2006) highlights a potential dilemma, that although people active in the domain one is designing for certainly possess knowledge about that domain, their ideas about future use is just as much a prediction as anyone else's.

The key strengths identified with current product design models are that they describe and prescribe the core tasks and stages involved within the process; support design and project management issues; encourage the realisation of performance requirements and encourage the evaluation of best practice. The key weaknesses are that current models and practices do not elicit latent information relating to user needs and that there is insufficient testing and re-testing of issues and initial assumptions. An inherent weakness identified in many of the current models is the assumption that the designer acts purely as a reactive problem solver in search of best practice solutions. Another important issue to emerge is that the user and the designer often only communicate through the product itself (Norman 1988), although the problem is not just about inaccurate assumptions about user needs, but also about a potential lack of understanding of the product's perceived use, the *why* factor (see Jonas, 1993).

Citing Jordan et al (1999), Taylor et al. (1998) and Wood (1998), Siu (2003) suggests that more and more designers have begun to consider the diversity of users. He indicates that the designer's job is to no longer to produce finished and unchangeable solutions, but to develop solutions from continuous two-way communication with those who will use his or her work. However important the elicitation of user needs, success within the product design process cannot be achieved without introducing multiple information sources, particularly in relation to business and manufacturing issues (Sanders 1993, Keeley 1993). This notion is supported by a vast number of studies undertaken within the field of new product development to identify factors intrinsic to success and failure (Craig & Hart, 1992), summarised in figure 3.

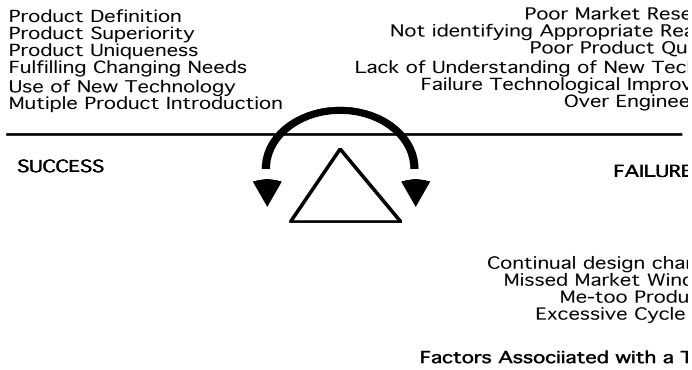


Figure 6: The Balance Between Success and Failure within the NPD Process

To address these challenges the Design Council, since the mid 2000's, has systematically attempted through its guidance services and it's on-line support material to indicate the relationship between primary information sources and effective idea generation and development. IDEO has pioneered and championed the interrelationship between design, management and technology information underpinned by a human centred approach (see figure 7). The IDEO design model has been widely publicised and adopt by both academic and professional organisation over the last twenty years.

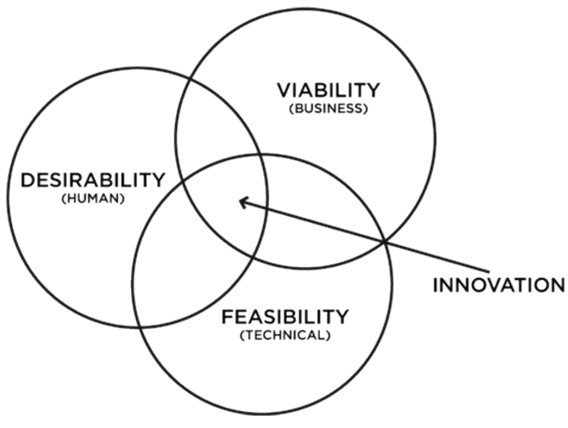


Figure 7: IDEO Model

Summary of Factors Affecting Customer Involvement

Multiple issues and themes have emerged alongside potential new research areas in the above review. These include the need for better understanding of semi-structured research activities within organisations – formal/informal and structure and unstructured practices. The following themes have been identified and summarised, in relation to design and customer involvement, which have impacted upon and have or are influencing user centred design practices:

- Definition of User Centred Design
- Importance of User Involvement
- Barriers to Success
- Shifting Emphasis of User Centred Design
- Levels and Nature of User Centred Design Activities

Definition of User Centred Design

User centred design focuses on two types of involvement: (1) understanding activities related to use – user; and (2) understanding activities related to consumption – customer. In many situations the user is also the purchaser but in some circumstances the person purchasing a product or service may not be the end user, such as in military equipment and in service provision in health care or local public services. This is a distinction that appears not to be made frequently in much of the published literature. The term 'user centred design' is a term used as an overarching expression to describe user and customer involvement in design related activities.

User centred design activities and techniques are used to capture a variety of different types of information and data, ranging from user profiles (personas), consumer attitudes and perceptions, lifestyle aspirations through to consumer behaviour (social, cultural – lifestyle based through to task based activities– product /service usability).

Importance of User Involvement

Building the voice of the customer into the new product development process has been identified as one of the crucial factors in getting new products to market more quickly and effectively (Cooper and Kleinschmidt, 1994). Numerous studies have established the link between understanding the needs of the user/consumer and successful product innovation practices (Eisenberg, 2011). In addition, influential design and innovation driven organisations such as the Design Council and NESTA started to highlight and embed the importance of user involvement into their activities and user-led innovation within their debates. During the early and mid 2000's the Design Council was focussing on the importance and impact of design on business and stock market performance (2005), evident in their "Value of Design" initiatives. This message, the impact of design on business performance, was also being reinforced by the DTI (2005). By 2008 the Design Council was focussing on the importance of user involvement as a key contributing factor to success and had embed related activities into their 'Design in Demand' program and their guidelines for effective design practice. NESTA (2008) emphasised how practices within the creative industries were evolving and integrating a more strategic approached to design research, involving more emphasis on user issues focusing on user-led innovation. One key organisation to champion the importance of user involvement was IDEO, an internationally recognised design firm and innovation consultancy founded in 1991 in Palo Alto (USA). They raised the profile of the importance from an industry perspective and this is reflected in their desirability, feasibility and viability innovation model. In context of research, key players such as Cooper and Kleinschmidt, Yeaple, von Hippell, Ulrich and Eppinger, Marzano and Nygaard over the last twenty five years have consistently championed and demonstrated the benefits of user involvement and user centred design practices. User involvement has been has also been acknowledged in helping companies address ‘fuzzy front-end’ activities. Based on the plethora of articles, research outcomes and case studies it would be possible to assume that companies would be embracing, adopting and building in the ‘voice of the customer’ into their product development and business activities. However, there is an undercurrent to suggest that this is not the case and that the generic nature of many of the studies do not fully indicate what activities are undertaken, what issues are sought and what tools and methods are used, particularly from a UK perspective. These factors are key to this study and its contribution to the field.

Barriers to Success

Even though building in the ‘voice of the customer’ has clearly been demonstrated to be useful and effective, historically multiple studies have identified that little market research is done in the early stages of the product design and development process to determine interest in new product ideas (Symons, 1988; Souder and Moenaert,1992; Veryer,1993). The over-reliance of basing new product specifications on a combination of the best single features observed in available competitive products is no longer sufficient for long term success. Souder and Moenaert (1992) established that many companies experience uncertainty when attempting to identify user needs. A lack of adoption has been attributed to cost issues in a number of studies (Barczak et al.,2009). Based on the issue of cost, it has been interesting in the literature review to see how these lead-user models and the ‘innovation tool kits’ have apparently been adopted by business due to ease of use and cost benefits. However this must be seen in the context of the findings of Barczak et al., (2009) who suggest that formalised tools are reducing innovation and impact on sales and profits. This study aims to understand in more detail why and where companies, particularly UK SMEs, experience uncertainty. An area of future research that would be useful would be to determine the differences between design research and market research and the contribution each makes to other discipline.

Shifting Emphasis of User Centred Design

As would be expected there is a strong link between new product development and user centred design trends. User centred design originated from ergonomic and task based scenario analysis techniques in order to help understand the boarder context in which users used products and services, and also how they live their lives. TU Delft, an internationally rated University in the Netherlands, have been a key player over the last twenty-five years in the development of cognitive ergonomics engineering (Norman, 2010). Their research has focussed on understanding how people experience products (be they physical, immaterial of virtual), the measurement of such experiences and supporting designers in designing for them. Hekkert and Schifferstein (2008), of TU Delft have led the shift from understanding pure technical performance to comprehending softer innovation issues such as the value and meaning of experiences. This can be seen in the context of the growth of design intensive companies (Verganti, 2008) where they are innovating through creation of new experiences. Another change in emphasis has been the application and use of participatory design practices, particularly within a service design context, in helping to introduce new working practices into companies and organisations (Eisenberg, 2011). Increased participatory and co-creation activities within user centred design activities have been the key shifts in emphasis in the last decade.

Levels and Nature of User Centred Design Activities

One of the observations from the literature review has been that user centred design tools and processes appear to be generic and adaptive in nature. The adaptiveness of the tools and processes appears to be an inherent strength and weakness. The generic tools and processes are subject to change dependent on the specific design process they are linked to and adapted to the specific needs of project. This requires tools and in particular processes to be 'tailor made' (Buur and Matthews, 2008), which could be a contributory factor in creating uncertainty in companies and organisations that are unfamiliar with user centred design practices. If this observation is then linked to growing desire of companies to introduce formalised and standardised NPD approaches, this may be a contributing factor to why user centred design is not as widely adopted as would be first anticipated.

Three other contributing factors have been identified via the literature review that impact on the role and use of user centred activities at strategic and tactical levels: (1) determining the level of depth of user involvement within a product development project (design for (in-direct), design with (direct) and design by (participatory)); (2) establishing the level of structure and formality within the processes and activities (unstructured/informal to formal/structured); and (3) type and quality of the insights and information required (function through emotional issues, lifestyle through to task based information). Factors one and two require knowledge, understanding and prior experience in order to plan and implement, thus creating potential scenarios for uncertainty within people, projects and organisations. In relation to factor two, consumer segmentation and user profiling are two critical factors that determine the level of structure and formality of a project. For example the use of clearly defined user segmentations and the selection of users with related profiles, such as age, sex, income, attitudes, behaviours etc. allows for a much more focused study with less variation in the outcomes and more potential validity of the resulting insights. Whereas when user segmentation is undertaken with a mixed user profile, it can provide very useful insights but will be more variable, creating another trajectory of uncertainty for people, projects and organisations (guerrilla research and presearch). It has been established that designers typically undertake activities in an unstructured way (Craig et al., 2000) and this introduces yet another strand of uncertainty.

User centred design has evolved dramatically since the 1970's. It has progressed from task-orientated approaches to more co-creation based activities that address both emotional and functional based issues in order to understand both meaning and value as well as performance based issues. Buur and Matthews (2008) highlight three emergent strands of user centred design methods: (1) lead-user approach, (2) participatory design and (3) design anthropology. What is apparent in practice (design and development) but not clear in the literature, is that multiple methods and approaches are needed in any single user centred design project, requiring knowledge and understanding of different tools and techniques. The most used technique in design practice appears to be ethnographic research due to its ability to be undertaken at its simplest level by a single designer and generate immediate results for a given project. The most dominant technique within the literature is von Hippel's 'lead-user method' and the subsequent 'innovation tool kit method'. The 'lead-user method', when analysing its use, appears to be most effective in industrial sectors involving clearly identifiable supply chain partners rather than users. It has been suggested that the technique is harder to apply in mass consumer related sectors where defining lead users is more difficult. The term 'lead-user' also seems to have created an element of confusion with the concept of 'expert user' (specialist expert within a define area of practice often associated with niche activities – sports or medical for example). The notion of ‘expert users’ has been extensively used historically in industrial design based activities particularly in medical and technical areas where specialist input is necessary.

User centred design techniques have proven themselves to be useful through multiple stages of the product development process. In particular in recent years they have been actively used in fuzzy front-end activities. Although many formal user centred tools for product development have been designed the awareness and usage of them is still infrequent (Hanna et al., 1995; Nijssen and Lieshout, 1995). Certain tools or generic methods have been adopted in many cases due ease of use and ability to be implement by a single person such as ethnographic studies.

What is crystal clear from the literature review is that user centred approaches are beneficial to businesses and impact positively on creation of innovative outcomes that can fulfil latent and unmet needs in the market. However what is also evident is that they are not widely adopted and this study aims to understand why, in relation to UK SMEs.

Factors Affecting New Product Development Practices

Introduction

New Product Development (NPD) review section aims to provide the study with a thorough grounding and platform for understanding trajectories and emergent themes, key commentators (authors) that have contributes to subject area and development of the discipline. The following four trajectories are explored:

- Fuzzy Front-End
- Voice of the Customer within NPD Practices
- Changing Role of Design in NPD Activities
- Trends and Drivers of Success within NPD Practices and Activities

This section concludes by summarising the emergent themes within the explored trajectories.

1 Fuzzy Front-End

The fuzzy front-end, a term made popular by Smith and Reinertsen (1991), is considered as the first stage of the New Product Development (NPD) process and roughly covers the period from the generation of an idea to its approval for development or its termination (Murphy and Kumar, 1997), or what they call 'the start date of team alignment'. Cohen and Levinthal (1990) suggest this concept in another way by highlighting the fuzzy front-end as that territory leading up to organizational-level absorption of the innovation process.

Cooper (1988) distinguishes four phases of the fuzzy front-end, the generation of an idea, initial screening, preliminary evaluation, and concept evaluation. He stresses the importance of both market-related and technical activities. Khurana and Rosenthal (1998) further develop Cooper's viewpoint, suggesting that the front-end includes product strategy formulation & communication, opportunity identification and assessment, idea generation, product definition, project planning, and executive reviews.

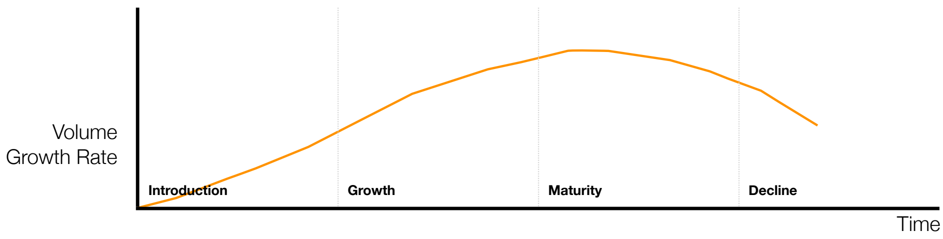
While a concentrated effort toward better understanding the fuzzy front-end has been undertaken in earnest only during the last decade, scholars of NPD have discussed 'up-front activities' in for more than 20 years (Crawford, 1980). In the case of early fuzzy front-end activities, key topics are discussed including problem/opportunity structuring and/or identification/recognition (Leifer et al., 2000; Urban and Hauser, 1993); information collection/exploration (March, 1991); and 'up-front homework' (Cooper, 1996). Late fuzzy front-end activities are seen as involving aspects of idea generation and concept development (Cooper, 1990; Urban and Hauser, 1993), continued information collection, and informal or pre-screening (Crawford, 1980; Crawford and Di Benedetto, 2003) with possibly some initial fund allocation for exploring a new idea (Cooper, 1990; Cooper and Kleinschmidt, 1986).

Several studies also highlight the importance of the fuzzy front-end (e.g., Booz, Allen, Hamilton, 1982; Dwyer and Mellor, 1991; Atuahene-Gima, 1995; Shenhar et al., 2002). Cooper and Kleinschmidt (1994, p. 26) found that 'the greatest differences between winners and losers were found in the quality of pre-development activities'. The fuzzy front-end determines which projects will be executed. Quality, costs, and timings are mostly defined during the front-end. At this early stage, the effort to optimize is low and effects on the whole innovation process are high (Smith and Reinertsen, 1991; Verganti, 1999). Thus, a deeper understanding of the fuzzy front-end and its impact on NPD success could help firms to be more successful in their efforts to develop new products.

Factors Affecting the Product Lifecycle

Cox (1967) showed that the lifecycle of a new product is characterized by four stages: introduction, growth, maturity, and decline. According to Kotler (1991) the role and function of the product lifecycle concept is based on three key characteristics: (1) that products have a limited life expectancy; (2) that profit levels are not consistent but change throughout a products life; and (3) that products require a different marketing strategy at each stage of their life. A case can be made that one of the main management implications of the PLC is to avoid having a high proportion of a company's products at the end of their lifecycles (Kotler, 1991). However, it is important to note that nothing is fixed about the length of a cycle or the length of any of the various stages. Studies over the last two decades show that the length of each cycle is governed by the rate of technical change, the rate of market acceptance and the ease of competitive entry (see Figure 8).

Technology has been established as a critical factor in influencing the rate of change and market cycle times. De Praduddha et al's (1991) study confirmed that product lifecycles in industries characterised by high rates of technological change tend to be short. Additionally they found that companies that develop new products requiring technological innovation's, frequently attempt to bring the products to market as quickly as possible in order to achieve market advantage. Qualls et al (1987) found two interrelated issues. That product lifecycles are reducing due to the increase in demand and variety of products being offered to the customer and that product lifecycles are shortening particularly during the introduction and growth stages. Guveritz (1983) earlier had suggested that the introduction of 'new



Sales	Low	Increasing rapidly	Peaking	Declining
Cost Per Customer	High	Average	Low	Low
Profits	Negative	Increasing rapidly	High	Decline
Customer type	Innovators	Early adopters	Middle and late majority	Laggards
Competitors	Few	Increasing. Emergence of emulators	High, but beginning to decline	Declining with rapid shake-out
Competitors' Strategies	Unfocussed and indirect	Attempting to achieve trial. Undifferentiated products/ services. Emphasis on fighting for share.	Price cutting to achieve volume. Fighting for market share . Emphasis on efficiency and low cost. Shake-out of weakest players.	Exit of some competitors
Product Mix	Basic product	Develop product extensions and service levels.	Modify and differentiate. Develop next generation.	Phase out weak brands
Price Mix	Low price strategy or Niche positioning	Penetration strategy	Price to meet or beat competitors	Reduce
Distribution MIx	Selective	Intensive. Limited trade discounts.	Intensive. Heavy trade discounts.	Selective. Phase out weak outlets.
Advertising	Heavy spending to build awareness and encourage trial among early adopters and distributors.	Moderate to build awareness and interest in mass market. Greater word of mouth.	Emphasise brand differentiation and special offers.	Reduce to a level that maintains hard core loyalty. Emphasise low price to reduce stock.
Structure	Task force	Product Division	Business division with task force for new product development.	Reduced

Figure 8: Adapted from: Wilson et al, (2005) Strategic marketing Management pp. 276

technologies' (either new to the company or to the market) has been a major factor in helping to reduce/shorten the product lifecycle due to the ability to introduce new and innovative features more easily. An example cited by Guveritz (1987) in his study of how the product lifecycle of a video game had dropped to 9 months. Gomory and Schmitt (1988) correctly suggested that rapid developments culminate into major product changes that leave competitors behind if they lack quick response capabilities. This has become common practice now in virtually all industries.

Murray et al (1992), through their survey of major approaches for accelerating new product development identified and accurately predicted that products will have lifecycles which are much shorter than those experienced by products of the past. They identified two important factors: (1) that the key variables affecting a manufacturing organisation are product and market cycles; and (2) that accelerating lifecycles will mean that a product will typically undergo multiple incremental development phases. Based on these emerging trends, Millson et al (1992) recommend five basic approaches to accelerating new product development: simplify; eliminate delays; eliminate steps; speed up operations and undertake parallel processes. More specifically Cordero (1991) established that there was a need to reduce the time, from introduction to maximum product performance, before reaching maturity. Relating to the steepness of the S – curve. The ability to anticipate the need for the introduction of a new product, relating to the closeness of the S – curve. An interesting observation by Smith (1990) was that many companies and mangers had problems in determining the actual length of their product development cycles.

Factors Affecting Product Development Strategies

Johne and Snelson (1990) suggested that the choice of strategies available is no longer as wide as it used to be. They suggested that concentrating on low - cost manufacturing is an unattractive method of competing globally for most companies (US and UK), with new entrants from low-cost producing countries easily able to copy this approach. This observation has proved to be true. The perceived strongest strategy is suggested to be based on building up strong global brands, which can support a whole range of product lines, offered by constituent businesses. Mahajan and Wind (1992) suggested that market penetration is the key factor that dominates all other objectives. In an attempt to aid the selection and development of product design strategies Booz, Allen and Hamilton (1982) established six categories of new products. See table 11.

Category:	**Characteristics:**
New-to-the world products	Products which create an entirely new market
New-product lines	New products that allow a company to enter an established market for the first time
Additions to existing product lines	New products which supplement existing products
Product improvements to existing product lines	Products that either improving current product performance or by altering peoples perceived value by replacing existing products
Repositioning	Products that re-targeting existing products at new marketing opportunities or segments
Cost Reduction	New products that provide similar performance at lower costs

Table 11: Product Development Categories and Characteristics, adapted from Booz, Allen and Hamilton (1982)

Although Nystrom (1985) advance a more simplified view, suggesting that fundamentally that there are essentially two types of product strategy: (1) defensive strategies based on product modification; and (2) offensive strategies based on product diversification
Successful product development strategies have now been clearly linked to running key activities in parallel rather than in sequence. This parallel process has been referred to as the 'rugby approach', where team members work together in a parallel approach as opposed to a 'rely approach' Parallel development work is ideal for high value-added products were speedy development is critical for achieving profitability. In the relay approach each function takes it in turn to undertake its required task, thus making the process longer (Takeuchi and Nouaka, 1986).

It has emerged over the last three decades that product development strategies are influenced by the level of desired 'product innovation'. Haines et al (1989) identified four principle product development strategies in relation to desired levels of product innovation: incremental, break-through, pioneer and followers strategies. Two common factors influencing product development strategies appear to relate to the newness of the product to the company and the market; and the intend level of product innovation.

Technology with in the 1980's and 1990's was seen as a key driver. Nystrom's (1985) research demonstrated that product development strategies where strongly influenced by two specific factors: (1) Technology environments and (2) Market environments, and that these affect the selection and choice of strategies.

Nystrom (1985) has identified a number of factors influencing the product development strategy: (1) Technology use: relating to the way in which technologies are applied to critical technical problems within the product development process; and (2) Technology orientation: relating to the extent to which a company relies on its own internal technical competence and resources or depends on outside sources. Nystrom (1985), a strong suggest for technology driven strategies, suggested that technological use and orientation are of crucial importance within a manufacturing environment, but suggests that the 'technology use' concept needs to be 'synergistic', requiring the bridging of gaps between specialised experts. Nystrom's (1985) research highlights that few companies are at the extremes of an internal orientation - complete self-reliance, or an external orientation - complete reliance on outside resources. Although he has identified that there is often a strong tendency in one direction or the other. Within the context of the "marketing strategy', Nystrom (1985) stated two, now well established strategic parameters, that drive success: (1) the product and (2) the customer. When defining the notion of “Product”, he suggested that there are essentially two types of product strategy: (1) Product modification: which is defence oriented and (2) Product diversification which is attack oriented. In relation to customers, this relates to understanding whether or not customers are either existing clients or new ones.

Success has been attributed to the way in which an organisation profitably exploits identifiable opportunities, requiring companies to focus on adding value by considering not only the inherent quality of the product but also other benefits associated with it (Johne and Snelson, 1990). These processes require a level of support appropriate to the needs of the target customer, Mathur, (1988). In analysing UK and USA best practices, market-based competitive strategies has been evolving. Johne and Snelson (1990) have identified four strategic levels, see table 12.

Market Based Strategies	Characteristics
Level 1	Differentiates product features above all other attributes. This involves developing a better product offering.
Level 2	Involves offering customers a tailor - made unique package of product features plus special support, such as installation, operation and servicing. This approach is known as the system offering.
Level 3	Commodity offering, which relies primarily on price usually because the product is offered without support and is undifferentiated from that of its suppliers.
Level 4	Service offering, which relies on advice concerning how the product can be best used.

Table 12: Market Based Strategies and Characteristics, adapted from Johne and Snelson (1990)

Importance of Formalised and Structured NPD Frameworks

New product success and failure can be traced back to NPD frameworks (Cooper and Kleinschmidt, 1991). Several studies have identified that it is those organizations that excel in managing the “upfront or fuzzy front-end (FFE)'” phase that are more likely to win the innovation race (Cooper, 1988, 1998; McGuinness and Conway, 1989; Dwyer and Mellor, 1991).

The need for formalised and structured NPD frameworks is associated with high quality costs, inconsistent terminology and definitions, garbled or confused hand-offs (up to 39 per cent has been measured) causing wasted effort, misdirected work and demanding increased numbers of clarification meetings. Another factor is the inability to estimate resource requirements and schedules'; resulting in sub-optimal planning and execution in support of programmes is also attributed to weak NPD frameworks (Anthony et al., 1992). Anthony et al (1992) credit this to excessive task interdependence, resulting in complex and inefficient communication channels and plans being made disjointedly between groups and a poor understanding of responsibilities. In some instances, 42 per cent of work has been repeated because of upstream changes, which have occurred due to late customer input, something being overlooked, or errors in specifications. They also established that too much attention (in weak companies) focused on fire fighting, often with at least 48 per cent of development work has been identified as fire-fighting and caused by unplanned work which appears unexpectedly but requires immediate attention. Interrelated is the emergence of the importance of cultural change. Anthony et al (1992) highlight, that the time required for cultural acceptance and integration is often longer that the lifespan of the processes being implemented and thus cross functional changes are difficult to make from within, manifesting itself in problems across process boundaries.

Cooper (1988) established that one product concept out of seven becomes a commercial success; and only one project in four results in a winner. During the 1980's it was identified that roughly half of the resources that US industry devoted to product innovation was spent on failures and killed projects. It was not surprising that 63 per cent of executives where "somewhat" or "very disappointed" in their results of their firms' NPD efforts. This was characterised by a 35 per cent failure rate at launch of new products. To address these challenges, firms where driven to implement changes to help speed products through development and improve process efficiency and NPD effectiveness (Griffin, 1997). Cooper (1994) suggested that the "third generation" stage-gate models differ by having overlapping, fluid stages integrating "fuzzy" or conditional "Go" decisions at gates (see figure 9).

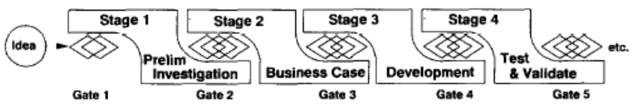


Figure 9: Third generation stage gate model, Cooper (1994)

The adoption of formalized and structured new product development processes such as "stage-gate" systems for deriving new product development processes for driving new product projects from idea through to launch has widely been adopted (Cooper, 1994). The benefits of adoption are that it provides companies with a more efficient roadmap that can managed, controlled and measured, helping to bring products to market faster and improving the use of resources. The use of a structured development process, provides the “rules of the game" and describes the entry and exit criteria between key programme milestones, primary tasks, schedules and resource assignments (Power, 1993).

Experience has shown that predevelopment work pays for itself in reduced development time and improved success rates (Cooper, 1993, 1995). “Poor definition of product requirements” was the reason most cited for product development delays. About 71 per cent of the respondents in a study focusing on product development acceleration noted that process delays occur when there is poor understanding of customer requirements and insufficient knowledge of a product's technology and market forces such as competition, suppliers and distributors, all of which should be addressed in the FFE (Gupta and Wilemon, 1990).

NPD Framework Characteristics

Power (1993) established that the majority of NPD frameworks possess a number of similar important characteristics (Power, 1993):

- A team of senior executives, called a review board, who provide oversight of the programmes by resolving cross-project issues, setting project priorities, resolving issues and make Go/Kill decisions
- Use of realisation teams (cross-functional execution teams), operating under a product “champion" and reporting to the assigned senior management oversight board
- Phase or stage/gate reviews at major development milestones, when funding, resources and project schedules are approved or rejected by the review board

2 Voice of the Customer within NPD Practices

Voice of the Customer

According to Dahan and Hauser (2001), ‘‘listening to consumers’’ helps a company to know more about a specific consumer need and to better understand the potential possibilities for satisfying those needs. Understanding customers’ problems and needs has been established as a critical success factor (More, 1986; von Hippel, 1986; Gruner and Homburg, 2000). External communication with key customers has been highlighted as a key success factor for product development projects (Allen, 1971; 1977; Katz and Tushman, 1981; More, 1986; von Hippel, 1986; 1988). “The unique capacity of informal and generally face-to-face communication is to facilitate transfer of complex, ambiguous and novel information and to provide the possibility to capitalize on surprising and unexpected answers” (Salomo et al., 2003, p. 446). It has been established that customers can provide first-hand information regarding their needs, can help create innovative ideas for new products, and provide feedback regarding concepts and prototypes (Bruce and Biemans, 1995). Bebb (1992) suggests that 'total' product development process is influenced by the prediction of customer’s future needs that involve customer input to team discussions

Joshi and Sharma (2004) suggest the importance of “customer knowledge development” for new product success, defining customer knowledge development as an evolutionary process of collaborative learning with customers during the pre-launch stage of a product. They suggest that customer preferences evolve through engagement with new product ideas, concepts and prototypes across the stages of new product development.

However, the capturing of need-related information can be inherently ambiguous, with many experts suggesting that often consumers may not be able to articulate their needs clearly (von Hippel, 1986), and or their needs may change as they use a given product (Rosenberg, 1982). These issues frequently cause uncertainty. In an effort to reduce uncertainty, many companies focus on the negative voice of customer. Collecting consumer complaint data is a common practice in many companies. Interviews and focus group approaches also fall within this category. These methods are often used in practice and have received a considerable amount of research attention (Greenbaum, 1998; Holstein and Gubrium, 1995). They are used to understand consumers’ expectations and to determine consumers’ views on the importance of particular product attributes. Sophisticated market researchers employ them at the end of surveys to add insight to quantitative results (Woodruff and Gardial, 1996). With more complex product offerings, focus groups are used to gain an in-depth evaluation of these offerings (Krueger, 1994). Focus groups are often used to validate internally generated product ideas and are occasionally used at the idea generation stage.

Jeppesen (2005) suggests that successful product development deals effectively with information costs. A crucial consideration of conventional market research is how to economize on the acquisition of reliable need-related information that allows product developers to create exactly the products consumers want (Jeppesen, 2005).

However Leadbeater and Miller (2004) suggest that the activities of innovative, committed and networked amateurs are changing our economy and society, so much so that it is increasingly difficult to distinguish between market-based and collective forms of innovation.

Relationship between Customer Involvement and NPD Activities

Hyysalo (2004) suggests that bringing together innovation development with customer needs seems to be particularly difficult in the development of radical innovations. Their newness hinders reaction to customer needs. Therefore, customer-related pro-activeness (i.e. acting based on the information gathered about the customers before their behaviour has had a direct impact on the firm, or deliberately influencing and creating changes in customer behaviour) may play an important role in creating a market that did not even exist when the innovation development began. In the case of radical innovations, "user-needs emerge only gradually for the users themselves" (Hyysalo, 2004). There is a school of thought that suggests that this may even make the collection of customer feedback insignificant, and the results distorted. Hence, it has been suggested that focusing on customers may even impede radical innovations (Christensen, 1997).

Customer needs can be defined as divergences between the existing and the desired situation (Karkkainen, 2002), and may exist or materialize in the future (Holt et al., 1984). Existing needs can be further divided into articulated and latent needs. Latent
needs are not apparent to customers, but they still exist and are unmet within the market

(Jaworski et al., 2000). Thus, they do not emerge onto the conscious level until the new product or service is presented (Holt, 1976). As long as these needs are not met, customers are not dissatisfied because they are still ignorant of them (de Heer et al., 2002). Customer behaviour can be influenced directly, i.e. without regard to the cognitive structures, or indirectly, i.e. causing cognitive change, which then changes the behaviour (de Heer et al., 2002).

Idea Generation Stage

Customer-related pro-activeness and reactiveness at the idea-generation stage seem to be connected to market opportunity, i.e. whether the opportunities are reacted to, anticipated or created. According to the study conducted by Veryzer (1998b), ideas for radical innovations tend to be generated internally and are often driven by the desire to apply a particular technology. This indicates that basic research often plays a significant role in the emergence of radical innovations. The benefit of scientific knowledge gained as a result of basic research can often be felt later on in the applied research (Rogers, 1983).

In the idea generation of radical innovations, even customers' existing needs tend to be rather vaguely expressed. Since they rarely understand what is possible, it is often difficult for them to articulate their needs. Consequently, previous studies (e.g. Kaplan, 1999) suggest that radical innovations are not usually born by reacting to specific desires expressed by customers. The ideas coming from lead users are not usually adopted as such, but rather combined with ideas from other lead users and in-house developers (see Veryzer, 1998b). In general, the utilisation of lead users seems to be more applicable to the development of incremental rather than radical innovations (Olson and Bakke, 2001).

Product differentiation is a widely used concept both in marketing and strategy (Porter, 1985). Dickson and Ginter (1987) define product differentiation as: "A product offering that is perceived by the consumer to differ from its competition on any physical or nonphysical product characteristic including price". The aim of differentiation is to earn superior profit through, for example, reduced price sensitivity or achieving a price premium (Sharp and Dawes, 2001). Differences in product offerings can be perceptual and created by mechanisms such as usage experience, word of mouth and promotion, or actual and created by specific product characteristics (Dickson and Ginter, 1987). Svendsen et al (2011) suggest that differentiation is related to delivering something different to the customers compared to the offerings of the competitors, and developing and implementing a differentiation strategy requires access to information and knowledge.

Competitor Orientation

Competitor orientation is defined as the ability and willingness to acquire information about competitors' actions in the target market, and the will to respond to these (Narver and Slater, 1990). In particular, it refers to "the extent to which a firm will go to differentiate itself from competition.

Brand Profiling

Brand profiling refers to the extent to which the company profiles its brands and reputation in its sales and marketing activities. Generally, when a firm puts a high emphasis on brand profiling, it seeks to obtain highly desired and valuable market positions (Ghosh and John, 1999), resulting in an incremental increase in cash flow relative to the cash flow normally accruing to the product (e.g. Simon and Sullivan, 1993). A strong brand profiling emphasis means that the supplier seeks to build brand equity and focus on the extra margins caused by the brand.

On the other hand, Fuchs and Schreier (2011) suggest that the traditional new product development (NPD) model, in which companies are exclusively responsible for coming up with new product ideas and for deciding which products should ultimately be marketed, is increasingly being challenged by innovation management academics and practitioners alike (e.g., Chesbrough, 2003; Cone, 2006; Lakhani, 2006; Pitt et al., 2006; von Hippel and Katz, 2002). NPD enables firms to develop better products and at the same time to reduce costs and risks if customers in a given domain are willing and able to deliver valuable input (if following a structured cross-disciplinary process REF), with customer empowerment a potential key route to understanding and exploiting new opportunities and at the same time utilising resources more effectively (Fuchs and Schreier, 2011). They indicate that customer empowerment not only affects the firm's internal NPD processes as reflected in the products that are ultimately marketed, but can also affect the way companies are perceived in the marketplace (by customers who observe that companies foster customer empowerment in NPD).

Fuchs and Schreier (2011) suggest that it is useful to think of customer empowerment in NPD in terms of two basic dimensions: (1) customer empowerment to create (ideas for) new product designs; and (2) customer empowerment to select the product designs to be produced (see Figure 10). Therefore suggesting that customers can be empowered to (1) submit (ideas for) new products (empowerment to create) or (2) to ‘‘vote’’ on which products should ultimately be marketed (empowerment to select). Citing Ogawa and Piller (2006) Muji, a Japanese manufacturer of consumer goods, case study example of were a company has started to empower its customers in both dimensions.

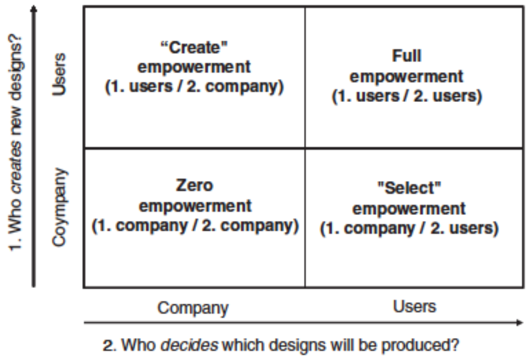


Figure 10: Fuchs and Schreier (2011) Customer Empowerment strategies

Role of Customer Involvement in Developing Radical Innovation

More and more companies are preoccupied with the need to create radical or discontinuous innovations. Companies are seeking radical innovations that allow them to develop products for which there is no (or less) competition and potentially even change value networks and industry “rules” to their own advantage (Tushman and Anderson, 1986; Christensen, 1997).

Radical innovations can be defined as innovations that break with traditions in the field. They can be labelled radical, discontinuous, generational or breakthrough (Dahlin and Behrens, 2005). Radical innovations can also be termed disruptive, when they give rise to major transformations of entire value networks (Tushman and Anderson, 1986).

The importance of radical innovations is widely recognized, developing them is still rather poorly understood (Leifer et al., 2001). Creating a radical innovation that fulfils customer needs is extremely difficult, primarily because in the some cases at the earliest stages of the development process the firm may not even know who the customers for the innovation under development might be (Deszca et al., 1999). Commercializing a radical invention requires coping with considerable market uncertainty (McDermott and O'Connor, 2002).

Some earlier studies on innovation management have highlighted the importance of proactive approaches when developing innovations. Kaplan (1999) and Rice et al. (1998) accentuated the role of proactiveness in stimulating radical innovations within the firm. Hyysalo's (2004) study emphasized the importance of anticipating prospective use during a radical innovation development process, and the study by O'Connor and Veryzer (2001) concentrated on market visioning in radical innovation development. Narver et al. (2004) studied reactive and proactive market orientation in terms of creating and sustaining new-product success, and came to the conclusion that both were needed, but proactive orientation seems to be especially important. Furthermore, Verganti (1999) studied how anticipation and reaction interact in the early phase of radical innovation development.

Heiskanen et al (2007) suggest that closer involvement in radical or discontinuous innovation is critical but indicated that they are more difficult to reach and learn to know well than professional users. They suggest that that really new-to-the-world products and radically innovative concepts are regularly discarded because consumers fail to understand them and thus to appreciate their benefits: consumers are often too conservative. The usefulness of involving consumers in product development is often questioned in the context of radical innovation because customers do not know what their requirements are for products that require different behaviour patterns or that open up new applications (O'Connor, 1998). Most solutions to this problem focus on educating the consumer, or bringing more experience into the evaluation situation. For example, it has been suggested that concept tests for radical innovations should be organized in stages (Duke, 1994) or employ "quasi-experts" (Trott, 2001). Methods have been developed to help consumers learn about the new product concepts. These include "live with the concept", in which consumers take images of the product concept home and spend time getting used to them (Morris et al., 2003), or "information acceleration" (Herstatt and Lettl, 2004; van Kleef et al., 2005), in which the future context of the innovation is presented in detail, thus helping consumers to orient themselves toward the concept. Yet experience with these methods has produced mixed outcomes. Sometimes, learning about the concept does not seem to make consumers more positive (e.g. Morris et al., 2003).

Lead Users and Innovation Tool Kits

Building in the voice of the customers can involve introducing deep immersive techniques, such as ethnographic studies. However, Von Hippel (2001) suggests that they are both difficult and time-consuming to use. To address this issue von Hippel (1986) suggests leaving the essential problem-solving activities up to consumers. He also goes further, by arguing that the task of understanding user needs has grown ever more difficult as firms increasingly strive to learn about and serve the unique needs of "markets of one," and as the pace of change in markets and user needs grows ever faster.

Thomke and Von Hippel (2002) recommend that there are three key signals that suggest migration to customers-as-innovators approach: (1) Market segments are shrinking and customers are increasingly asking for customised products and or services; as organisation respond to those demands, cost increase and is difficult to pass on costs to customer; (2) Product development process is involving multiple iterations before an agreed solution is found; and (3) Supplier and customer use high quality computer-based simulation and rapid-prototyping tools internally to develop new products and flexible manufacturing technologies.

Von Hippel (1986) focuses on the importance of connecting with advanced "lead users", describing advanced users as including lead users, ''users whose present strong needs will become general in the market place months or years in the future''. Expert testers, who are typically able to spot errors and mistakes in prototypes during testing. The key characteristics of these users are their interest in and frequent use of a developer's products or services; and their ability to recognise benefits and shortcomings faster and more accurately than other users (Herstatt and von Hippel, 1992).

Von Hippel (2001) suggests that manufacturers are starting to abandon their increasingly frustrating efforts to understand users' needs accurately and in detail. Instead, they learn to outsource key *need-related* innovation tasks to their users, after equipping them with appropriate "user toolkits for innovation". He also outlines five parameters of why companies should adopt innovation tool kits: (1) They enable users to carry out complete cycles of trial-and-error learning; (2) They offer users a "solution space" that encompasses the designs they want to create; (3) Users are able to operate them with their customary design language and skills–in other words, well-designed toolkits are "user friendly" in the sense that users do not need to engage in much additional training to use them competently; (4) They contain libraries of commonly used modules that the user can incorporate into his or her custom design – thus allowing the user to focus his or her design efforts on the truly unique elements of that design; and (5) Properly-designed toolkits ensure that custom products and services designed by users will be producible on manufacturer production equipment *without* requiring revisions by manufacturer-based engineers.

Jeppesen (2005) suggests that this approach calls for renewed considerations concerning the organization of product development. He highlights an important distinction between the application of toolkits in a business-to-business and a business-to-consumer setting is that in the former setting, customers derive important economic benefits from having a custom product and therefore have a strong incentive to invest in toolkit problem-solving capabilities.

In order to solve a problem Jeppesen (2005) thinks that all necessary information and problem-solving capabilities must be brought together-virtually or physically at a single locus. To the product developer, the identification of user needs is an essential undertaking, which, however, is constrained by the costs of acquiring the relevant information. In addition they face the problem that users locally hold essential sticky information . Von Hippel (1994) defines sticky information as ‘‘the information that is costly to acquire, transfer, and use in a new location.’’ The degree of stickiness is defined as the incremental expenditure required to transfer a certain unit of information to a specified locus in a form that is useable to the information seeker. Von Hippel (1998, page 630) also indicates that when the cost is low, information stickiness tends also to be low; when it is high, stickiness is high. It is suggested that high information stickiness may be due to the attributes of information itself, specifically the way in which information is encoded (Nelson, 1982; Pavitt, 1987; Rosenberg, 1982); alternatively, it may be a function of the absorptive capacity of information seekers (Cohen and Levinthal, 1990). Jeppesen (2005) suggests that sticky users’ need-related information, the information called for by product developers, can only be acquired at high costs. Adding to those costs is the observation that users’ needs typically change over time (Rosenberg, 1982).

Managing the Risk of Customer Integration

Customers can provide first-hand information regarding their needs, can help create innovative ideas for new products, and provide feedback regarding concepts and prototypes (Bruce and Biemans, 1995). The early innovation phase, especially in the search field process is inspired by – and in turn inspires – the company's innovation strategy (Lichtenthaler, 2003). Whenever a customer is integrated into the company's search field or innovation process, he or she almost unavoidably acquires company know-how while contributing his own knowledge or ideas, this can be perceived as a risk (Lukas and Ferrell, 2000).

Enkel et al (2005) suggest that the obvious risk of integrating a customer is that they could use the company know-how for their own purposes – this risk may (but, again, may not) be negligible – or that he could trade it to a competitor, which is far more dangerous. Citing Wynstra and Pierick, (2000) they discuss how a potential customer who actively supports the early innovation process, consciously or subconsciously puts his stamp on the outcome. However they suggest that the customers' point of view and their specific interests in a product may influence the combined search for innovative ideas' directions. This influence contains the inherent risk of customers agreeing to be integrated into the innovation process mainly because they expect a personal benefit, as illustrated by the Rasselstein Hoesch case (von Hippel, 1986).

Applying solutions that help consumers to learn about the concepts and build up experience may be extremely useful, but product developers need to learn about consumers, too. Such forms of learning imply "Probe-and-Learn" innovation processes rather than Stage-Gate processes (Herstatt and Lettl, 2004).

3 The Changing Role of Design in NPD Activities

Innovation as an Agent of Change

Innovation is often associated with change and can be regarded as a process that brings about something new which leads to change (Drucker (1985), 1996; Hellriegel et al., 1998). Innovation can be defined as the implementation of a new and possibly problem-solving idea, practice or material artefact (e.g. a product) which is regarded as new by the relevant unit of adoption and through which change is brought about (Cox, 2005).

Successful organisations have the capacity to absorb innovation into the organisational culture and management processes (Syrett and Lammiman, 1997; Tushman and O'Reilly, 1997). According to Tushman and O'Reilly (1997) organisational culture lies at the heart of innovation practices. The basic elements of organisational culture (shared values, beliefs and behaviour expected of members of an organisation) influence creativity and innovation in two ways: (1) Through socialisation processes in organisations, individuals learn what behaviour is acceptable and how activities should function. (Tesluk et al., 1997); and (2) The basic values, assumptions and beliefs become enacted in established forms of behaviours and activity and are reflected as structures, policy, practices, management practices and procedures.

Martins et al (2003) articulate that companies are moving towards being knowledge-based organisations and their success and survival will depend on creativity, innovation, discovery and inventiveness. However they must respond to a rate of change that is accelerating rapidly as new knowledge, idea generation and global diffusion increases (Chan Kim, W; and Mauborgne, R; 1999; Senge et al., 1999). Creativity and innovation have a role to play in this change process for survival. Many organisations and leaders are trying to create institutional frameworks where creativity and innovation will be accepted as basic cultural norms in the midst of technological and other changes. Organisational culture appears to have an influence on the degree to which creativity and innovation are stimulated in an organisation (Martins et al. 2003).

Martins et al. (2003) highlight the problem of miss use of terminology in relation to creativity and innovation; they indicate that the concepts of creativity and innovation are often used interchangeably in the literature. They suggest that some definitions of creativity focus on the nature of thought processes and intellectual activity used to generate new insights or solutions to problems. Other definitions focus on the personal characteristics and intellectual abilities of individuals, and still others focus on the product with regard to the different qualities and outcomes of creative attempts (Arad et al., 1997; Udwadia, 1990). They suggest that evaluating creativity should therefore be considered at the level of a person, organisation, industry, and profession and wider (Ford, 1995). From an innovation perspective creativity is driven by insight that leads to generation of ideas that can be translated into concepts via some form of design process (Cox, 2005). De Mozota (2002) suggests that design is a key mechanism in helping, organisations to differentiate, integrate and transform innovation opportunities.

Value of Design

The value of design for product development has been increasingly recognised (Verganti, 2006). Product design is an essential aspect of product innovation (Perks, Cooper, & Jones, 2005; Roozenburg & Eekels, 1995). The effective use of design can contribute positively to business performance (Bruce et al., 1999; Chiva & Alegre, 2009).Berends et al (2008) state that design is often perceived to be costly, time-consuming, and unnecessary, because products are assumed to be sold mainly based on technical characteristics and small firm owners may have a narrow view on design, limited to styling only. However Perks et al. (2005) have identified three possible roles for design: (1) design as a functional specialism; (2) design integrated in a multifunctional team; and (3) design as product innovation process leader. In addition Dell’Era & Verganti, (2009), also suggest the use of design and designers to help transfer and integrate knowledge about different socio-cultural contexts to propose new aesthetical solutions or product meanings

Yet, good design practices seem to be marginalised in small firms (Moultrie et al., 2007). However Berends et al (2011) have found from their research that small manufacturing firms, often fail to recognise the benefits of good design practices and make limited use of external designers in their product design processes, or for narrowly defined aesthetical activities only (Utterback et al., 2006). Therefore, small firms do not grasp the full potential of their product design efforts (Lewis & Brown, 1999; Moultrie, Clarkson, & Probert, 2007).

The dynamics of design are driven by a divergent and convergent sequencing of activities (cf. Basadur, Pringle, Speranzini, & Bacot, 2000; Howard et al., 2008). Iterations between divergence and convergence are associated with the progression through subsequent core design activities (Basadur et al., 2000; Pugh, 1991). Van de Ven, Polley, Garud, and Venkataraman (1999: 185) suggest that innovation trajectories consist of repeating cycles of divergent and convergent phases, instead of following a linear process of idea generation (divergence) and subsequently the development of the most promising alternative (convergence). As divergence and convergence require different types of behaviour, people with different skills are ideally needed in different phases (Cross, 1994; Van de Ven et al., 1999). Dorst and Cross's (2001) model of co-evolution of problems and solutions in creative design manages the iterative nature between goal setting and idea development.

Changing Role of Design

The role of design in new product development has been evolving over the last three decades (Perks et al 2005). Traditionally, emphasis has been placed on design skills associated with the intuitive, visual, and sensual ways of working (Cross, Naughton, and Walker, 1991).

In the 1980s design was seen as a brand. Brands were frequently associated with design and the designer label. The origins of well-known current designs, such as Alessi or Gucci and Ralph Lauren, can be traced to this decade. New British design consultancies boomed.

The backlash to the "designer label" tag in the 1990s saw design perceived as an expensive superlative activity and was brought back into firms. Design was no longer perceived as a holistic process. It emerged as a discrete functional sub activity, to be integrated at specific stages of the product development process. Research efforts focused on defining and specifying the distinct activities and skills associated with design, conceptualized as one of many separated functions within the whole innovation process. Designers kept to their discipline and concentrated on their own set of specific tasks. Relevant information was passed on to other functions (Moenaert and Souder, 1990). However, the separation of design from other functions was indicated as one of the major factors contributing to the poor record of innovation in the United Kingdom (Bruce and Vazquez, 1999). Emphasis was placed on understanding success and failure issues (Bruce et al.,1996), many indicating the relationship between design and the marketing function was particularly critical. However, studies revealed that design frequently miss-interpreted information deriving from the marketing function (Bailetti and Litva, 1995). Marketing and design also each have their own technical language, which can exacerbate problematic communication processes (Calabrese, 1999; Jones and Cooper, 1994).

Harsh competition in the early 2000s led to increased emphasis on creativity and innovation as a crucial dimension in business strategies. In response, it is suggested that designers are undertaking a leadership role in the product development process (Von Stamm, 2003). In addition, understanding the customer has become a prerequisite for new product success. Yet the transfer of customer knowledge from marketer to designer still proves to be problematic. The lack of useful information is driving designers to generate their own information. It is suggested that designers should embrace traditional marketing tasks (Von Stamm, 2003) and should directly interface with the marketplace to effectively understand the customer (Leonard-Barton and Rayport, 1997).

4 Trends and Drivers of Success in NPD

NPD Knowledge and Understanding

Considerable knowledge and understanding has been built up about how to manage the new product development process once it is in place in a firm (Adler et al. 1996; Ettlie 1997; Hultink et al. 2000). For instance, it is known how to select product portfolios and to allocate resources to new product development projects (Cooper 2001), efficiently to plan for it through product innovation charters (Bart 2002; Crawford 1980), to speed it up (Kordon 2002; Swink 2002), to improve the tools for development (Cooper et al. 2002; Griffin 1997), and to manage collaborators (Sobrero and Roberts 2002; Teague 2002). Many of these insights, as Iansiti (1995) observes, are for 'traditional models of product development (that have) emerged from observations in relatively stable industries.'' In contrast, insights also are gleaned from unstable industries with studies highlighting how to manage new product development projects for radical innovation (Rice et al. 1998; Rice et al. 2001) and how the attributes of managing new product development for incremental innovation differ from those for radical innovation (Cardinal 2001).

The influence of product innovation on business performance has been one of the issues of most importance in recent literature, with the development of solutions to market threats and opportunities, creating the "basis for the survival and success of the firm well into the future" (Hult et al., 2004, p. 429).

Ettlie and Subramaniam (2004) highlight that there is a long tradition of research that highlights the differences in the types of innovation generated by organizations. The earliest observed, and probably the best known of these differences, are classified as incremental and radical. Incremental innovations are a result of refining prevailing knowledge, whereas radical innovations arise because prevailing knowledge gets transformed (Tushman and Andersen 1986). A third kind of innovation, described as architectural, results from the reconfiguration—rather than the refinement or transformation—of prevailing knowledge (Henderson and Clark 1990).

Discerning the underlying differences across these types of innovation is important for organizations, given their distinctive impacts on markets and competition. Christensen (1997) further underscores the significance of realizing such differences in the market impact of innovations when classifying them into different types.

Incremental innovations reinforce prevailing market structures and competitive positions as they strengthen existing barriers to entry, whereas radical innovations transform prevailing market structures by demolishing prevailing barriers to entry (Abernathy and Clark 1985). Architectural innovations, on the other hand, tend to rearrange competitive positions among the incumbents in an industry, as these innovations enable their initiators to gain significant inroads into the market shares of established competitors (McGahan 2000).

In contrast, a firm's market orientation influences its product innovation, since its market orientation effects it ability to keep in close contact with the market, enabling the acquisition of new ideas and increasing the motivation to respond to its demands (Lukas and Ferrell, 2000; Deshpande´ and Farley, 2004; Jimenez-Jimenez et al., 2008). Additionally, market orientation also has the potential to increase the probability that innovations are better suited to market circumstances, increasing the firm's confidence in innovating as a competitive tool (Atuahene-Gima, 1996; Gatignon and Xuereb, 1997). Empirical results obtained by Han et al. (1998) and Hult et al. (2004) found that market orientation influences innovativeness to a higher degree when environmental uncertainty and market turbulence are higher. Moreover, intelligence dissemination and interfunctional coordination can create an organizational environment that facilitates innovation (Damanpour, 1991).

It is recognized that incremental and radical innovations require very different management approaches, organizations find it difficult to straddle both these types of innovation (Ettlie and Subramaniam, 2004). Research thus has observed that organisations generally are good either at incremental or at radical innovations (Tushman and O'Reilly 1996). They provide a concise example of this citing, Xerox Corporation, a company that invented the computer mouse, did not capitalise on this discovery. Ettlie and Subramaniam (2004) suggest that Xerox found it difficult to bring this about because it was geared toward innovating incrementally.

Competitive advantage

The competitiveness of manufacturing firms is constantly under threat from producers based either in the Tiger economies or from Eastern Europe (Woodcock et al,2000). Three strategies have emerged out of these pressures. First, there is the cost cutting strategy, which includes reduction in product ranges (Atkins, 1999). The second is a variant of the first and is based around either relocating to a new lower cost area or involving “make v. buy” decisions about parts of the value chain (Yoon and Naadimithi, 1994; McIvoret al., 1997). The third strategy is to enhance the company's level of differentiation from competitors by boosting its innovation.

Efforts to sustain competitive advantage can be focused on the creation of new markets and new ways of competing (Matthyssens et al., 2006). Product differentiation is a classic marketing strategy to gain competitive advantage. In planning marketing offering, Among which, radical innovations present significant challenges to development teams (Seidel, 2007). Because it is often difficult, expensive, or even impossible for a manufacturer to add to its products’ important attributes where it is clearly superior to its rivals (Brown and Carpenter, 2000).

Market-oriented companies are better equipped to meet the generation of superior customer value and, as a consequence, to attain sustainable competitive advantage (Guenzi and Troilo, 2006). In planning its market offering, the marketer needs to address five product levels: (1) core benefit; (2) basic product; (3) expected product; (4) augmented product and (5) potential product.

Sun (2010) indicates that as a consequence, many companies have attempted to develop and design new products by adding a “trivial attributes” to differentiate them and to draw consumers’ attention as well as to influence their purchasing decisions. For example, Procter & Gamble differentiates its Folger, an instant coffee, by the “flaked coffee crystal” (COMMERCIAL INNOVATION). A trivial attribute is defined as an attribute offered by a brand that is distinct from its competitor, for which consumers my have a prior preference but which provides no significant performance benefit (Broniarczyk and Gershoff, 2003). Consumers prefer to choose on the basis of easily justified, cognitively available reasons – ideally, reasons based on an important attribute for which one brand is clearly superior. If no reason for choice on the basis of more important attributes can be constructed, consumers will rely on reasons based on a trivial attribute (Shafir et al., 1993). Past research indicates that, in many social and consumption contexts, individuals make inferences or guesses based on limited information (Broniarczyk and Alba, 1994).

Simonson et al. (1994) indicated that bundling a product with unneeded promotional offers can reduce brand choice. However, Carpenter et al. (1994) proposed a different theory. They believed that differentiating a brand by adding a trivial attribute can lead to greater valuation of the brand, and that consumers apparently value such a differentiating attribute even though it is, in a sense, irrelevant. Broniarczyk and Gershoff (2003) proposed that the ability of a brand manager to capitalize on the use of a trivial attribute strategy to create a competitive advantage is dependent on a brand's equity and the decision context.

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(1) Core benefit;
(2) Basic product;
(3) Expected product;
(4) Augmented product; and
(5) Potential product.

Factors Affecting Product Development Activities

Johne and Snelson (1990) found that businesses in the early 1990's rarely followed NPD activities in a strict sequence, suggested by Booz, Allen and Hamilton (1982). They attribute this to too many businesses at that time, having an undisciplined approach stemming from a lack experience. Mahejan and Wind (1992) research underpinned these views by identifying the key used steps used and least used. See table 13 for steps and recommendations. However, Johne and Snelson (1990), did identify new emerging practices that would become common practice, of pursuing certain NPD activities in parallel in order to achieve speeder completion.

Most used steps	Least used steps	Areas of Improvement
(1) Initial screening (2) Product Development (3) In - house product testing	(1) Market test/ trial sell (2) Detail market study for positioning (3) Pre-launch business analysis	1) more quantitative approaches; (2) Improved models for idea generation, concept screening and market analysis

Table 13 Adapted from Mahejan and Wind (1992)

Schmenner (1986) identified that concurrent approaches can be characterised by delegation of control over product development to multi-functional teams. It necessitates the need for shared information: market needs, technical feasibility, product costs and manufacturing capabilities. The concurrent approach requires teams to work closely with customers, watch competitors and to involve suppliers early in the product development process. The advantages of this approach are that it reduces cost (time) and increase quality, but conversely the disadvantages are that it reduces managerial control due to the time issue. It has emerged that the faster phased approach is more appropriate for low and high levels of 'product innovation'; and the concurrent approach is more appropriate for moderate levels of 'product innovation', according to research undertaken by Schmenner (1986). It has been in mature and apparently stable markets that product improvement has become a critical means of gaining competitive advantage. Product improvement has enabled some organisations to rejuvenate core business previously viewed as in decline. Rejuvenation through product improvement has been attributed to identifying the key attributes of current products and testing how far these dimensions might be stretched. Additionally the product life expectancy of a line can be extended by careful realignment of existing products within evolving market needs (Schmenner, 1986).

A key factor, which differentiates unsuccessful and high achiever businesses, has been established as 'preparation'. Successful companies have been proven to be more adapt at planning for product change. Johne and Snelson (1990) have determined this factor by establishing - 'the extent to which the product development is an explicit part of the strategic planning process'. They suggest that without explicit recognition of product development activities within the business planning mechanism, product change will either not be undertaken at all, or will be pushed into areas unrelated to core operations or strengths. In less successful businesses there is a wide spread reliance on rudimentary product planning procedures based only on the need to prepare annual budgets. Less successful companies usually have lower levels of skill, lack good co-ordination and have a lack of participation apart from top management involvement. Their management styles, according to Johne and Snelson (1990), are characterised by (1) being short termed based; and (2) predominately top - down in terms of planning.

Johne and Snelson (1990) established that engineering businesses are especially vulnerable to constantly undertaking developments on an unplanned basis. At the time of their research, engineering businesses, the divisional or business managers often lack the skills necessary to formulate appropriate development plans. Product planning has now been established as a major contributor to success particularly when structured through some form of regular product policy meeting. The purpose of the 'product policy meetings' is to review adjustments to existing plans and to agree to them, and to address resource conflicts head - on.

A common problem in new product planning is the reluctance on the part of senior management to involve a wide spread of personnel in what is, generally, a most sensitive area of commercial operations, Johne and Snelson (1990), and suggest that project planning is essential for successful product development and aids responsive decision making.

Generating Ideas

Idea generation is essential to achieving success. It requires companies to establishing an extensive enquiry network of contacts; develop a steady flow of new materials and information that is likely to stimulate new ideas; and introduce an objective process for the evaluation of options for product improvement or new product introduction (Handscombe, 1989). An additional factor often overlooked is creating an environment, which encourages the generation of ideas (Handscombe,1989). In less successful businesses there is a: (1) the lack of focus on encouraging ideas to emerge; (2) the lack of opportunity to explore and pursue ideas; and (3) 'top down suggestion syndrome' which forces lower management to taken on board ideas with varying degrees of enthusiasm. Johne and Snelson (1990) suggest that the main focus within idea generation is to determine the potential business opportunity rather than product features, placing emphasis on market opportunities not on overriding product features. They suggested that the need for products must come from the market - not solely from product champions. A key issue that emerged in relation to generating ideas is the need to quantify the likely market potential for an envisaged new product. The research undertaken by Johne and Snelson's (1990) into UK and US businesses highlight that many

technical respondents expressed disappointment, if not frustration, with their marketing counter parts who were widely accused of being reluctant to quantify market policies.
Innovation can be seen as ideas that have been developed and implemented (Van de Ven, 1986). Such a perspective means that all innovations originate from ideas and that, to successfully innovate, firms need to have a sustainable flow of ideas from which to choose (Boeddrich, 2004). Firms that successfully innovate have an ability to implement more and better ideas than their competitors and thereby to gain an advantage (Francis and Bessant, 2005).

To turn new knowledge in the form of an idea into an innovation, the idea in question also has to be made explicit so that the knowledge can be shared with other organizational members and realized through action. The knowledge needed to discover, invent, and innovate often involves not only existing knowledge but also the generation and acquisition of new knowledge, shared knowledge, and learning (Howells, 2002). To support and facilitate the ideation process, the knowledge about what influences the quality of the ideas created is therefore important.

Irrespective of where an idea emerges, it is clear that what is crucial for creating innovation is knowledge (Howells, 2002). Hence, the sources of innovation can be found anywhere good opportunities exist for accessing information and for creating new knowledge. From a managerial standpoint, the fact that innovation ideas like other types of knowledge (Tsoukas,
1996) are distributed not only in the formal organization but also throughout informal networks gives rise to a set of challenges.

Bjork and Magnusson (2009) suggest that in order to increase the number of high-quality innovation ideas created by individuals, the possibility of interacting with other people should be supported and facilitated. They suggest that key examples of this include creating and supporting communities, using idea generation techniques in projects and other groups, increasing formal collaboration between individuals from different departments, and improving sharing.

Screening Product Ideas

Johne and Snelson's (1990) determined that high achiever businesses are more likely to apply common criteria to assessing product development proposals than are less successful businesses. Two factors appear to be crucial in screening and evaluation: (1) the accuracy of the screening and (2) the speed at which it takes place. Success has been attributed to maintaining screening and evaluation as an on going activity throughout the development process. It has been established that in less successful businesses tend to screen only, formally, once in the early stages of the development - otherwise known as the 'snap shot' approach. Best practice has been attributed to monthly assessment reviews under the direct control of the chief executive with strategic reviews undertaken quarterly or twice yearly. The intended purpose of the monthly reviews is to allow the release of appropriate resources for particular projects. Johne and Snelson (1990), have established that the key factor appears to be related to the willingness of heads/chief executives to assume the responsibility for the ultimate success of product developments.

Product Introduction

In terms of establishing the factors affecting new product introduction, Moore (1987) established that most new products introduced are guided by 'strategic considerations', relating to a strategic plan. Specifically establishing that 85% of new products are based on a necessary extension of a product line; the result of an on-going stream of R&D projects that focused on an important performance parameter; part of a planned strategic change; or as a result of consumer research. Consequently the findings indicate that the other 15% is based on the need to utilise existing plant; being forced to respond to a new product idea generated by another part of the company; or responding to a competitors products.

Competitor Analysis

Johne and Snelson, 1990, have identified three important market related skills of product management; market analysis and segmentation; and competitor analysis. For many high achiever company's, analysing what competitors are doing is as important as investigating at first hand customer needs and preferences (Johne and Snelson, 1990). Company's that are most vulnerable typically have the following characteristics, according to Johne and Snelson, (1990): product based, outdate technologies, investment geared to low - cost production; and an emphasis on short term returns

Bebb (1992) suggests that 'total' product development process is influenced by the prediction of customer's future needs that involve customer input to team discussions.

Factors Affecting Success and Failure within the Product Development Process

Product development, which is an essential part of R&D, can be seen as an activity that is expected to improve a company's competitive advantage and future success in terms, for example, of profitability and market share. Success in product development can be considered a general aim for any R&D activity. Unfortunately, success is very multidimensional. Yet, as Hart (1993) puts it: "Clearly, the way in which NPD success is defined influences the findings which describe the factors contributing to NPD success." Griffin and Page recognize that success is elusive, multifaceted and difficult to measure. Still, companies and academics use over 75 measures of success in product development (Griffin and Page, 1996).Booz, Allen and Hamilton (1982) logically identified that success is achieved when a company adopts a conscious step-by-step approach to product development based on asking the right questions, Ronkainen (1985), identified three primary questions to be: (1) Is there a market for the idea? (2) Can the idea be transformed into a physical product? and (3) Can the physical product be manufactured and marketed profitability? Although many organisational failures are associated with paying too little attention to the need for detailed evaluation, Cooper and Kleinschmidt (1987) established three main factors that contribute to success. These relate to: (1) the financial performance that a product generates; (2) the opportunities that the product creates; (3) the impact that the product has on the market place. See table 14 for specific success factors.

Financial performance that a product generates	**Opportunities that the product creates**	**Market Impact Factors**
The level of profit and sales generated by a product; A products ability to meet profit and sales objectives; Profitability; The pay back period for the product investment	Product uniqueness: relating to a products ability to perform a unique task or solve a particular problem in a changing or dynamic market Fulfilling changing customer needs The use of new advanced technologies Multiple product introductions	Introducing a superior product A high quality product A product featuring unique customer benefits A product which solves customer problems A product that has made use of advanced technology

Table 14. Adapted from Cooper and Kleinschmidt (1987),Factors Associated with NPD Success

The performance measures identified by Cooper and Kleinschmidt (1987) focused on determining the factors associated with generating new opportunities. They established that the degree to which a product opened up new opportunities either via product category or new market areas; the quantifiable market impact a product has on domestic and foreign market share and profitability, which are also measures that impacted on performance.

Cooper and Kleinschmidt (1987) also recognised that market size and growth rates have little to do with the eventual market share achieved by a new product and suggested that 'product advantage' is the dominant factor in success.

From their influential research, it has emerged that products aimed at large market sectors were no more successful than those aimed at smaller markets. Follows are more factors appearing to have little or no effect on success:(1) low priced products relative to competitors, were deemed to be no more successful or unsuccessful than others; and (2) the use of 'low price' entry strategies for new products also appears not to be as successful as some experts have previously believed.

Hopkins (1981) had earlier identified that new product success was influenced by market research, technical issues; and timing. He found that insufficient or faulty market research information was the most frequent cause of new product failure. This was linked to a lack of thoroughness in identifying real needs in the market place was at the heart of market research problems. In addition he established that many companies were failing to spot early signs of competitor offensives. In relation to timing he identified two parameters relating to positioning and design changes, arguing that companies needed to be wary of any proposed new product that strays too far from the company's main areas of expertise - marketing and technical (positioning) and the need to avoid continual changes to the product specifications (cost and delays).

In relation to technical issues it emerged that technical problems in design or production were the second most common cause of failure from a number of sources, Cooper and Kleinschmidt (1987) and Roberts and Meyer (1991). Hopkins (1981) additionally identified that technical problems were generally associated with unsatisfactory product quality caused by poor manufacturing or bad design; a lack of understanding of introducing new material or components brought in from outside suppliers; a failure to keep up with technological improvements; and or over engineering

Roberts and Meyer (1991) identified three technological factors which influence growth: (1) that rapid growth is achieved through focused technological areas, yielding a distinctive core technology that may evolve over a period of time to produce a foundation for the company's product development; (2) that company growth and prosperity is dependent upon 'excellence' at something that the market values (expertise); and (3) that technology based companies must continue to innovate their products to survive. They also suggest that young companies which focus their product's on extension's to a single key core technology are far more successful than those who pursue technical diversity.

It appears that Hopkins insights where still not being adopted into NPD practices. Failure was still being attributed to 'Me - too' products, missed market opportunities, lack of technical expertise, excessive cycle costs (DTI (1991); Anthony and Mckay (1992))

Two recurring themes attributed to troubled NPD activities relate to a lack of adequate market research and understanding of positioning principles (Berry,1981). A prerequisite of understanding the issues that affect the product development process is an understanding of how success is measured. Arnold De Meyer and Bart Van Hooland (1990) have established that the traditional measures of product development performance relate to quality of design; the cost or the utilisation of resources to obtain the design; and the lead-time in which the design can be made ready for market introduction

It has been established, that in certain circumstances, that simple niche markets are vulnerable to competitors with a broader vision of market opportunities, and particularly to those who are prepared to exploit synergy's between national markets (Johne and Snelson, 1990). Japanese firms undertake such policies and are prepared to cross - subsidise natural business operations for the purpose of building up a strong presence in a particular product markets.

Johne and Snelson (1990) suggested that success has been attributed to the ability of an organisation to: (1) conceptualise market opportunities; and (2) supply these with product offerings. Firms have achieved success by: (1) carefully analysing emerging market opportunities both at home and abroad; and (2) developing appropriate offerings that are supported by 'umbrella brand names'.

There are two important but interrelated issues involved: (1) the interpretation of market trends for product development - identifying emerging market opportunities; and (2) the degree of global competition, (Johne and Snelson, 1990). The focus therefore must be on utilising customer feedback rather than being slavishly driven by the customer. That requires the assessment of two different market dynamics: (1) being able to discriminate between different types of customers. As customers who are innovators and market leaders in their own right are likely to be a critical source of ideas; and (2) evaluating emerging trends against individual customer suggestions (Johne and Snelson ,1990).

Furthermore, Leonard-Barton (1992) suggests that success is influenced by knowledge sets that consist of four different knowledge dimensions:

(1) Knowledge and skills embodied in employees.
(2) Employee knowledge and skills embedded in technical systems.
(3) The managerial system is the creation and control of knowledge.
(4) Values and norms, which are infused through the other three dimensions.

Meantime, from a more macro management aspect, Craig and Hart (1992) have identified six groups of similar success factors:

(1) Management;
(2) Process;
(3) Company;
(4) People;
(5) Strategy; and
(6) Information.

Emerging NPD Trends and Issues

Many of the issues and trends highlighted have been identified through research undertaken by previous Product Design Management Association’s (PDMA) NPD best practices studies

(1989 and 1997). The most recent, the third best practice study in 2003, provides an opportunity to identify current best practices and determine if existing insights are being acted upon. Barczak et al (2009) make a number of core recommendations, and identify series of emergent issues for NPD practice resulting from the Product Design Management Association's (PDMA) third best practices study (2003).

In the intervening period (eight years), Barczak et al (2009) have identified the following trends:

- Competition has become more globalised
- Formalised NPD processes are now the norm;
- Cycle times continue to drop dramatically, especially for radical innovation;
- Attention within the NPD processes was/has moved towards managing multiple projects across portfolios in a more orchestrated manner;
- Success rates and development efficiencies had remained stable at 59%;
- Only 6.6 ideas were now required to generate a new product success;
- Reduction in cost of computing power was enabling more trial-and-error prototyping, build-and-break-up steps to move to computer based analytical steps, improved 3D visualisation of products for pre-production feedback;
- Greater adoption and use of a wide variety of software support tools is taking place in various aspects of NPD processes.
- Multiple consumer needs gathering market research tools are used by most firms;

However they also found that firms had become slightly more conservative in the portfolio of projects, identifiable through the lower percentages of the total number of projects in the new-to-the world and new-to-the-firm categories (attributed to increased accounting regulations). In addition new products that are being commercialized, within the context of a more conservative approach to NPD, apparently impacted upon sales and profits negatively.

What remains unclear is whether there is a preferable approach for organizing the NPD endeavour, as no one organizational approach distinguished top NPD performers, but statistically they found that successful companies:

- Use some formal NPD processes.
- Adopt a specific NPD strategy.
- Measure NPD outcomes and expecting more out of NPD efforts.
- Use cross-functional development teams.
- Use multiple different types of qualitative market research, including voice of the customer, customer visit, and beta testing techniques.
- Use engineering design tools such as computer-aided design (CAD) and computer simulations.
- Close NPD projects with completion dinners

In terms of aspects of NPD management that differentiate the ‘‘best from the rest,’’ Barczak et al (2009) indicate that the best firms: emphasize and integrate their innovation strategy across all the levels of the firm; better support their people and team communications; conduct extensive experimentation; and use numerous kinds of new methods and techniques to support NPD. Similar to the 1995 results, the 2003 top three market research tools used by firms are (1) beta testing; (2) customer site visits; and (3) voice of the customer.

Barczak et al (2009) suggest that all companies appear to continue to struggle with the recording of ideas and making them readily available to others in the organization, even at the best performing level**.** They specifically (2009) identified three key NPD areas that still require improved management:

- Idea management;
- NPD project leadership and training;
- Cross-functional training and team communication support.

5 Summary of Factors Affecting New Product Development Practices

Multiple issues and themes have emerged (with potential new research significance)from the review in this section. These include the need for better understanding of "idea management" within organisations. The following themes are identified and summarised:

- Growing importance of front-end new product development activities
- Use of formalised processes within new product development
- Emergence of innovation facilitators

In addition to identify key emerging topics it has been possible to map the factors that contribute to success and failure in new product development activities.

Front-end Activities

Companies that excel in managing up front fuzzy front-end activities are more likely to win the innovation race. This factor has been highlighted by a numerous studies particularly in the early to mid nineteen nineties (Cooper, 1988, 1998; McGuinness and Conway, 1989; Dwyer and Mellor, 1991). Linked to front-end activities is the clear acknowledgement that understanding and determining customer needs is an important factor associated with success (More, 1986; von Hippel, 1986; Gruner and Homburg, 2000). Building the "voice of the customer" into a company's new product development process and its importance to new product development success has been extensively researched, defined and discussed over the last 25 years. It is therefore possible to assume that company awareness levels would be high and adoption levels would be similar.

Formalised NPD Processes

The adoption of structured NPD processes such as 'stage-gate' systems have been commonly adopted. Unfortunately it appears that designers have little formal understanding of the process and its related language. This is not to say that design and designers do not follow or have their own processes but there appears to be a critical miss-match that would potentially be a valid research area in its self. A consequence of the adoption of formalised NPD processes has seen the continued dramatic reduction of product development cycle times, particularly related to radical innovation. NPD processes have moved away from singular project management towards managing multiple projects across portfolios in a more orchestrated manner. However, the result of more formalised processes has impacted on performance negatively. It seems that firms have become slightly more conservative, this is represented in low percentages of the total number of projects in new-to-the-world and new-to-the-firm categories (Barczak et al., 2009). Another characteristic of the impact of formalised processes appears to be that the products developed by these approaches are returning lower sales and profits (Barczak et al., 2009). These findings are potentially confusing, as it is suggested that most companies use multiple market research tools! This then raises the question why, which a central theme of this study.

Innovation Facilitators

One of the interesting findings has been the impact that the reduction in the cost of computing power is enabling more trial-and-error prototyping and pre-production feedback via 3D computing tools. Combined with this is the observation that companies apparently are using multiple market research tools (beta testing; customer site visits; and voice of the customer methods) to aid their developments.

Success and Failure Factors

Success within the product development process has been attributed to product definition, superiority and uniqueness. On unpacking these factors, companies that develop products and services that fulfil changing customer needs (ideally latent needs referred to as hidden innovation), combined with the use of new advanced technologies, supported by multiple product introductions have been proved to be more successful. Factors attributed to product success relate to the clarification of the product in terms of the target market, customer needs, the product concept and a well-defined product specification. Measuring product development performance is a thorny subject. In successful companies it is measured relative to the quality of design; the cost or the utilisation of resources to obtain the design; and the lead-time in which the design can be made ready for market introduction.

Failures in new product development practices highlight the continued contradiction between good and bad practices. Insufficient or faulty market research and a lack of thoroughness in identifying real needs are associated with failure. This highlights the need for this study to understand in more detail why this is the case. Research into best practices over the last twenty-five years has continually identified success, as stated above, as being related to a sound understanding of the customer. Companies that fail to spot early signs of competitor offensives are another continuing area of concern. Other factors relate to unsatisfactory product quality caused by poor manufacturing or bad design; a lack of understanding of when and how to introduce new material or components; failure to keep up with technological improvements and over engineering (particularly in SMEs). Troubled new product development processes have been identified as suffering from symptoms such as continual design changes, missed market windows, excessive cycle costs and the reliance on 'Me - too' products.

On analysis of the literature, it appears that businesses do not follow product design and development activities in a strict sequence due to a lack of ability and or discipline (Craig et al, 1992) and do not focus on the needs of customer as a primary goal. A key objective of this study is to understand in more detail the reasons that decision-making is not being made closer to the customer.

Factors Affecting Design Practices

Introduction

This chapter engages with the complexity and diversity of design practices. In order to unpack and explore the complicated nature of design practices and the associated factors affecting it. The following trajectories have been explored:

- Design and Innovation Definitions and Confusions
- Value of Design
- Design and Development Process
- Design-driven Innovation Strategies
- New Relationships for Design

This section concludes by summarising the emergent themes within the explored trajectories.

1 Design and Innovation Definitions and Confusion

Design Definitions

Sebastian (2005) cites Dorst (1997) in order to suggest that there are two main paradigms of design: the one that sees design as a rational problem-solving process related to engineering sciences; and the other that describes design as an activity involving reflective practice related to the social sciences focusing on value and meaning (Verganti, 2010).

Ulrich (2011) indicates that academics have a compulsion to define, and the subject of design seems especially compelling to those who love taxonomies. He states that the word design comes to English via French from the Latin root signum and means literally to mark out (Oxford English Dictionary). He goes onto articulate that the term product design presents definitional challenges as it is used in practice in different ways, and even varies in usage regionally. He cites Silicon Valley product design as an example that as the reference where the nuts-and-bolts activity of turning elegant forms created by industrial designers into production-ready plans takes place. Ulrich (2011) defines product design (process) as conceiving and giving form to goods and services that address needs, adopting an information processing view of design in general, largely consistent with that articulated by Simon in the 1960s (Simon, 1996). He also cites two alternative perspectives (demonstrating the diversity of meaning) that of Edgar Kaufmann, Jr. (curator of the industrial design department at the Museum of Modern Art, 1946–1948) who defines design as the ‘‘conceiving and giving of form to objects used in everyday life’’, he then cites Krippendorff and Butter (1984) who defines design as the ‘‘conscious creation of forms to serve human needs’’. This defines product design as a transactional activity. See figure 11.

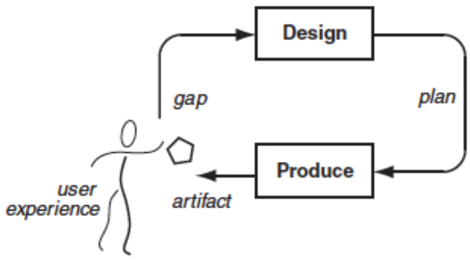

Figure 11: Design as a decision making process, Ulrich (2011)

Verganti (2008) adopts the definition and construct proposed by Krippendorff (1989) that the etymology of design goes back to the Latin de + signare, meaning making something, distinguishing it by a sign, giving it significance, designating its relation to other things. Based on this original meaning Verganti suggests that design is about making sense of things. Bruce Archer (1976) supports this perspective by advocating that product design acts as a predictive tool blessed with the ability of discovering which set of attributes prospective purchasers would value and the discovery of product configurations embodying them at the right price'. This definition also refers to the power of transforming intangible concepts into tangible product attributes – developing meaning and value.

Kotler and Rath (1984) define design from a strategic perspective, suggesting that design has a key role to play as a strategic tool within a corporate strategy. They define design as a process that can enable marketers to 'match, customer requirements to product performance, 'fitness for purpose', quality, durability, appearance and price. In essence their definition refers to product design as a linking mechanism within the 'total value chain'. A pragmatic and functional definition has been suggested by Caldecote (1979), that the product design process is based on the notion of converting an idea into information from which a new product can be made.

Additionally there are those who feel that the notion of product design cannot be considered without taking into account the influence of innovation. The OECD (1982), have defined product design in relation to (1) the creation of a concept (design) and (2) the process of creating a physical product (development). They suggest that design is 'the very core of innovation, the moment when a new object is managed, devised and shaped into prototype form; and that development relates to 'the activity in which prototypes are tested and modified until a satisfactory pre-production version of the product has evolved'.

Visser (2009) suggests that design is a type of cognitive activity rather than a professional status, stating that design is a problem solving activity where designer frequently have to develop context specific procedures in order to formulate a solution. He cites Simon (1969/1999) who states that 'design' are not restricted to engineers, who are not the only professional designers. 'Everyone designs who devises courses of action aimed at changing existing situations into preferred ones', he also states that design problems are often considered to be ill defined.

Swan and Luchs (2011) suggest that whilst there are clear similarities amongst various design definitions, they diverge along the three dimensions: process, outcome and artefact. They then such that these dimensions raise a number of questions: (1) is product design a process, the outcome of the process (i.e., the designed object or artefact), or both; (2) if product design refers to a process, how broad is the process (i.e., does it also include design-relevant activities that precede those that are often subsumed within the New Product Development (NPD) process); and (3) if product design refers to the designed object, does this include the form of the object, its function, and/or the integrative properties of the combined form and function.

As can be seen design (product) has a variety of different interpretations influenced by a number of different perspectives which view the product design process as either a: (1) strategic tool; (2) predictive tool or (3) a functional tool or (4) tool for creating meaning. What is common is the notion of design is basis for implementing change.

Creativity, Design and Innovation – Confusion

Howard et al (2008) suggest that without creativity (insight) in design there is no potential for innovation, they specifically state that this is where creative ideas are actually implemented (Mumford and Gustafson, 1988; Amabile, 1996) and transformed into commercial value (Thompson and Lordan, 1999). Their assertions imply that without creativity no idea can be produced or problem solved. It can be suggested that creativity helps to define and create the level of innovativeness that an idea or solution embodies as well as its meaning and value.

Chapman (2006), cited by Howard et al (2008), suggests that where activities focus on improving design processes to enable more creativity that these new process models are often termed 'innovation processes'. These statements highlight the often confused and miss use of the words 'innovative' (ground-breaking or state of the art) and 'innovation' (bring something novel to market). Far too frequently innovation is used as a substitute word for creativity, when the use of the word innovative would be more appropriate and less confusing.

Cox (2005) provides useful definitions of 'creativity' and 'design', which have been widely adopted. He defines 'creativity' as the generation of new ideas, which typically involves either new ways of looking at existing problems, or of seeing new opportunities, perhaps by exploiting emerging technologies or changes in markets. Essential to creativity is the notion of insight. An insight(s) is often the key driver that gives a project and or company a deeper understanding of an unmet need or desire that helps them focus on delivering something innovative and novel that is needed and ideally also has meaning and value to the end user or consumer. Design, the report suggests, may be described as creativity deployed to a specific end and defines 'design' as component that links creativity and innovation that shapes ideas to become practical and attractive propositions for users or customers.

The Cox Report (2005), based on its surveys by the leading business organisations and wide discussions with businesses identified a series of obstacles and barriers to effective use and application of creativity, design and innovation in business practices. A principle barrier was a simple lack of awareness and experience of application and use of creativity, design and innovation, which in turn creates a lack of belief in the value of, or confidence in, the outcome. Another understandably related barrier related to not knowing where to turn for specialised help. These three factors could be suggested as being expected, however businesses cannot condone limited ambition or appetite for risk and avoiding innovating due to the excuse of too many other pressures on the business to warrant investment.

Sustained success in business – regardless of sector – increasingly depends on the ability to innovate: to exploit new ideas and new opportunities ahead of the competition. According to PricewaterhouseCoopers' *Innovation Survey* (Cox, 2005), top innovators generate over 75 per cent of revenue from products not in existence five years ago. The ability to innovate, in turn, depends on the availability and exploitation of creative skills.

Cox (2005) findings supported the importance of creativity by indicating that the top UK innovating companies produce 75% of revenue from products or services that did not exist 5 years ago.

Principles of Good Design

There is little consensus on what constitutes the core "common" principles of good design (product/industrial design). There is much debate about the principles of design and it could be suggested that there are areas of agreement. In a personal letter Dieter Rams (1970), via VITSOE, he indicates: *"Design must become one of the driving forces for the change to a sustainable product culture. I am convinced that efforts directed towards good design are of cultural and social importance. I feel that progress can only be expected here if companies, designers and marketers take themselves seriously and accept the fact that they have a contribution to make to the economy, civilisation and consequently our culture. Our culture is our home. Especially the everyday culture expressed in the objects for which I, the designer, am responsible. It would help a lot if we could feel more at home in this ''everyday'' culture. Ultimately, good design should never be a marketing instrument but instead quite fundamentally concerned with how we can and want to live."* (Personal letter).

Rams personal letter identifies several common themes such as sustainability, socially responsible growth and improving everyday experiences in relation to design outcomes. However explaining what constitutes good design to a non-design person is still a dilemma compared to other professional activities.

The World Economic Forum's Global Agenda Council on Design (2010) has attempted to define the principles of design by putting forward the following set of principles that they believe outlines the nature design (see table 15).

Design Principles	Characteristics
Transparent	Complex problems require simple, clear and honest solutions.
Inspiring	Successful solutions will move people by satisfying their needs, giving meaning to their lives, and raising their hopes and expectations.
Transformational	Exceptional problems demand exceptional solutions that may be radical and even disruptive.
Participatory	Effective solutions will be collaborative, inclusive and developed with the people who will use them
Contextual	No solution should be developed or delivered in isolation but should instead recognise the social, physical and information systems it is part of
Sustainable	Every solution needs to be robust, responsible and designed with regard to its long-term impact on the environment and society

Table 15: Design Principles, The World Economic Forum's Global Agenda Council on Design (2010).

The World Economic Forum's Global Agenda Council on Design (2010) six characteristics relating to design principles provide a qualitative framework for debate and discussion but do not provide any useful guidelines that would help a non-designer to assess a good design in relation to a product or service. Once moving away from the engineering design there appears to be little consensus. It is therefore not surprising that there are no universal definition or guidelines on what constitutes good design from and industrial or product design perspective. Dieter Rams outlines his vision of what constitutes good design in table 16:

Good Design:	**Characteristics**
Innovative	Innovative design always develops in tandem with innovative technology and can never be an end in and of it. Innovative designs are unlikely to be exhausted since technological development is always offering new opportunities for innovative design. He also highlights that
Makes a product useful	Good design emphases the usefulness of a product whilst disregarding anything that could possibly detract from it. It has to satisfy certain criteria, not only functional, but also psychological and aesthetic.
Aesthetic	The aesthetic quality of a product is integral to its usefulness because products used every day have an effect on people and their well being.
Makes a product understandable	It clarifies the product's structure. Better still, it can make the product clearly express its function by making use of the user's intuition. At best, it is self-explanatory.
Unobtrusive	Products and their design should be both neutral and restrained, to leave room for the user's self-expression. Products fulfilling a purpose are like tools and are neither decorative objects nor works of art.
Honest	Design should not attempt to make a product seem more innovative, powerful or valuable than it really is. It should not attempt to manipulate the consumer with promises that cannot be kept
Long Lasting	It should avoid being fashionable and therefore never appears antiquated. Unlike fashionable design, it lasts many years – even when the trend may be in favour for disposable products.
Thorough down to the last detail	Nothing must be arbitrary or left to chance in the design of a product since care and accuracy in the design process show respect towards the consumer.
Environmentally friendly	Good design should make an important contribution to the preservation of the environment by conserving resources and minimizing physical and visual pollution throughout the lifecycle of the product.
As little design as possible	Good design should focus on the essential avoiding burdened with non-vital elements.

Table 16: Dieter Rams Ten Principles of what is Good Design

2 Value of Design

Visual Value

Users' requirements (design drivers) of designed products have frequently been compared to Maslow's (1987) hierarchy of needs. Thus, depending on motivation and context, a product's perceived attributes may be of greater importance than its tangible properties. Viemeister (2001) and Postrel (2003) separately suggest that visual appearance is important because consumers don't just buy a product, they buy value in the form of entertainment, experience and identity (Esslinger 1999). This supports Verganti's (2010) view that design adds meaning and value to products.

Referencing Bloch (1995), Crilly et al (2004) support the view that the visual appearance of a product is a critical determinant of consumer response and product success. Judgments' are often made on the elegance (Coates 2003), functionality (Mono 1997) and social significance (Dittmar 1992) of products based largely on visual information. Advocating that product appearance is a key component in defining product–person relationships and as such, can significantly affect commercial success (Apple products for example). It has been suggested that designing products that can present their value visually may provide the opportunity to command a higher product price and enjoy increased sales (Cagan et al 2002).

Communication of Visual Value

Shannon (1948) established a basic system of communication that comprises of five elements: (i) source, (ii) transmitter, (iii) channel, (iv) receiver and (v) destination. Within this system the information source (i) produces a message that is encoded into a signal and the transmitter (ii) sends it across a channel (iii). The receiver (iv) decodes the signal and the message arrives at the destination (v). Mono (1997) cited by Crilly et al (2004), has applied this basic model of communication to the study of product design, which explains how visual value is communicated and affects consumers' perception on product design. Within their model, the producer of the product is responsible for design and manufacture. The designer, or the design team, may be viewed as the "*source of the message*". The product itself may be regarded as the "*transmitter of the message*", and the environment in which the consumer interacts with the product may be regarded as "*the channel*". The consumer is involved in both the perception of products and subsequent response. Consequently, the consumer's perceptual senses may be regarded as the receiver of the design message and their faculty for response may be regarded as the destination.

Through aesthetic, semantic and symbolic interaction according to Crilly et al (2004), aesthetic impressions, semantic interpretations and symbolic associations are generated in the process of transmitting messages, see table 17.

Aesthetic–semantic interaction	**Semantic–symbolic interaction**	**Symbolic–aesthetic interaction**	**Relative importance**
The visual appeal of a design is influenced by the extent to which it makes sense to the viewer. The character perceived in a design affects consumers' understanding of that product and consequently influences both their aesthetic and semantic judgements.	Qualities such as the apparent power of a machine (semantic interpretation) may be transferred to its user, who may be perceived as being strong and capable themselves (symbolic association) Dittmar (1992).	Connections may be observed between the perceived aesthetic and symbolic qualities of objects. The aesthetic judgements that consumers make often reflect their taste. Thus, products hold a symbolic value in reflecting the social groups to which consumers belong.	The symbolic meaning associated with products often has the potential to dominate the aesthetic and semantic aspects of cognitive response. As such, branding and promotion activities often focus on investing mass manufactured products with meaning through the creation and communication of associated qualities.

Table 17 Product Design Communication Framework adapted from Crilly et al (2004)

Crilly et al (2004) also explain that when interpreting a product's visual appearance, consumers draw upon sources external to the perceived object as points of reference. These visual references help the consumer to understand the product by reflecting generic designs, alluding to other concepts or evoking comparison with living things.

As result, consumer response to design might be influenced by the visual references that are perceived, no matter whether they are what designers intended to communicate or not.

Specifically, Crilly et al (2004) suggest that visual references may influence the symbolic associations a product evokes by connecting it with other entities that are already seen to hold some social meaning. That can be related to stereotypes, similar products., metaphors, characters, conventions, see table 17, and also clichés, which is defined as the outcome of when too many products are seen to use the same visual references.

Stereotypes	Similar Products	Metaphors	Characters	Conventions
Mental images of generic exemplars of a product class. They present constant forms of a conventional character that suggests the familiar usage associated with the product category. For example, a stereotypical table may be thought of as having four legs and a flat surface (which affords object resting upon it). Stereotypes may typify many designs without necessarily being coincident with any of them.	Products may be explicitly compared to competing products. This informs purchase decisions because product form is often used to differentiate products within the marketplace (Baxter 1995). In particular, when consumers seek to replace existing purchases, prior knowledge may be used to make judgements on attractiveness. Beyond reference to recent designs, products may evoke recollections of historic or iconic designs (PHILIP STARK CHAIR).	McCoy (1984) cited by Crilly et al (2004) suggests that metaphors 'evocative connections between the (product) and memories from our experience'. They draw upon imagery from external sources may give the product a more descriptive appearance and assist the user in their process of interpretation, facilitating intuitive use.	Are designs that designs may often evoke comparison with living things as consumers empathise with objects and engage in a 'process of personification'. In order to indicate character, products may be proportioned or arranged so as to evoke associations with animate creatures.	Repeated use of analogies can result in the establishment of culturally accepted conventions

Table 18: Visual Conventions, adapted from adapted from Crilly et al (2004)

Semantic and Emotional Dimensions

Verganti (2008) indicates that the semantic dimension of design has also been recognized and underlined by several design scholars and theorists work (Heskett, 1990; Cooper and Press, 1995; Margolin and Buchanen, 1995; Petroski, 1996; Friedman, 2003; Karjalainen, 2003; Lloyd and Snelders, 2003; Bayazit, 2004; Norman, 2004; Redstrom, 2006). Research in marketing, consumer behaviour, and anthropology of consumption has also demonstrated that the affective/emotional and symbolic/sociocultural dimension of consumption are as important as the utilitarian perspective of classic economic models, even for industrial clients (Douglas and Isherwood, 1980; Csikszentmihalyi and Rochberg-Halton, 1981; Fournier, 1991; Newman, and Gross, 1991; Kleine, Kleine, and Kernan, 1993; Mano and Oliver, 1993; Brown, 1995; Du Gay, 1997; Holt, 1997; Bhat and Reddy, 1998; Schmitt, 1999; Pham et al., 2001; Oppenheimer, 2005; Sheth, Shu-pei, 2005).

3 Design and Development Process

The Process of Design and Development

Ulrich (2011) suggests, based on his co-authored article with Krishnan (Krishnan and Ulrich, 2001), that rather than view product development from the perspective of either a academic disciplines or of professions, we would benefit from focusing on what decisions must be made, and then consider what information, perspectives, and tools are most relevant to those decisions. Many of the decisions in product development are clearly not design decisions. Many of the decisions of product development are contextual and boundary spanning, forming the backdrop against which product design is performed. Other decisions are ancillary to product design, but central to the commercialization of a new product. Within a structure/semi-structured approach, product design often begins with a focal group of customers, defined as the market segment (Ulrich and Eppinger, 2011). Table 19 outlines Ulrich's (2011) analysis and articulation of the primary design decisions that must be made by intention or default in designing a product (Ducati Monster example) in order to establish a "specific design criteria". The nature and focus of the questions relate to generating a "performance driven design criteria", derived from user needs or from the objectives of the producer. Ulrich (2011) does acknowledge that many issues in relation to product design activities have not been made explicit here (aesthetics, meaning, cost, sustainability, and usability). Ulrich's (2010) framework does not encompass Verganti's (2010) emotional based design criteria's that he indicates lead to greater value and meaning of the designed outcome. This is an important difference, as you could suggest that the success of the Ducati Monster can be attributed to aesthetics and meaning (open frame aesthetic of the bike).

Decision	Example for Ducati Monster
What are the user needs?	"The motorcycle sounds powerful," etc.
What is the core product concept?	A *naked bike* as a raw counterpoint to the faired sport bikes in the market. Designer Miguel Galluzzi: "All you need is a saddle, tank, engine, two wheels, and handlebars."
What are the target values of the product attributes?	0–100 km/hr acceleration time < 4.0 seconds, etc.
What will be the overall physical form and appearance of the product?	. . . usually the form is initially represented with a sketch and eventually is represented by a three-dimensional computer model.
What is the product architecture?	Welded tubular frame; Ducati L-Twin engine/transmission hung from frame at four points; chain drive; rear swing-arm suspended from transmission casing; etc.
What variants of the product will be offered?	M900 initial model, to be followed by M400, M600, and M750 (differing primarily in engine displacement).
Which components will be shared across which variants of the product?	Most components except engine shared across all models. Different engines also share many components.
Which components will be designed and which will be selected?	Frame, seat, gas tank, fenders, wheels are unique designs; L-twin engine is an existing Ducati design; brake calipers, tires, etc. are catalog items from suppliers.
What are the values of the key design parameters?	904cc engine displacement; 1440mm wheelbase; 14 liter fuel capacity; etc.
What is the detailed design of the components, including material and process selection?	. . . usually the detailed design of components is represented with three-dimensional computer models plus annotations for materials, finishes, and other attributes.

Table 19: Ulrich (2011) – Ducatti Case Study

The design process has clearly defined stages (for example the Design Council for diamond model), with generic activities that take place at each stage, however whilst analysing the 'generic' nature of the product design process, it appears to have an 'evolutionary' nature influenced by a number of factors such as the nature of the planned developments, the magnitude of change required, the project and market situation, internal and external capabilities (resources, expertise and skills) and internal cultures.

Additional to the product design processes 'evolutionary' nature, there appears to be the presence of an 'organic' characteristic that builds upon past experience leading to the cyclic development of expertise and knowledge (often in relation to technology and market/customer requirements).

The product design process seems to coexists effectively within an organisation when there are predetermined long-term objectives supported by a structure that builds upon internal expertise and knowledge. Suggesting that a stop-start culture is not conducive to long-term success. This structure also needs to flexible enough to encourage the introduction of externally developed technologies and expertise, which is supported by research undertaken by Davis Cooper (1992) into diagnosing the sources of failure within the N.P.D. process.

The research of Bruce and Roy (1985) has previously suggested that the product design process needs to become an 'inherent structural component' within a manufacturing based organisation, aiming to help evolve and develop core areas of expertise and knowledge, As in many of today’s markets it is the ‘non- price’ factors associated with achieving success and directly related to design issues (Walsh et al, 1992). This viewpoint is also gradually emerged thorough reviewing current research findings.

It is becoming apparent that most companies follow some form of process in relation to performance based design development activities, however it is evident that not all processes follow the same structure or series of actions epitomised by an unstructured, semi-structured or structured approach. Moreover, the apparently ‘fluid’ nature and lacks of a definitive format compound problems of understanding the strategic importance of product design. In order to solve that problem, the 'design activity' concept must be fundamentally based on the notion of pursuing predetermined goals achieved by undertaking specific tasks. Although a major dilemma does occur due to fact that each individual company's strategic goals differ, as does their ability to perform the tasks and their level of expertise. Therefore understanding the design process and the communication of its function may be influenced by the organisations ability to: (1) identify and establish strategic goals in relation to internal and external capabilities; and (2) set tasks that can be achieved with resources available. This infers that the 'product design process' has a nebulous form, but built up of identifiable components - 'core building blocks' which can have specific emphases placed upon them. This notion may indicate why many industries understand the importance of design, but why many individual companies find it difficult to identify and analyse the process within there own organisation. Intrinsic to the understanding of the product design process is the notion of design emphasis. Walsh et al (1992) suggest that there is a strong relationship between design and technology as a guiding factor in determining design emphasis. They suggest that in relation to three specific points within the product lifecycle, (1) development /introduction; (2) maturity; and (3) rejuvenation, that different design emphases emerge. In summarising their notion, they suggest that as the technology matures, the emphasis on the product design process changes - from innovation through to variants. See table 22.

Relationship of Design and Product Lifecycle

Expanding on the notion of differing design emphases, Berkowitz (1987) has reviewed the affects of the product lifecycle on the design emphasis during different phases of the cycle. He has specifically looked at four phases within the product lifecycle concept and identified how design emphasis changes as follows in table 20:

Phases within the Product Lifecycle	Design Emphasis	Technological Influence on Design Emphasis
Product Introduction	Creativity and Change	Experimentation Search for technical innovation
Growth	Modification and Maintenance	
Maturity	Standardisation	Technical improvements Cost reduction policies Design for manufacture
Decline	Repositioning and Enhancement	Product Variants Search for new markets and applications

Table 20: Impact of PLC Phases on Design Emphasis and Technology Influence, Adapted from Berkowitz (1987)

The main findings are summarised in table 21. Emerging from this information is a number of issues: (1) how do companies establish their current positioning within the cycle? and (2) what are the key factors affecting the changing of phases within the cycle?

Phases within the Product Lifecycle	**Product Introduction**	**Growth**	**Maturity**	**Decline**
Design Focus:	Technical and functional design	Design for manufacture; Modification of basic product features; Removal of bugs and problems	Tailoring to specific customer lifestyle demands	Product enhancement features
Design Aims:	Creative leaps	Introduction of cost containment issues	Introduction of cost containment issues; Introduction of value analysis: standardisation and cost cutting emphasis	To capture late buyers and repeat customers
Design Emphasis	Dramatic changes in performance, reliability, compactness, portability, user costs, user friendliness	Maintaining product advantage and creating barriers to competition	Extending performance specification	Repositioning by re-design/design modification

Table 21: Design Emphasis During Different Phases of the Product Lifecycle, Adapted from Marvin Berkowitz (1987), Product shape as a design innovation strategy, Journal of Product Innovation Management 4, p. 274 - 283

The design process has been proven not to be sequential in nature, even though it has a number of clearly identifiable components such as - market analysis, product design specification, concept design, detail design and manufacturing management (Hollins and Pugh, 1990). Walsh et al (1992) support this notion through their research, that the product design and development process is an iterative-based process involving the repeated process of problem exploration, solution generation and selection.

Walsh et al (1992) indicate that the design and development process involves 3 key stages: (1) planning, (2) design and development and (3) manufacturing and sales. The functions of analysis and planning, design and development and manufacturing management are core components of the product design process and have identified a series of key tasks to be performed. See table 22.

Functions	Tasks
Analysis and Planning	Identifying potential products Analysis of potential demand Feasibility Assessment Briefing
Design and Development	Product design specification Concept development Detail Design Prototype development & testing Production engineering
Manufacturing Management	Production planning Tooling Test manufacture Full scale production Market launch

Table 22: Adapted from Walsh et al (1992): Core Functions and Tasks within the Product Design Process

Freeman (1983), cited by Walsh et al (1992), suggests that there are four clearly identifiable design emphases and associated activities: (1) experimental design: design prototypes/pilot plant planning leading to preparation of production drawings; (2) routine design engineering: adaptation of existing technology to specific applications; (3) fashion design: aesthetics and styling and (4) design management: planning and co-ordination.

Inherent to issues indicated in tables 21 and 22 is the '4 C's" notion suggested by Walsh et al (1992). The '4 C's' concepts relates to the core issues relating to the design activity:

- Creativity: Involving the creation of something that has not existed before;
- Complexity: Involving decisions on a large number of parameters and variables;
- Compromise: Balancing multiple and sometimes conflicting requirements;
- Choice: making choices between possible solutions from basic concepts through to detail design changes.

Conflicts between Design and Design Management

London (2002), cited by Sebastian (2005), suggests that the key differences between product design and design management functions, are based on fact that the design product function focuses on meeting all value and performance criteria, where design management function is responsible for defining the values to be met, translating them into a design brief, and guiding the designers in their understanding of the requirements. However, Koskela et al.

(1997), cited by Sebastian (2005), suggests that design management should not interfere with the designer's prerogatives regarding the quality of design products, but rather take a supporting role by making the design process effective, efficient, and lean through the coordination of tasks and information. Sebastian (2005) discusses the notion of uncertainty within the design by citing Buchanan's (2001) assertion that "design is a knowledge-intensive human activity, which works with and within uncertain situations, to deliberately initiate and devise a creative process for shaping a more desirable reality." He attempts to reinforce this view by citing Simon (1969) who indicates that the complexity in human behaviour is largely a reflection of the complexity of the environment in which he finds himself.

De Jong and Van Der Voordt (2002), research demonstrated that design cannot fully comply with the general criteria for scientific activity such as reliability, validity, and evaluative potential. To comply with validity and evaluative potential, the design must be able to be generalized in different situations or contexts. In fact, design thinking is less focused on causality for generalization reasons, but more on conditionality since designers are hired particularly for solving problems in a unique way.

Laurie Flynn (1991) indicates the importance of taking into account the changing expectation levels of the customer and that design is driven by compromise but must deliver differentiation.

When trying to summarise the role of product design, it is impossible to separate two types of cultural beliefs: (1) economic beliefs and (2) creative and cultural beliefs. Both cultures have different views but both utilise the same processes, although one has a dominant impact! Economically the role of design is to increase profitability and competitive advantage by linking together a series of functional and technical requirements in order to achieve a physical product that will differentiate itself within the market place. Creatively the role of design is based around the analysis of potential alternative solutions to a given problem, encouraging the participation of often conflicting groups of people within an organisation and the bringing together of a creative mixture of marketing and technical considerations that not only fulfils a need but creates value and meaning.

4 Design-driven Innovation Strategies

Innovation Definitions

Best (2008) unpacks the meaning of innovation by defining innovation as: (1) the “process” of identifying opportunities that can sustain brand/business leadership; (2) an “outcome” that delivers positive, discontinuous business results; and (3) a “concept” that causes competitors to think and interact differently with your business proposition. It could be suggested that Best’s (2008) definition is derived from Cox (2005). Cox defines ‘innovation’ as: (1) the successful exploitation of new ideas; (2) the process that carries ideas through to new products, new services; and (3) new ways of running a business and or doing business.

Best (2008) identifies three major types of innovation. The invention of new businesses or definition of the future state of business he defines as ‘core innovation’. Creating new product features and benefits as ‘product innovation’ and the framing and re-framing an opportunity through new positioning as ‘commercial innovation’.

Traditional Design Innovation Spaces

Walsh et al (1992) have established that the majority of 'product designs' are based on past inventions and innovations. They suggest that invention (discovery and origination of something novel) and innovation (delivering something novel to the market) are the primary vehicles for initiating the generation of alternative 'design configurations' and these subsequently lead to 'design modifications'. They suggest that the role of product design is much broader than that of invention and innovation, because invention and innovation are primarily involved in technical advance, which relies on developing specific core technological skills in a focused manner. Whereas design is inherently involved with making variations and needs to involve more cross functional activities in order to be successful, relating to the notion of design being an 'inherent structural component ' discussed previously. This may be one of the reasons why design has had great difficulty in establishing itself as a core discipline within many organisations. The primary use of product design, within a manufacturing context, appears to be to respond to the requirements of internal functions driven by internal and external needs. When not responding to other 'functions' requirements, how is the design function contributing to overall business aim of profitability? This question may be at the heart of the problem relating to the fact the design function and the designers are usually one of the first casualties when there is a fall in demand. One of designs key problems within many manufacturing organisations is that the design function and designers do not initiate strategic design decisions. Walsh et al (1992) suggests that the role of design within a manufacturing context is seen as creating new concepts or ideas, which involves the balancing of multiple considerations including: (1) functions; (2) Market requirements; (3) Manufacturing and (4) Reliability.

Walsh et al (1992) suggest that (when needed) design has an important role to play in each stage of creating a new or modifying an existing product. Although design is expected to play a different role at each stage. The effectiveness of the product design process is based around the notion of 'tacit knowledge', Walsh et al (1992), i.e. knowledge that we know but cannot explain as it is derived from experience. The nature of design and its inherent skills are perceived to be based around the ability to visualise something that does not already exist, and to manipulate and represent that idea through sketching and modelling, Walsh et al (1992). Although this notion is somewhat contradictory when stating that the majority of designs are based on past inventions and innovations. One of its present core functions (design - acting primarily in responsive mode) is that of visualising modified and improved concepts in relation to existing knowledge and new potential. This may be one of the key problems relating to designs lack of perceived value to an organisation.

Levitt (1984), indicates that design skills enable mental pictures to be constructed of 'what is not actually present and what has never been experienced' - prediction. Walsh et al (1992) suggest there is a relationship between the role and use of design and that of the market sector, which subsequently affects the selection of design strategies. They imply that the role and function of design changes dependent on the market segment. They cite two examples, within a consumer product context, relating to the two extremes of the spectrum: (1) that in low 'utility' market products (consumer)the design emphasis is based on styling and product image; and (2) that in 'up-market' products the design emphasis focuses on technical specification and performance. Terence Conran (1989) indicates that product styling, “projects an image of a desirable lifestyle and helps turn need into want”. The question(s) arising from this notion of market segmentation impacting on the role and use of design are: (1) would the ability to identify the correct market and technological positioning prior to commencing the design and development stage aid the development of more effective design strategies? and (2) would this concept be appropriate and useful to engineering related design? In relation to Conran's (1989) view, Flynn (1991) suggests 'image' associated with a product or a company is now replacing the concept of product features (advocating a corporate design language) and that design elements that help to distinguish one product from another are becoming more essential (the notion of differentiating features).

Changing Design-driven Innovation Spaces

Oldbach (2001) states that the validation criteria used to measure design success, needs to move away from factors such as type, colour and form (which often disintegrates into subjective discussion) to focus on experience-based factors that can be defined by objective criteria. Sebastian (2005) suggests that the actual complexity of a design project results from a combination of technical difficulty, social difficulty, and the uniqueness of design.

Brown and Katz (2011) suggest that over the course of their review of a century-long history of creative problem-solving, designers have acquired (evolved) a set of tools to help them move through ‘‘three spaces of innovation’’: (1) inspiration - the problem or opportunity that motivates the search for solutions; (2) ideation - the process of generating, developing, and testing ideas; and (3) implementation - the path that leads from the project room to the market. They indicate that these skills now need to be dispersed throughout organizations. In particular, design thinking needs to move ‘‘upstream,’’ closer to the executive suites where strategic decisions (making) are made. Brown (2008) draws on the interrelationship between inspiration and ideation when determining the characteristics of design thinkers:

- **Empathic** - people centred
- **Integrative thinker** - lateral and vertical thinking (left and right brain thinking – Pink (2006))
- **Optimist** -half class full mentality
- **Experimentalist** - looking for new directions
- **Collaborative** - can work in multidisciplinary context
- **Prototype** - generating and evolving ideas through feedback

Growing Importance of Design-intensive Activities

Firms are increasingly investing in design and involving design firms in their innovation processes (Nussbaum, 2004). Academic journals are publishing articles that explore the contribution of design to product development and business performance (Gemser and

Leenders, 2001; Hertenstein, Platt, and Veryzer, 2005; Platt, Hertenstein, and Brown, 2001). Brown and Katz (2011) advance the notion that the underlying reason for the growing interest in design is related to the shifting economic activity in the developed world from industrial manufacturing to knowledge creation and service delivery, in the context of that change innovation has become a central delivery strategy, and thus designs importance (need) is becoming more evident.

Ravasi and Lojacono (2005) state that, for producers of traditional or high-tech consumer durables seeking to differentiate themselves from their competitors, the role of the product designer is increasingly taking a key role. In tandem they also suggest that design and designers in both large and small companies have built or reinforced their positions through renewed attention to product design by observing how competitors in different industries have achieved this. Quoting Stefano Marzano, chief design manager at Philips, the Philips-Alessi line did not merely indicate a new style direction, but reflected an innovative approach to the exploration of consumers' latent needs and to the use of technology in consumer products, and triggered a change in the way the company's managers looked at design.

Ravasi and Lojacono (2005) suggest that scholars have documented the rising centrality of design and designers in both large and small companies, and observed how competitors in different industries have built or reinforced their positions through renewed attention to product design (Lorenz et al). The increasing relevance of design may be explained by the increasing role of culture and lifestyles in consumers' decisions. Through the review process, the product design process has essentially emerged as a response mechanism, responding to inventions and innovations in order to seek out alternative solutions/configurations and to modify and improve existing products. Walsh et al (1992) suggest that design plays an important role in product differentiation and reliability. Differentiation being the vehicle for alternative configurations and market appeal. Reliability representing the notion of modification and improvement to existing products. Although in some extreme cases product design is sometimes involved in front-end decisions, but arguably not enough.

Verganti (2008) highlights that design-intensive manufacturers such as Alessi, Artemide, and other leading Italian firms shows that their innovation process does not start from a close observation of user needs and functional requirements they follow a different strategy called design-driven innovation. This strategy aims at radically change the emotional and symbolic content of products (i.e., their meanings and languages) through a deep understanding of broader changes in society, culture, and technology. Rather than being pulled by user requirements, design-driven innovation is pushed by a firm's vision about possible new product meanings and languages that could diffuse in society. The aim is to create superior capability to propose innovations that radically redefine what a product means for a customer (reframing and recontextualising). An example is the well-known Alessi product line called ''family follows fiction.'' In 1991 Alessi created playful, colourful, and metaphoric kitchenware, with corkscrews shaped like dancing women or parrots and orange squeezers shaped like Chinese mandarins.

Culturally Driven Design Value

Designers play an important role in helping companies to access, interpret and exploit knowledge of emerging socio-cultural models and latent market needs (Verganti, 2010).

Dell'Era and Verganti (2010) suggest that the innovation of product signs and meanings requires a dispersed and tacit knowledge of socio-cultural trends and emerging societal phenomena. Specifically suggesting that culturally driven knowledge enriches collaborative efforts supported by creative resources. This ability is particularly important in industries that have well defined and mature archetypes such as the furniture industry (the chair) and household goods (a coffee cup).

Designers have the potential to act similarly to technology brokers in moving languages and meanings between subsectors (Dell'Era and Verganti, 2010). This is consistent with the emerging approaches to innovation such as the connect-and-develop paradigm or open innovation, were innovators in design-intensive industries collaborate with several external designers (Chesbrough, H. W., (2003); Huston, L., and N. Sakkab, N., 2006).

Why is culturally driven design becoming more important? Dell'Era and Verganti (2010) suggest that customers are paying increasing attention to product design, whether the aesthetic, symbolic or emotional meanings of products. They suggest that design and designers can support companies in exploring customers' needs and the appropriate signs (such as form, colours, materials, etc) that give meaning to products. Therefore design is increasingly being viewed as an important strategic asset, both in the business and academic arenas. (Gemser and Leenders, 2001).

Dell'Era and Verganti (2010) highlight that the role of the ''look and feel'' of people, places and things demonstrates that the aesthetic and the symbolic dimensions of a product are increasingly relevant in many industries (Postrel, 2003). They support this view by citing that several studies demonstrate the fact that consumers are increasingly make brand choices on the basis of the aesthetic and symbolic value of products and services (Bloch et al, 2003; Schmitt, B. and Simonson, A.,1997).

Design-driven Innovation Capabilities

Best (2008) indicates a series of 'core innovation capabilities' that can be incorporated into design-driven innovation practices:

- Robust process for accelerated idea generation
- Holistic rationale for idea provocation and idea assessment
- Multi-function opportunities for idea enrichment
- Trend assessment and activation skills
- Experimental prototyping methods and capabilities
- Mechanism for rapid research and idea validation
- Experience

Best (2008) suggests that for design to succeed in the future, the integration of brand, product and services innovation will be key to the disciplines success a concept reinforced by Esslinger (2009). He refers to this concept as 'convergent innovation'. Core to this integration he suggests is the role and use of scenario planning encompassing the following core activities:

- System framing
- Understanding stakeholders
- Determining trends and directional forces
- Assessing variability and uncertainty
- Looking for connections and synergies among component parts of the system
- Considering the extremes of possibilities

- Expressing scenarios in words, pictures, stories and experience prototypes
- Developing research and validation methods to understand progress versus scenarios
- Adjusting scenarios and planning accordingly

Product Innovation Strategies

Cordero (1991) suggests that there are four principal types of product innovation strategies: (1) an incremental strategy, (2) a break through strategy, (3) a pioneer’s strategy and (4) a follower’s strategy. Through his survey of techniques of product development strategies he established that the Japanese companies favoured an emphasis on incremental product innovation, versus the 'break through' product innovation approach. These strategies have now become well-established techniques.

Cordero (1991) indicates that there are three key phases within a incremental strategy relating to improving product performance: (1) Introduction phase is characterised by the appearance of small improvements; (2) Growth phase describes the stage where discoveries are made, larger improvements of the product typically follow; and (3) Maturity phase defines the period where the natural limits of the technology are reached only small improvements of the product are possible.

In relation to incremental strategies Cordero (1991) has established that they are cheaper to implement and enable companies to gain competitive advantage due to the fact that it is easier to market product innovations, this factor is typically attributed to the fact that the market has greater familiarity with the technology and the product. Internally he found that familiarity with marketing current product generation(s) is a contributing factor. Cordero (1991) does highlight potential barriers to success and recommends that when trying to implement incremental product improvement strategies that companies prohibit design changes unless absolutely necessary and aim to achieve constant product specifications within determined timescales. According to Cordero (1991) the principal reasons for adopting a break through strategy, are that the incremental product innovation process eventually slows down and become ineffective over a period of time and that they enable greater impact on introduction and achieve greater initial initiative. He indicates that pioneer strategies, are typically adopted by companies who want to introduce dominant designs. On the other hand follower strategies aim to achieve competitive advantage by focusing on developing new to the world innovations that have been introduced by other companies.

Freeman (1982), suggests that there are several identifiable design innovation strategies: (1) offensive; (2) defensive; (3) imitative; (4) dependent; (5) traditional and (6) opportunist. According to Freeman (1982) the goal of offensive strategies is to attack technical or market leadership by introducing new products ahead of competitors. Conversely he suggests that defensive strategies plan to build upon mistakes made by early innovators and the opening up of new market opportunities in order not to be left behind, this is similar to followers strategy outlined by Cordero (1991). Imitative Strategies try to take advantage of cost savings and established markets either by licensing or imitating proven technology. Freeman (1982) describes dependent strategies as those based on the use of customer or parent company technology, usually undertaken by satellite firms. Traditional strategies are based on cosmetic design changes not technology improvement, with opportunist strategies focussed on developing niche market opportunities rather than technological shifts.

Differentiation is a key attribute sought within product innovation. There are a number of factors to be considered in relation to the notion of product differentiation, Van Dierdonck (1990), established by analysing the manufacturing and design interface that market segmentation has a direct effect on the design function. Van Dierdonck (1990) suggests that there are three principal segments that affect design strategies: (1) customer oriented segments; (2) production oriented segments; and (3) fashion oriented segments. When reviewing the factors that Van Dierdonck (1990) attributes to influencing performance, there appears little difference between the customer and production orientated segments, and it appears that customers relate to supply chain actors not market related customers.

In reviewing the issues attributed to successful product design innovation strategies, the ability to establish: (1) the competitive nature of an industry/market; (2) the price sensitivity of the market; and (3) the appropriate level of 'added value' in relation to customer needs will affect the selection of appropriate design strategies.

In relation to the notion of competition, determining and providing a cost effective level of technical performance linked to an appropriate level of 'added value' features appears crucial to success. The concept of price sensitivity is felt to reflect the degree of movement and flexibility within a specific product/market sector.

Defining the relationship between technical performance/specifications v. quality design issues tensions emerge in relation to being able to define what constitutes good design. Technical performance and specification issues have emerged to be associated with price related factors and the notion of quality design issues were found to be associated with 'non price factors' linked to concept of 'value added' features.

Davis Cooper (1992) indicates several factors intrinsic to the product (added value components):

- Appearance/aesthetics - style, fashion, shape, pattern, texture
- Uniqueness
- Usability
- Quality
- Performance
- Cultural suitability
- Reputation/Brand Image

Within the listed factors there are both price and non-price factors, although there are a predominance of non-price factors. Walsh et al (1992) established that non-price factors relate specifically to the quality and design of the product. Product design quality can be attributed to several factors such as performance, reliability, appearance, safety, durability, ergonomics/ease of use and maintenance

The notion of visual appeal has previously emerged in terms of its ability to differentiate products within specific market segments, Berkowitz (1987) established that product design has become an effective competitive tool for a number of key companies such as Apple, Sony and Braun. Linked to this successful companies have used product appearance to achieve product differentiation against its competitors. He established that good design not only adds sales appeal but also encourages individuals to 'trade up' and provides the basis for market segmentation; and that product design strategies have been used to effectively build lines from pre-existing engineering investments.

Product appearance is frequently used to specifically target customer lifestyles and to capitalise on trends, i.e. nutrition and physical fitness (Berkowitz, 1987). In aggressively priced markets, design variants of size, colour, shape, packaging, features and accessories have become a basis for creating differential advantage. Product design strategies have also been used to capture valuable market segments by attracting customers through innovative design, i.e. Swatch watches. According to Berkowitz (1987), although there is much opportunity for design innovation in the product design process, much depends on the lifecycle of the product.

Cordero (1991) has established several factors will influence the effectiveness of a product design policies such as the use up-to-date technologies (internal and external sources). Cordero's policies are strongly influenced by design for manufacturing strategies that focuses on the use of standardised modules were possible (i.e. keyboards, power supplies etc.), part reduction policy (design for manufacture) and the utilisation-standardised parts were possible (internal components or external components or parts). In principle he is advocating that products be designed so that it can be fully integrated into the company's manufacturing strategy (standard product concept, flexible or cellular manufacturing) in order to encourage the reduction of parts and the improvement in quality. Perhaps surprisingly these well-founded concepts are still not fully adopted in SME activities.

Ughaanwa and Baker (1989) discuss price as an influencing strategy. They suggest that purchasers generally regard price as an indication of quality rather than an independent factor. Therefore this notion could lead to the assumption that choosing between alternative products could relate to the effects of non-price/added value factors on the perceived value of a product's price.

Walsh et al (1993) indicate through their research into the financial impact of design that neither design nor innovativeness is of absolute significance and neither of them is independent of price. They also stress that certain markets are more price sensitive than others. Additionally they state that the two key issues are quality and price. Achieving the right balance delivers value for money giving competitive advantage, achieving the wrong balance delivers poor value for money. See table 22 for summary of competitive factors and their influence of design strategies (Walsh et al, 1992).

Walsh et al (1992) have established several factors, which influence competition and have a direct influence on design strategies. These encompass the product sales price, product lifecycle costs, the Product design specification, delivery time and after sales service. In relation to these factors Walsh et al (1992) have identified three types of competitive factors: (1) direct price related issues; (2) intrinsic non price factors embodied in the product; and (3) associative non price factors relating to service issues. Please table 23.

Competitive Factors	Examples	Influence on Design Strategies
Price	Sales Price, Discount, Financial Arrangements for purchase, Trade-in allowances, Depreciation, Running Costs, Servicing Costs, Parts Costs	Sales price: Is the product designed for economic manufacture? Lifecycle costs: Is the product designed to take into account cost of use and maintenance?
Intrinsic Non Price	Quality, Appearance, Factors (embodied in Innovation, Technological product) Sophistication, Ease of use/ Maintenance, Reliability, Durability, Compatibility with other products, Ergonomics, Portability, Safety, Comfort	Product design specification: The design proposal affects product performance, uniqueness, appearance, finish, reliability, durability, safety etc
Associative Non Price	Advertising Delivery time, After sales service networks, Availability of spare parts, Technical back-up,	Company Image & Sales presentation, Packaging and display, Design user-friendly manuals Is the product designed for ease of development and to meet delivery schedules? Is the product designed for ease of service and repair

Table 23: summary of competitive factors and their influence of design strategies adapted from Walsh, Roy, Bruce, and Potter (1992).

In relation to the notion of value for money, Moody (1984) has established that purchasers of professional ophthalmic equipment decided mainly on the basis of design and quality factors such as appearance, ease of use, handling, finish and technical performance.

In terms of expanding the theory of non-price/ added value factors, Pavitt (ed.) (1980) has established that innovativeness or technical sophistication were the key 'non price' factors most strongly associated with competitive success in international markets.

In analysing these competitive influences on design strategies it is possible to link appropriate design strategies in order to build a competitive edge see table 24. This relationship between the competitive factors and design-based strategies has been derived from reviewing literature.

Competitive Factors	Design Strategies
Direct price related issues	Design for Manufacture Design for Assembly Cradle to Grave Analysis
Intrinsic non price factors embodied in the product	Specific Design Policy Product Design Specification
Associative non price factors relating to service issues	Product and Promotional Strategy

Table 24 : Author - Factors Influencing Competition

5 New Relationships for Design

Interrelationship between Design and Brand Development

Roscam Abbing et al (2008) suggest that as the nature of innovation shifts from the application of new technology to the delivery of meaning and value, brand and design (as well as partners) are becoming critical resources in the development of market-leading products and services. There is growing recognition of the strong interrelationship between design and brand development and that it delivers competitive advantage. Beverland (2005), citing Gemser and Leenders (2001) trumpets the benefits of the effective use of design strategies, "Being innovative with respect to design and design strategy can enhance competitiveness regardless of industry evolution".

Beverland (2005) suggests that there is strong synergy between design and marketing. Advocating that this synergy is manifested in an increasing number of firms relying on design innovation for a competitive edge (Berkowitz, 1987; Dickenson et al.,1995; Gemser and Leenders, 2001;Olson,Cooper, and Slater,1998; Ulrich and Eppinger,2004). He highlights that many firms also use design to help revitalise brands (Berenson and Mohr-Jackson,1994; Danzig, 2002; Leonhardt and Faust,2001) and suggests that such revitalisations have led to calls for greater integration between marketing and design (Cuffaro,Vogel and matt, 2002; Just and Salvador, 2003; Stompff, 2003; Ulrich and Eppinger, 2004).

However Beverland (2005) states that there is evidence to support the notion that the typical designer's subcultural values or frames of reference are inconsistent with marketing's profit-based, rational aims. He states that the common perception of designers is that their approach to their subject matter differs from the rational approach analysis and scientific rigor of the business disciplines (Heskett,2002; Leonard and Rayport, 1997). Citing Jones (2002), he indicates that there are three overarching values held by designers: humanistic, organisational and technical engineering. Heskett (2002) suggests that the rational analysis is often perceived to be too deterministic for most designers, because they prefer individuality of expression, vitality, and human elements in design. Molotch (2003), cited by Beverland (2005), argues that designers are suspicious of market research because “market research isolates a product from the context of its purchase or use and cannot predict how it might catch on with time and exposure. Designers think they are the ones who project forward in terms of market preferences, whereas market research documents preferences in the present.”

What appears to be clear is that design and brand development are influenced and guided by strategic and brand positioning. Beverland’s (2005) research indicates that designers have different values than those of marketers, but both designers and marketers agree that design must be integrated with other business functions or, at the very least, be guided by the brand’s position.

Lockwood et al (2001) suggest that the value of design can be further enhanced within a business by co-locating an organisations’ design functions with its brand management functions. They suggest that by adopting a co-location strategy, this helps in moving design up the hierarchy of importance in a company, and by grouping all design and design management related functions within one location, this often helps to elevate the importance of design function to the whole business.

Strategic versus Brand Positioning

There are multiple definitions of strategic (market) positioning. Porter (1979) and Evans et al. (1996) refer to the competitive market standing of a firm against its competitors; by means of which a firm seeks to find ways to deploy firm-specific resources and assets to build positional advantages in product-markets (Day and Wensley, 1988; Morgan et al., 2003). Brand (operational) positioning, on the other hand, focuses on (the process of creating and altering) perceptions of consumers about a firm’s products or brands (Crawford, 1985). It is suggested that strategic positioning sets the basic direction for the development of the brand positioning (Ellson (2004); DiMingo (1988); Hooley et al. (2007)). The key difference between brand position(in) and brand image is that the former uses an explicit frame of reference, usually the competition (Aaker and Shansby (1982), Balmer and Greyser (2006) Brown et al. (2006), Dowling (2001), Ellson, 2004). Dobni and Zinkhan (1990) suggest that conceptually, brand positioning is similar to the brand image construct, which helps define the concept of a brand held by the consumer. They suggest that this retention is largely a subjective and perceptual phenomenon that is formed through consumer interpretation, whether reasoned or emotional.

Fuchs et al (2010) suggest that it is possible to position a brand on an almost infinite number of characteristics and or values (e.g. a mobile phone can be positioned upon its size, shape, handiness, user-friendliness, stylishness, etc.). They stress that the positioning bases (characteristics and or values) underlie the positioning strategy of the brand. They provide through their research an overview of important identified positioning bases .

Brand Extension Strategies

Klink and Athaide (2009) suggest that a new product's brand name is an important determinant of its success in the marketplace citing Cooper (1994). They indicate that companies frequently choose either to create a new brand name for the product or to borrow an existing brand name from another category (i.e., Mars ice cream products are a brand extension). However they highlight that whilst it can be true that brand extensions do experience greater cost savings and market share, these benefits are relatively marginal and reflect primarily short-run gains (Smith and Park, 1992). Their findings indicate that despite these potential risks, a vast number of new product managers are using brand extensions in an attempt to improve the likelihood of new product success (Smith and Park, 1992)—for example, as many as 95% of all new consumer product introductions are some form of brand extension strategy (Ogiba, 1988; Somji, 2000).

Brand and Innovation Management Shifts

Roscam Abbing et al (2008) suggest that the concept of brand has moved from being thought of as merely an addition to the offering (logo on the product), to a greater acceptance as a medium representing culture, knowledge, and vision that inspires and strategically guides an organisations offering. This change they attribute to shifts in brand and innovation management and their interrelationships. Roscam Abbing et al (2008) have identified (in successful companies) that significant changes to brand (see table 25) and innovation management (table 26) have emerged in several key areas.

Table 1: Shifts in the way brands are managed.			
Aspect of branding	**Old branding paradigm**	**New branding paradigm**	**Implication**
Focus	Creating promises	Fulfilling promises	There is a strong new focus in brand management on touch-point design and offering innovation.
Ownership	Marketing	Entire organization	The "usability" of the brand for all stakeholders becomes increasingly important.
Place in process	At the end	At the beginning	The brand as foundation for business process has to be rooted in strong organizational and stakeholder insights.
Content	About the strengths of the organization	About the relationship the organization aspires to have with its stakeholders	The brand as relationship has to be based on insights within the organization *and* its stakeholders.

Table 25: Brand management shifts, Roscam Abbing et al (2008)

Table 2: Shifts in the way innovation is managed.			
Aspect of innovation	**Old branding paradigm**	**New branding paradigm**	**Implication**
Drivers	External	Internalized	Organizations have to develop a strong and authentic vision of who they are and what they can mean to their stakeholders.
Attitude	Reactive	Proactive	In creating opportunities, organizations need a strong and shared sense of direction.
Role of design	At the end	At the beginning	Design thinking, methods, and techniques become vital parts of an organization's innovation toolbox, in both research and development processes.
Focus	Pushing technology	Creating value	Value innovation can only be based on a deep understanding of the organization's culture and potential, as well as the needs and desires of the people using its products and services.

Table 26: Innovation Management shifts, Roscam Abbing et al (2008)

The change in emphasis and focus from technology performance benefits, to placing more emphasis on the meaning and value underpinning product and service experience has had a significant impact on both brand and innovation management attitudes and strategies. This is linked to a growing trend and desire from consumers for greater corporate genuineness and correctness in the brands they use. The use of "authenticity" as a strategy for developing and delivering new product and service experiences is becoming more important to businesses. This is being driven by the consumers push for greater transparency on ethical based issues. These changes have not been restricted to external facing strategies and activities only. Internally there appears to be a clear shift to developing more holistic ownership of brand values in companies and how these are framed in company's relationship aspirations with their customers. They also identified that more and more companies are starting to place greater emphasis on maximizing utilization of internal capabilities, underpinned with a more proactive culture for searching for and developing innovation opportunities (see table 27).

Brand Management Shifts	**Innovation Management Shifts**
1. **Brand focus**: shifting from creating compelling promises to fulfilling those promises in a meaningful and authentic way	1. **Innovation drivers** - shifting from external (new technologies, competitor behaviour, market metrics) to internal (unique insights, vision, competence, and ideas), underpinned by how an organisation handles external changes and influences as a springboard for innovation.
2. **Brand ownership**: shifting from marketing function to the entire organisation, involving internal and external stakeholders	2. **Proactive innovation** - shifting from reactive to proactive change culture that translates change into innovation opportunities
3. **Brand positioning in business**: shifting from being an end of process activity to a front-end engaging with innovation and creation of offerings	3. **Role of design in innovation process** - shifting from delivering purely appeal to delivering meaning and value (Verganti 2010) through cross-disciplinary interaction
4. **Brand content:** shifting from stressing organisational strengths to framing a vision of relationships that the organisation aspires to have with its stakeholders.	4. **Technology drove innovation** - shifting from reliance on pure technology functional benefits to delivering meaning and value.

Table 27: Brand and Innovation Management Shifts, adapted from Roscam Abbing et al (2008)

From a product development perspective, Roscam Abbing et al (2008) suggest the following brand-driven innovation touch point layers:

(1) Aesthetics - sensorial layer (how a product looks)
(2) Interaction - behavioural layer (how the product feels)
(3) Performance - functional layer (what a product does)
(4) Construction -physical layer (how the product is made)
(5) Meaning - mental layer (what the product means)

The proposed touch point layers appear to address some fundamental product design issues but appear not to integrate many of their useful insights identified in relation to emergent brand (see table 25) and innovation management practices (table 26).

Brand Positioning

Beverland et al (2009) suggest that firms that aim to develop new products and fail to take brand positioning into consideration may suffer negative consequences on their business performance. They identify two key areas where a lack of brand positioning can impact on performance. Firstly, they have identified that customer confusion regarding brand meaning can arise due to a lack of congruency or fit with expectations. Secondly, a brand's competitive points of differentiation may be lost and over time brand equity undermined if brand positioning does not take place effectively. Underpinning both of these parameters is brand equity. Brand equity has become an important intangible resource and thus represents a competency that innovators must manage and exploit (Cooper, 2006).

Beverland et al (2009) assert that brand positioning is a contingency factor that moderates the success of new product development efforts (citing. Citrin, Lee, and McCullough, 2007) and state that this directly addresses Christensen and Raynor's (2003) assertion that ''a surprising number of innovations fail not because of some fatal technological flaw or because the market isn't ready. They fail because responsibility to build these businesses is given to managers or organisations whose capabilities aren't up to the task.'' This links to Beverland et al (2009) two key themes of lack of positioning (confusion) and undifferentiated offers.

Beverland et al (2009) suggest that in terms of innovation effort versus brand positioning they identified two metrics: (1) the type of innovation (radical vs. incremental); and (2) the overall orientation of the firm to the market (market driven vs. driving markets). Table 28 provides an overview of the innovation types, market orientation and their associated characteristics.

Types of Innovation and Characteristics	Market Orientation and Characteristics
Market-Driven Incremental Innovations: Follower Brands focus on satisfying customer needs through incremental improvements to existing products Follower brands focus on matching competitors' offerings through incremental innovations to existing offers to ensure competitive parity. These brands subordinated the innovation effort to the marketing department.	**Craft-designer-driven Brands** Craft-designer-driven brands closely integrated the brand and innovation efforts, with designers often having final say over brand initiatives, or at the very least a strong input to the process. The central role of design or craftspeople in the brand process reinforced the brand's position, especially in cases where the brand was named after the designer.
Market-Driven Radical Innovations: Category Leader Brands. Market-driven brands that sought to undertake radical innovations were defined as category leader brands. In contrast to follower brands, the primary driver of innovations was customers rather than competitors. These firms sought to dominant their category by constantly launching new innovations that tapped into consumers' unmet needs (cf. McDermott and O'Connor, 2002). Category leader brands use customer-driven radical innovations to capture a dominant mass-market position. Customers are typically involved in multiple stages of the product development process, often responding to prototypes and final mock-ups to ensure mass-market acceptability. Such an approach follows the standard customer-led new product development process recommended by marketing researchers	**Product Leader Brands** Product leader brands placed radical innovation at the nucleus of the brand's identity. Marketing typically challenged research and development (R&D) and production to come up with new concepts and ideas that would take the company into new markets and reinforce the brand as a product leader.

Table 28: Innovation effort versus brand positioning Adapted from Beverland et al (2009)

Brand Alignment and Realignment

Beverland et al (2009) argue that increasingly brands are being recognized as valuable strategic assets within firms (especially successful ones) and that it is therefore becoming more important to give consideration to a brand's positioning and its associated meaning when developing new products. Central to their argument is the importance of brand alignment and realignment within business. They suggest that in order to ensure effective brand positioning that organisations' should routinely undertake brand audits in order to fully understand consumer perceptions of a brand and there beliefs regarding what a brand is (and is not) capable of doing in order to ensure alignment.

Beverland et al (2009) suggest that brand misalignment can be realigned by: (1) changing the underlying business philosophy, shifting from a market-driven to a market-driving approach or vice versa; (2) changing the type of innovations (i.e., radical vs. incremental) it brings to the marketplace (long term strategy); and (3) changing a brand's positioning in order to alter how consumers think and feel about a brand, represented through changes to the product and services to establish more compelling points of difference (Keller, 2003).

Communicating Brand Values through Product Features

Brand identities are strongly influenced by the emotional response of people who use the products (Stompff, 2003). It is also suggested that the relationships between people, their emotions and their products can be expressed through concerns, standards, attitudes, objects and agents.

To establish the bond between the brand a product designer needs to understand more fully company and brand positioning (Stompff, 2003), and also consumers' motivations and aspirations. Professor Schmitt reinforces this point by noting that, "consumers want to be stimulated, entertained, educated, and challenged", cited by Kathman (2002). Ravasi and Lojacono (2005) further suggest the strategic role of design, pointing out designs (product, service, communication) potential to drive strategic innovation on the basis of a design philosophy. Such a philosophy comprises a stylistic identity (based on value-based design features) and core design principles (a coherent set of beliefs and principles about the company's approach to design). Ravasi and Lojacono (2005) have a strong belief that a design philosophy has to co-evolve with the brand and market positioning in order, ''to help designers relate their work to broader issues of competition and (the) market''. Therefore the key link to communicate brand values and emotions may be through the design of key features on products (Stompff, 2003).

This notion is also supported by Karjalainen and Snelders (2009), who suggest that design is one of the media through which a company can communicate its core brand values. They suggest that in product design, the brand message is composed of a number of product features (hereafter called design features) that embody the core brand values. Kreuzbauer and Malter (2005) stress that the connection between the design features and brand value is based on more than repeated exposure. Building on the work of Barsalou (1999), Biedermann (1987), and Zaltman (1997), brand recognition is not purely an exercise of semantic classification based on a set of otherwise arbitrary design features. Instead, it is the relevance of the design features themselves in codetermining the meaning of the brand. Therefore products features can be regarded as language of an organisation when ''talking'' to other people (Oppenheimer, 2005).

Role of Product Design in Brand Recognition

Karjalainen and Snelders (2009) suggest that brand recognition is key in competitive markets. According to Schmitt and Simonson, (1997) and Stompff (2003) product design is a core mechanism for fostering and building strong visual identity for a brand and in creating brand value (Borja de Mozota, 2004) thus creating recognition in the market place. Recognition is a mode of attention defined by Krippendorff (2005) as ‘‘identifying something by its kind (name) and in view of the use to which it could be put.’’ He describes recognition as a process of identification and is linked to the work of Biederman and colleagues on visual recognition (Biederman, 1987; Biederman and Ju, 1988) that is connected to semantic memory (classification of the product) as well as procedural memory (understanding product usage).

Brand Equity and Growth

Kathman (2002) argued astutely that we were entering a new era in 2002, characterized as the “new marketplace.” This assertion was based on a growing awareness of the increase in niche brands, short-life-cycle brands and product diversity for consumers. This development was driven in some respects by the growth in the use of the internet. He cites The Economist, February 12, 2000, “the Internet’s promise is to gather in the same virtual place, at hardly any cost, lots of information and processing power, and vast numbers of potential buyers and sellers”. To emphasise the importance of brand equity Kathman (2002) cites Sir Hector Lang, chief executive officer of United Biscuits, PLC, who said, “Buildings age and become dilapidated, machines wear out, people die, but what live on are the brands”.

Kathman (2002) suggested in order to maximize these emerging growth opportunities there was a need to manage key tasks such as product innovation, undertake more compelling advertising, and manage public relations effectively in order to help define brand propositions and to create equity. However brand management was not a new phenomenon. The birth of brand management is attributed to Procter & Gamble Co., in a famous memo in 1931 that articulated the principles of brand management focusing on research, development and communication.

Product and Service Design - Convergent Innovation

Multiple authors and studies suggest that product and service innovation are vital to on going brand equity because it reinforces and in some cases broadens brand meaning

(Berenson and Mohr-Jackson, 1994; Beverland, 2005; Christensen and Raynor, 2003; Crawford and Di Benedetto, 2003; Keller, 2003). Product innovation has been responsible for revitalizing brands such as Apple, Dunlop Volley, Mini, and Gucci. For example, the iMac (and later the iPod) revitalized the Apple brand, increasing market share and boosting profits (Gemser and Leenders, 2001). However, according to Pinhanez (2009), design as a discipline currently has almost no participation in the services sector, more than half of the world economy. Moreli (2002) had previously suggested that the business relevance of product service systems (PSS) has been widely discussed in management and marketing disciplines, however, the methodological implications of product/service systems have rarely been discussed in relation to design. Suggesting that this lack of engagement appears at odds with the direct relevance that design play a critical role in the development of PSS (see Figure 12).

Pinhanez (2009) defines service design as customer-intensive production processes, where the "production process" is a process in which inputs are transformed into outputs by a "producer," using the basic four means of production: capital, labour, knowledge, and facilities. PSS represents the evolution of traditional generic and standardized services towards targeted and personalized ones (Albrecht et al., 1985). Morelli (2002), citing Rocchi and Mont (1997), refers to PSS , from a product management perspective, as the extension of the service component around the product for business activities that are traditionally product-oriented or the introduction of a new service component marketed as a product for business activities that are usually service-oriented. Pinhanez (2009) breaks service design down as the application of human-centric ideas and methods of design to services and defines "customers" as the persons or organizations who receive most of the value created by a production process. His conceptual frameworks and thinking are underpinned by the services theory by Sampson (2001).

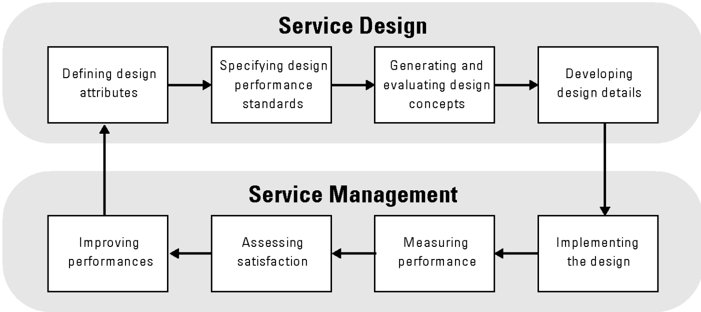

Figure 12: Service design model technological framework diagram, Morelli (2005)

Morelli (2005) indicates that PSS efficiency, visibility, and usability, are, in fact, heavily reliant on design aspects. Citing Goedkoop, et al. (1999), a PSS is a marketable set of products and services capable of jointly fulfilling a user's need. From a product management perspective, the notion of PSS refers to the extension of the service component around the product for business activities that are traditionally product-oriented or the introduction of a new service component marketed as a product for business activities that are usually service-oriented (Mont, 2000). Manzini (1993) suggests that PSS originates from the shift of marketing focus from products (whose characteristics are related to its material components) to a more complex combination of products and services supporting production and consumption.

Morelli (2002) suggests that different combinations of products and service can fulfil the same needs. However, the common point of those services, Manzini (1993) observes, is that they are conceived and offered as products, which are designed by taking into account a series of economic and technological criteria. While product manufacturers generally do not have contact with their customers, service providers usually *shape* the service together with users, who, in fact, participate in the production process.

The key differences between products and services to (1) *production and consumption times*: where products are produced and consumed at different times, while services come into existence at the same moment they are being provided and used; and (2) *material intensity*: where products are typically tangible objects, services are composed of intangible functionalities (Morelli, 2002).

Morelli (2002) citing Bijker (1995), indicates that design driven PSS should emphasize elements of convergence between several social and technological factors, including:

(1) The social, technological, and cultural frames of the actors participating in the development of the system
(2) The technological knowledge embedded in the artefacts used for the service

Bijker (1995) suggests a criteria for generating different profiles of the possible users of a service. The generation of such profiles requires the designer to undertake a thorough analysis of users' characteristics based on interviews, surveys, or even by generating hypothetical use cases (see table 29)

The set of criteria proposed by Bijker to describe a technological frame.

Criteria	Explanation
Goals	The main needs each group wants to satisfy in relation to specific aspects of their work activities.
Key problems	The main problems to be solved or overcome for each group in order to achieve their goals.
Problem solving strategies	The strategies each group believes to be admissible and effective in solving the main problems.
Requirements to be met by problem-solving strategies	The criteria for admissibility and effectiveness of problem solving strategies.
Current theories	The theoretical knowledge supporting the activity of each group in setting goals, identifying and selecting problems, and proposing admissible problem solving strategies.
Tacit knowledge	The practice based-knowledge, upon which each group relies to set goals, identify and select problems, and propose admissible problem-solving strategies.
Testing procedures	The procedures each group uses to evaluate the effectiveness of each problem-solving strategy.
Design methods and criteria	The methods and parameters used for proposing technological solutions to emerging needs.
Users' practice	The users attitudes towards the existing solutions to the present needs.
Perceived substitution function	The products, services, or sets of functionalities each group believes is to be replaced when proposing or using innovative solutions.
Exemplary artifacts	The products and services that are used as models in developing new solutions. These often are derived from the perceived substitution function.

Table:29: Service Design Criteria within a Technological Framework, Bijker (1995)

6 Summary of the Factors Affecting Design Practices

Multiple issues and themes have been discussed. Some offer potential for new research. A theme of particular relevance to the current study is the need to explain the barriers to understanding core business design principles in design practice.

Unpacking the themes discussed it has been possible to identify four distinct subject areas which have impacted upon and have or are influencing design and design practices, in relation to new product development and customer involvement:

- Definitions and Meanings of Design
- Shifting Emphasis and Nature of Design Practices
- Importance of Value and Meaning within Design
- New Relationships

Definitions and Meaning of Design

The act of defining and determining the meaning of design appears to occupy a significant amount of academic time and resources (Ulrich, 2011). Many authors have referred to the origins of the meaning of design as derived from the Latin de + signare, which means distinguishing something by a sign and giving it significance in relation to others.

Establishing a single common definition of design is not a simple task. The adaptive nature of design and its universalism causes a series of latent dilemmas. Design can be seen as a process (verb) and as an outcome (noun). In addition design also encompasses a wide spectrum from technical (engineering sciences) to visual based activities (social sciences) and outcomes. Disciplinary perspectives influence the perception and meaning of design. Engineering sciences see design as a rational problem-solving process, whereas the social sciences see design as an activity that involves reflective practices and creation of value and meaning. This could be described as being influenced by different 'designs emphases'. It is important to stress that neither technical nor visual based design activities are of more significance or importance than the other. In reality design frequently requires multiple design emphases within an activity or project.

Through the literature review process, it was possible to identify a number of common parameters across both technical and visual based 'design processes and activities', such as the convergent and divergent nature of the design processes itself (design thinking); the ability to identify clearly defined phases within the process (for example discovery, defining, developing through to delivery phases – The Design Council's Double Diamond Process Model); and the recognition of common core activities that routinely take place (for example, identifying user needs, alignment of ideas to business objectives).

From the literature review it emerged that the nature of the design context (setting), the complexity of the design issues (problems and questions), the level and nature of design expertise required (knowledge and understanding) and the frequency of design activities (continual versus project by project culture) can impact on the type (form and character) of design to be used and subsequently this influences the definition and meaning of 'design' by designers, managers and organisations.

Defining design and its meaning could be a research topic in its own right. It is therefore understandable that friction can occur between designers (ranging from designers from different disciplines to designers from within the same discipline) when they attempt to define design and its meaning. The reflective nature of the social sciences approach (Schon, 1984) is often typified by the introduction of 'individualised creativity' by the designer and or organisation that 'personalises' and 'tailors' their definition and meaning of design.

In order to avoid polarised thinking, it has been found to be helpful by the author when discussing 'design' with different types of designers and mixed audiences (technical and non-technical backgrounds) to talk about design as a 'spectrum' with a 'range' of design emphases (Bolton, 2012) from technical to visual based focus (visualised by an axis). This enables designers, managers and organisations to 'locate' where they perceive themselves to be positioned on a spectrum in terms of their 'design emphasis' and allowing them to contextualise their meaning and definition of design without friction. It also helps designers and organisations to recognise the need and contribution of other 'design emphases' in their own projects or within the work of other designers and companies.

The definition and meaning of design employed in this study is influenced by the Cox (2005) and Verganti (2010) interpretations: 'D*esign' is* what links creativity and innovation. It shapes ideas to become practical, attractive propositions that add value and meaning to the user or customer experience.

However another key area of confusion and miss-use relates to the use of the terms innovative and innovation. It appears that far to often people and organisations use the term innovation very loosely, either as a substitute word to describe creativity or innovative outcomes. Innovation appears to have become a generic catch all term as “designer labels” for example did in the 1990’s for design.

Another key observation was the apparent absence of agreed principles on ‘what is design’ and what constitutes ‘good design’. There are general areas of agreement on the characteristics of design such, as it needs to be sustainable, participatory and focussed on socially responsible growth. This insight must however been seen in the context that this particular issue was not the primary focus of this study, although this area of defining the core principles of design and what constitutes good design is a potential new research area.

Shifting Emphasis and Nature of Design Practices

The concept of ‘development’ has emerged where design is now seen as being embedded within the product development process rather than design development process (Perks et al., 2005). This emerged in the early 2000’s where organisations needed (via cost driven) and wanted (via the desire for formalised NPD processes) to embed design into their innovation processes at a more strategic level. The increasing competitive nature of the markets, the need to address increasingly challenging and sticky problems, and the need for the design industry to remain relevant to industry has seen the emergence of the concept of ‘design thinking’ (Brown, 2010) as a strategic tool. We have also seen many top business schools embrace the concept of design thinking (Rotman School of Management, University of Toronto, Canada).

However design and business at an educational level need to connect more in order to address two other tensions that appears to be impacting on design practices. What emerged from the literature review and discussion with designers during the pilot study activities is a lack of understanding of certain core principles that drive the use of design in business. The two specific areas relate to the ‘product lifecycle concept’ and the ‘stage-gate process’. There is a strong link between the stages of the product lifecycle and the need for design to deliver different types of design outcomes with different strategic foci. Understanding these different stages and the different design emphases required is crucial within all NPD activities, what is apparent is that designers have little formal training on this subject and rely on professional experience in order to fill the vacuum. The second core principle is probably more crucial to design on tactical level. Research has shown above (indicated in the Factors Affecting NPD) that most companies have adopted some form of formalised NPD process. Fundamental to these formalised processes is the adoption and use of some form of stage-gate process. The stage-gate process effectively creates a series of decision gates that a project goes through in relation to stages and phases of the product development process. Typically a project will go through multiple review points that look to assess for example the market and technical feasibility, fit with business objectives and consumer demand. At any one of the review points a project can be put on hold, cancelled or agreed to go forward to the next stage. This core principle is fundamental to design practice yet few designers have any formal understanding of the concepts or how to utilise it to enhance the role and use of design in organisations.

On a tactical level, design has shifted from a fit for purpose activity, to focusing increasingly on experience development and the translation of intangible qualities, meaning and value into product and brand identity. This shift has been influenced by the general trend or transition from an emphasis purely on technological performance as an innovation strategy, to the delivery of value and meaning to consumers. This shift has created the growing recognition of the strong alignment between design and brand development. Many companies (especially design-intensive ones) now see the use of design as being the key delivery mechanism for competitive advantage. This delivery relates to the importance of designs capability to generate ‘differentiated’ outcomes.

In addition there has been a shift in where organisations perceive the best use of design within their NPD processes. Numerous research articles suggest that design operates more effectively at a strategic and tactical level when involved in front-end activities (positioning) (Lockwood, 2009). This study aims to understand if this is true in UK SMEs.

A significant observation has been the perceived shift in design practices from a multi-disciplinary activity to being a more ‘participatory’ process involving more inclusive design practices, with outcomes developed directly with the people who will use the outcomes (co-creation). It will be interesting to see within study how wide spread is the adoption of these best practices in the UK.

Buchanan (2001) highlights the importance of design's ability to deal with uncertainty. One of the observations noticed within the research is that the effective use of design is frequently dominated by the need for 'Design Champions' within organisational contexts (Walsh et al., 1985). Champions are needed because, in many situations design deals with creating 'new possibilities' that are by their very nature uncertain. Therefore without a strong vision and commitment from the top design can be and is often seen as a risk. Buchanan (2001) suggests, correctly in the view of the author, that design is equipped to deal with uncertain situations and has the capabilities to shape insights into opportunities (i.e., intangibles into tangibles). Companies such and Procter and Gamble and Apple have demonstrated this strong vision and commitment and have profited from this approach. Uncertainty is a key interest of this study and it aims to understand better where companies experience uncertainty within concept development stage of the NPD process.

The literature review also highlighted a series of core tensions that are impacting on the role and use of design. Tensions exist within the product design development process caused by conflicting belief systems of managers and designers. Managers are driven by an economic ecosystem where as designers are driven by cultural and creative beliefs.

Importance of Value and Meaning

Design operates within a project driven culture and appears unfortunately in far too many instances to have a stop start nature. In design intensive companies design is seen as an integral activity to new product development, manufacturing and marketing and is used as a key differentiator within their innovation processes (design-driven – Verganti, 2010) and design outcomes (experience – Marzano, 2005). Design intensive companies build and evolve an extra dimension to their activities and more importantly to their thinking. They develop and utilise a deeper understanding of culture (trends) and its interrelationship to society (behaviour) and technology (capabilities) in order to create value and meaning (new scenario opportunities). The development of unique visual languages is a common differentiating attribute, combined with the application of new technology to create new user experiences and or the re-application of existing technologies (often material and processes) in new and innovative ways. Visual languages can encompass a spectrum from retroclassics (BMW Mini for example) through to new exciting languages utilising new technologies to an industry (For example Constantine Giriitch's Chair One design for Magis in Italy). A significant shift in relation to design language has been the re-emergence of the importance of materials and manufacturing processes in the development and realisation of design languages that create value and meaning (Thompson, 2007).

The creation of differentiated value and meaning in design-intensive companies, when successful, creates strong brand equity often linked to a differentiated pallet of visual and material languages, but always connected to the delivery of some form of needed or desirable new experience (iPAD for example).

New Relationships

Traditionally design has had strong relationships with manufacturing and the marketing functions in many organisations. A significant amount of research was undertaken in the 1980's relating to these two areas. The literature review identified two new areas where strong relationships with design are emerging. These new relationships are emerging due to the increasing importance of the need to develop meaning and value through product features and brand identity (Lockwood et al., 2010), the convergence of product and service experiences (Manzini,1993), and the growth in product service system activities (Marzano, 2005). Design and Brand Development are now seen as having an impoprtant new relationship where both activities are complementary to each other. Service design is now seen as a growing sector where design thinking and processes are valuable assets in unlocking unmet needs and delivering innovative customer experiences (both of these areas would warrant research projects in their own right , but are beyond the scope of this study).

Literature Review Conclusions

The main aim of the literature review was to generate an in depth understanding of the factors that impact on identification and fulfillment of customer needs in front-end product activities. In summarising the literature review, several key points have emerged and these have influenced the focus of the study.

Three contributing factors have been identified that impact on the deployment of user centred activities at a strategic and tactical levels. First, determining the level of depth of user involvement within a product development project (design for (in-direct), design with (direct) and design by (participatory). Second, establishing the level of structure and formality within the processes and activities (unstructured/informal to formal/structured). Third, the type and quality of the insights and information required (information sought).

Success within the product development process has been attributed to product definition, superiority and uniqueness. Companies that develop products and services that fulfil changing customer needs and ideally latent needs have been proved to be more successful. It has been established that successful companies reaching out to their customers and users directly in order to tap into what matters most to the people who will purchase and use their products and services.

In relation to design practices, a significant observation has been the perceived shift in focus, from being a multi-disciplinary focused activity to being a more 'participatory' process involving more inclusive design practices, with outcomes developed directly with the people (users) who will use the outcomes (co-creation).

The knowledge gained from the literature review sparked the simple question, "why, with so much support and clear evidence of the benefits of customer and user involvement in identifying and fulfilling needs has it not become universally embedded within product design and development practices?"

Research Questions

Critically analysing the emergent themes from the literature domains (user involvement, new product development practices and design practices), enabled the identification of a series of research questions. This process was central in helping to focus attention onto the central questions (for sub-issues see page 7-9):

(R1) *What is the Nature and Frequency of Customer Involvement in SME CDS Practices?*

(R2) *What Processes and Methods do SMEs Typically Use to Collect CDS Information from Stakeholders?*

(R3) *What Issues do SMEs Address with Stakeholders in order to Identify Their Needs in the CDS Process?*

(R4) *What are the Key Areas of Uncertainty that SMEs Experience within the CDS?*

Operationalisation Of The Study – Methodology, Tools And Approaches

1. Introduction

The aims of this chapter are to set out and explain the underlying thinking behind the operationalisation of the study. It will provide a structured overview of why and how the study has been implemented and will then explain the rationale for how the research tools, fundamental to the study, where selected and developed. Central to the outcome of the study is the approach to data analysis. This will also be outlined in the chapter. The section will conclude by reflecting on the study as a whole and by highlighting potential limitations.

The chapter is structured around six themes:

- Orientation to the Study
- Development of Research Tools
- Implementation of the Study
- Data Analysis
- Discussion and Conclusions
- Limitations

2. Orientation to the Study

The following information outlines the philosophical precepts and rationale that have helped orientate the study.

The underlying reasons behind undertaking the study where born from professional frustration and academic anxiety. The frustration stemmed in professional practice from observing a lack of adoption and use of even the simplest forms of user centred approaches in UK SMEs front-end activities. Academically the anxiety flowed from an apparent inability of the academic community to create a compelling argument to convince companies to utilise user centred approaches within their business processes, despite decades of evidence on the benefits of user centred design on product and business success.

Furthermore, the anxiety stems from the knowledge that customer and user involvement has been acknowledged both academically and in practice as helping companies address ‘fuzzy front-end' activities. Numerous studies have established a direct link between understanding the needs of the consumer and successful product innovation practices (Eisenberg, 2011). Over the last twenty years building the voice of the customer into the new product development processes has been identified as one of the crucial factors in getting new products to market more quickly and effectively (Cooper and Kleinschmidt, 1994). Direct contact with customers and end users, whether participatory or co-creation in nature, has clearly been identified as one of the best sources of information about new product ideas, whilst experiencing the use environment of a particular product, function or task has now become a prerequisite for generating high quality information in product design and development processes (Yeaple 1992, Herstatt & Von Hippell 1992, Ulrich and Eppinger 1995, Von Hippell 2005). Awareness of this knowledge sparked the simple question that ignited the study, "why, with so much support and clear evidence of the benefits of customer and user involvement in identifying and fulfilling needs has it not become universally embedded within product development practices?"

Guided by and based upon, the described exasperations and concerns the study was designed to try to shed light on what UK small and medium sized manufacturing companies (SMEs) actually do (understanding why and how they engage and utilise users within their front-end product development activities) and illuminating the barriers to adoption (identifying why and what stops them doing it).

Preliminary reading prior to commencing the study reinforced the professional and academic irritations, by highlighting the importance of building the voice of the customer into front-end product development activities but far too often failing to provide any detailed insight into what companies actually do (or more importantly what they don't do).

Grounded by the above principles, a detailed exploratory project framework (see page 5) was developed, to better understand the actual front-end practices that the SME sample typically carry out, to help them determine (i) user needs and (ii) new market opportunities. Based upon an extensive literature review, four factors were identified as critical to understanding the actual front-end practices of the SME sample: (i) level of customer involvement within CDS activities, (ii) activities undertaken with users within the CDS, (iii) nature of issues addressed with users and (iv) the key areas of uncertainty that SMEs experience when trying to identify user needs and new market opportunities. These four factors form the principle question areas of the study.

The framework adapts and adopts Ulrich and Eppinger's (1995) six core activities (1: identifying/ collecting user needs, 2: establishing target markets, 3: evaluating competing products, 4: generating product design specifications, 5: generating/selecting product design concepts, 6: prototyping and testing new product ideas) of their concept development stage (CDS) as the setting for the phases of the framework (see page 4).

The study was specifically orientated to undertake a multi-perspective (importance, frequency, uncertainty, success and failure) examination of the two clearly defined problems – (1) understanding what UK SMEs actually do and (2) determining what stops UK SMEs from doing it. It was also designed to combine qualitative and quantitative data. This positioning established a strong quantitative evidential base for the study, providing a systematic solid static image of the defined problem area ('what' issues and frequency). This was complemented by rich contextual data and explanations via qualitative materials ('why and how' issues –) that enabled the unpacking of the narrative explanations. Planning for the study was structured around a systematic, logical and coherent, step-wise process.

3. Development of Research Tools

An extensive multi-trajectory literature review combined with practitioner knowledge of the industry provided the basis for development of a qualitative 'scoping interview' guide. The main study was driven by the development of the survey document underpinned by literature review, existing knowledge and responses to scoping interviews. The purpose of the survey document is to address the identified gaps in knowledge, highlighted in the literature. The survey document constitutes the introduction of a major research tool designed specifically for the study.

Extracting Theories From The Review of Literature

At the heart of the study was the multi-theme literature review. Following Robson's (2011) model of investigation, it focussed on exposing the main gaps in knowledge and principle areas of uncertainty, identifying patterns in findings from multiple sources in the same area, and finding appropriate research methods. The review was guided by the study's principle focus on understanding the factors that impact on identifying and fulfilling customer needs in front-end product activities in UK manufacturing companies.

The multi-theme literature review specifically explored three distinct but interrelated themes of user involvement, new product development and design practice. The review set out to understand existing and emerging trajectories (Intersections, sets of common elements, linkages, relations). This understanding helped to inform and better frame the principle focus of the study. The underlying reason for adopting a multi-theme literature review is based on the interdependency of user's and design, and user's and design to front-end new product development activities'.

From the preliminary reading it was apparent that many of the empirical studies, although they highlight important issues, are generic in nature. The aim of multi-theme literature review was to try to focus on not just the gaps in knowledge but also to identify the factors affecting (issues, influence, level of impact) user involvement, new product development practices and design practices. By adopting a systematic literature review it was possible to identify a series of principle issues that helped to focus the study. Achieving this focus was important. The literature review targeted excavation of the main gaps in knowledge in the following principle areas:

1. User Involvement Issues:
- Need for Greater User Involvement
- User Centred Tools & Methods
- The Role of the Product Designer

2. New Product Development Practices Issues:
- Fuzz Front-end
- Voice of the Customer within NPD Practices
- Changing Role of Design in NPD Activities
- Trends and Drivers of Success within NPD Practices and Activities

3. Design Practices Issues:
- Design and Innovation Definitions and Confusions
- Value and Meaning of Design
- Design and Development Process
- Design-driven Innovation Strategies
- New Relationships for Design

By critically analysing emergent themes from the review (user involvement, new product development practices and design practices), it was possible to identify a series of principle issues. This process was central to the design of the survey document and invaluable in helping to focus attention onto the four central research questions (see pages 149-150).

The benefits of undertaking a systematic and multi-theme literature review enabled the survey tool to be structured around three key factors: (1) phases within the CDS process; (2) principle question areas and (3) specific questions derived from the literature review process relating to the principle question areas. Figure 13 visualises the relationship between the central questions and the principle activities.

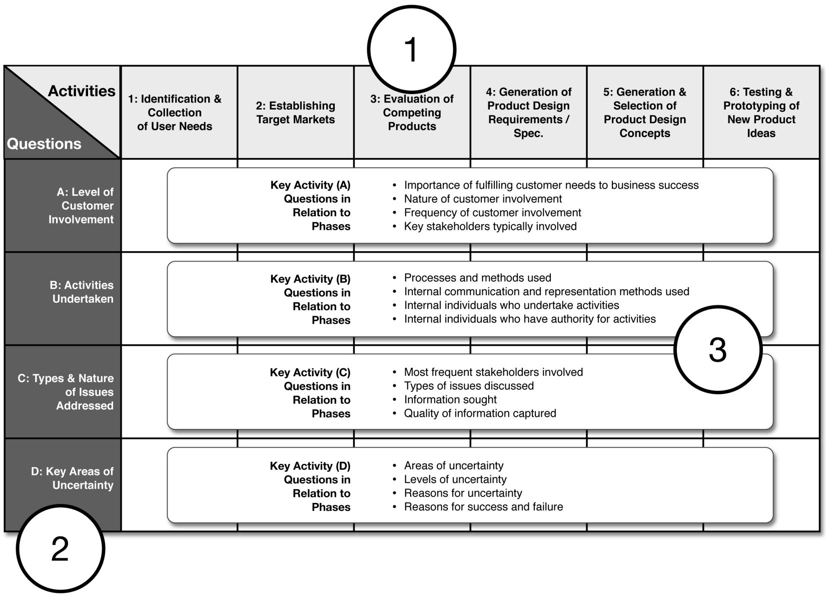

Figure 13: Exploratory Project Framework, Author

Survey Document

The survey adopted a deep dive approach. The rationale was to embed the emergent issues into the survey document in order explore the gaps in current knowledge and to gain a focussed and detailed understanding of these issues. As stated previously the survey document represents the introduction of a major research tool for the study (see Appendix 1).

A key aim of the study was to better understand what SMEs actually do in practice. The principle mechanism for achieving this goal would through survey document. The survey document adopted a cross-referencing strategy in order to identify and determine inconsistency, between perceived importance and actual day-to-day practices. The survey was designed to generate both quantitative and qualitative data. As previously stated the study adopted a systematic, logical and coherent, step-wise process. The key research questions were subsequently unpacked to identify the key sub-issues that would form the basis of the survey document:

(RQ1) What is the Nature and Frequency of Customer Involvement in SME CDS Practices?

Sub-issues explored to address research question:

- Importance of fulfilling customer needs to SME business success
- Nature of customer involvement in the key CDS activities
- Frequency of customer involvement in the key CDS activities
- Key Stakeholders typically involved in the key CDS activities

(RQ2) What Processes and Methods do SMEs Typically Use to Collect CDS Information from Stakeholders?

Sub-issues explored to address research question:

- Processes and methods typically used by the SME to capture information
- Communication and representation methods used internally by SMEs
- Who typically undertakes the information capture activities within the SMEs (role and function)
- Who Typically has responsibility and decision-making power regarding information capture activities

(RQ3) What Issues do SMEs Address with Stakeholders in order to Identify Their Needs in the CDS Process?

Sub-issues explored to address research question:

- Stakeholders most frequently involved in establishing key CDS issues
- Types of issues discussed with stakeholders within key CDS activities
- Information sought within key CDS activities

- Quality of the information captured within key CDS activities

(RQ4) What are the Key Areas of Uncertainty that SMEs Experience within the CDS?

Sub-issues explored to address research question:

- Level of uncertainty SMEs experience within the key CDS activities
- Reasons for uncertainty SMEs experience within the key CDS activities
- Levels of uncertainty SMEs experience within the key CDS issues
- Reasons for uncertainty that SMEs experience when discussing key CDS issues
- Levels of success & failure that SMEs achieve when undertaking key CDS activities
- Reasons for success/failure that SMEs achieve when undertaking key CDS activities

4. Implementation of the Study

The timeline incorporates three important phases in recent SME/Industrial history in the UK: (1) increased role and use of design in UK industry in the late 1990s; (2) importance of supporting the growth of SME in the mid 2000s, and (3) the increasingly competitive nature of industry in the late 2000s. The initial scoping interviews took place in 1999/2000 and were revisited in 2003 through interactions with industry. The survey tool was finalised in late 2007 and implemented in early 2008 with data collection completed in late 2008. The analysis of the data was concluded in late 2009. An additional SME test was undertaken in 2010 to determine relevancy of the existing findings.

Scoping Interviews

A series of four scoping interviews was undertaken to evaluate specific characteristics and needs of SME's in terms of achieving product success through front-end product development.

These companies operate in a variety of product sectors and market sectors. They vary from having 15 employees to just over 100 and their turnovers range from £750K to over £5 million.

Company A operates in the public address industry sector, employing 19 employees with a turn over of approximately £950K. It operated a product modification strategy supported by incremental product innovations to existing ranges but had no formal product development process. The company had limited design and manufacturing expertise and was attempting to reposition itself from being a marketing/distribution based company to a manufacturing led organisation. The key issues to emerge were a lack of effective product management; poor internal communication; inability to produce the product at a profit, spending too much time and money on trying to get the product 'right' during production and an inability to market products to other potential customers.

Company B operates in the print drying and dust extraction market sectors. It employs 18 employees with a turn over of approximately £750K. Company B operated an incremental product innovations strategy to existing ranges supported by an informal project-by-project process. The company had been traditionally focused on providing custom designed solutions based around core technological areas. The company wanted to move towards developing its own products based on its considerable technical expertise. However, lacked design and marketing expertise. The key issues to emerge were a lack of effective product marketing; poor internal communication; inability to produce the product at a profit, spending too much time and money on trying to get the product 'right' during production and an inability to market products to other potential customers.

Company C operates in the outdoor environmental hygiene products sector, employing 15 employees with a turn over of approximately £850k. Company C had introduced a new product to market originally but was now offering product modifications and adaptations. The company did not have a formal process for developing 'ideas to products' solutions. The company wished to determine how to expand its market share due to lack of growth within this particular sector. The company did posses engineering design expertise. The key issues to emerge were a lack of new product ideas; poor internal communication; spending too much time and money on attempting to get the product 'right' during production and spending insufficient time and resources on identifying real needs and understanding the needs of its customers.

Company D operates in the disability health care products market. It employs 36 employees with a turnover of approximately £1.5m and had an informal product development process.

The company was starting to identify strong competition with its core market sectors and had identified that it had become reliant on two product lines. The key issues to emerge were a lack of new product ideas; poor internal communication; spending too much time and money on trying to get the product 'right' during production and spending insufficient time and resources on identifying real needs and understanding the needs of its customers.

From the pilot study the following key issues were identified.

- The SME's approach new product development in a linear manner (consistent with Coughlan, (1987)).
- SME's spend a significant proportion of their time and money on trying to 'get the product right' during production (consistent with the results of Craig & Hart (1992)).
- SME's spend insufficient time and resources on identifying real needs and understanding the needs of their customers (as described by Cooper (2001)).
- SME's spend insufficient time on resolving front-end product development issues prior to introducing products to market (as identified in Dwyer and Mellorm (1991) and Sanchez and Elola (1991)).

It became clear from the pilot study that insufficient time is spent by the SME's in resolving strategic, developmental and implementation issues prior to introducing a product to market. This is often due to having insufficient experience and expertise to either tackle the process itself or specific components of it.
What also emerged from the use of unstructured pilot interviews with a random selection of the sample, was that they all indicated that the newer the product to the market or the company, there tended to be more emphasis placed on customer input. Although it was explained that this did not tend to carry on once the product was launched and the new market has been entered.

From these preliminary findings it was decided that the focal area would attempt to address the issue of the role of customer involvement in identifying and developing new product opportunities.

The Selection of Companies

The vast majority of manufacturing companies in the UK are small/medium enterprises, (SME's) as outlined by the Performance and Innovation Unit (PIU) in the Cabinet Office (2001). They constitute over 80% of the UK's manufacturing units and employ 45% of the total manufacturing workforce. They account for 30% of the manufacturing output and as Levy and Wen-Jeng (1991) point out they are therefore on average less productive than the larger companies but identify the greatest potential for improved performance.

Product development and change is becoming a way of life for those involved in designing products for the highly competitive markets. The time when an innovatory product could be launched with confidence and remain unchallenged has passed (Rothwell, 1992). This apparent change in the market now allows those SME's that are responsible for developing their new products, to respond more quickly than the much larger companies to the needs of the market, and indeed customers. This is a clear competitive advantage (Porter, 1995). Marsh (2000) found, that in general, smaller companies spent less of their turnover on new product development than larger companies and that nearly a third of the UK firms surveyed spent nothing on new products and processes.

The current study has adopted a self-completion sample survey method. The disadvantages according to Robson (2011) of self-administered sample surveys are that they typically generate low response rates. However, he suggests that the advantages are that they encourage frankness when sensitive areas are being explored. This offsets the typical disadvantages of interview surveys where data maybe affected by the characteristics of the interviewer and the interaction between the respondent and the researcher (Robson, 2011). Identifying the frequency count of the possible different responses, the percentage of responses to each of the statements and the overall and functional mean responses was the intended purpose of the survey. In addition, the survey is designed to gather qualitative data, for example the type of tools and methods currently used to capture and represent ideas (communication of the product opportunity i.e. market size, through to the visualisation of the potential product via sketches).

To achieve this goal a sampling frame was developed. The sample was selected as being a representative population of small and medium sized manufacturing based companies who where engaged in developing products that focus on fulfilling identifiable user needs (health care and safety products, plus a general product category). The SMEs were selected from the an initial data base of companies who had engaged in the Design Council's Design in Demand program and was cross referenced with Kompass business database in order to determine that they where classified as SMEs and that they had some form of design function within the business. Companies were approached in order to identify willing participants, with the aim of delivering questionnaires to three key functions (design, engineering and marketing) within each company. This was to be tried in order to identify an inter-functional perspective of the extent of user involvement within the product design and development process. In reality only one function per company took part in the study.

Undertaking the four pilot studies (indicated on pages 151 -152) enabled the testing and refining of the questionnaire design (language and structure) and an insight into the proficiency needed to run the sample survey – such as ensuring all questions where completed, following up on incomplete questions, and chasing agreed participants to undertake the process on time.

An initial target sample of 120 companies was established, with 40 companies per category. The sample focused on SMEs that had: (1) a turnover of greater than £500K to avoid start-up companies; (2) a minimum of 10 employees to ensure need for some forms of processes and structures within their business activities; and (3) a design function within the business. The objective was to adopt a focussed, deep and detailed approach rather than broad and shallow study. An 18-page comprehensive survey questionnaire was developed (see Appendix 1); incorporating both quantitative and qualitative questions based on the literature review and the pilot study findings. The overall response rate achieved was 13% - which equates to 15 companies. Comprising 40% safety, 27% healthcare and 33% general products.

5. Data Analysis

The objective of the data analysis approach is to provide uncomplicated summaries of the resulting data by performing appropriate analysis of the sample data. The adopted approach is a descriptive method. This is an appropriate choice, as descriptive statistics aim to summarise a sample, rather than use the data to learn about the population (Field, 2009). The adoption of this approach supports the central theme of the study of being able to describe what SMEs are actually doing in practice.

Descriptive statistics is a suitable method, as it can be used to establish a series of measures that can be used to help describe the data set. Specifically this approach helps to focus on measures of central tendency, variability and or dispersion. In this study, the measures of central tendency include the mean and mode, while measures of variability include standard deviation.

Determining the mean is the most common and best general-purpose measure of the mid-point of a set of values (Field, 2009). This is important, as the mid-point is where all the other values cluster. However the mean is prone to distortion by the presence of extreme values and may require use of a measure of distortion (standard deviation).

This study focuses on determining the most common or most-frequently occurring values in the data- referred to as the mode. It also takes into account that within the data sets there may be more than one mode. These are referred to as bimodal series (two modes) and multimodal (three or more).

The study also measures how well the mean represents the data – standard deviation. The aim is measure how close the data points are to the mean (small standard deviation). Large standard deviations typically indicate that the mean is not an accurate representation of the data (Field, 2009). In the context of this study the degree of deviation will imply that no one practice is being universally adopted or conversely, particular practices are more common across the sample for example. In order to ensure accuracy of results, the study was designed to optimise stability and consistency of data analysis by using SPSS (software that is designed to support descriptive statistical analysis). Therefore the findings will present descriptive statistics relating to the mode, the mean and standard deviation data derived from SPSS software (see appendix 2 – SPSS Data).

Triangulation via the use of quantitative and qualitative questions within the survey tool was used in order to identify similar patterns of findings. The primary purposes of the qualitative questions are to help gather an in-depth understanding of the behaviours taking place and the reasons that govern such actions (the why and how).

Thematic coding analysis, as described by Robson (2011) and Liamputtong and Ezzy (2005), was carried out to summarise key themes emerging from a large amount of qualitative data. This is also known as clustering, where concepts are grouped together categories (Miller, 2005; Davila et al., 2006). Coding is an interpretive technique that is effective in organising data, helps to cluster data issues, and provides a means to decode and interpret emergent themes and issues (Robson, 2011). This approach has been central to analysis of the qualitative responses and to triangulate the quantitative results (see appendix 3 – Qualitative Responses).

Multiple approaches have been adopted in relation to visualising and presenting the resulting data from the study. In the main findings section, a summary cross-tabulation method has been used in order to provide concise and uncomplicated summaries of the resulting data. In order to determine the summary data, frequency distribution methods have been used, adopting bar chart visualisation tools (see appendix 2 – bar charts).

6. Discussion and Conclusions

The purpose of these chapters is to discuss in more detail the emergent themes from the results and to discuss if they how are consistent with previously published knowledge on the topic. The discussion will highlight that the SME sample see the importance of customer involvement to achieving business success in front-end activities, but it will articulate that the sample typically focus more on the rear-end activities (typically relating to the selection of product concepts; testing and prototyping on new ideas) because they experience more uncertainty in identifying and collecting of user needs and establishing new target markets. These activities are typically undertaken in an unstructured and informal manner that leads to uncertainty.

7. Limitations

Three factors potentially impact on this study's findings: (i) validity, (ii) reliability and (iii) replication. Lecompte and Goets (1982) suggest that there are two forms of validity in relation to qualitative research; (i) internal validity - i.e. the effect between researcher's observation and the theoretical ideas being develop, and (ii) external validity – i.e. the amount of generalization of the findings.

This study has been designed around a self-completion sample survey method. This method is typically associated with low response rates (Robson, 2011) and could potentially impact on the validity and reliability of the findings if not properly considered in the design of the study. However, Robson (2011) suggests that the use of self-completion sample survey methods help to offset the typical disadvantages of interview surveys where data maybe affected by the characteristics of the interviewer and the interaction between the respondent and the researcher – reducing internal validity.

Guba and Lincoln (1994) propose two key criteria for assessing validity in qualitative studies: (i) credibility – relating to the believability and transferability of the findings, and (ii) applicability of the findings to other contexts. To address potential limitations of transferability and applicability, the study was designed to adopt a focussed, deep and detailed approach rather than broad and shallow study.

It could therefore be suggested that a limitation of this study is that it generalised. However, by developing a focussed study, based on a deep dive approach and underpinned by a triangulation strategy, it has generaterated findings that are transferable and applicable to other similar contexts – i.e., it is replicable (Guba and Lincoln, 1994). This study has developed indicative not definitive results that have contributed to the identification of the factors that contribute to uncertainty in front-end product development activities (CDS) in UK SMEs.

The theses will now addresses the previous issues described and are discussed in the following order: findings, discussion and conclusions.

Findings

Introduction

The following information will introduce and discuss the findings derived from the sample survey. The chapter comprises of four key sections that address the central research questions of the study as outlined on pages 9 and 10. In order to address each research question a series of related sub-issues were established (see below). Each section will summarise the key findings; discuss the emergent themes resulting from the analysed responses and will utilise quantitative and qualitative data were appropriate; and answer the related research questions.

Common to each section are tables that communicate the quantitate findings relating to mode, mean and standard deviation. As a means of helping to quickly pick out the important findings, selected data has been highlighted in bold with each table.

Specifically this chapter will explore the findings to study's four key research questions (see pages 9-10). Firstly it will present the outcomes to the investigation of the nature and frequency of customer involvement in SME CDS practices (RQ1). It will then move onto examining the results relating to the processes and methods typically used to collect information from stakeholders in SME CDS activities (RQ2). Building upon this theme it then discusses the findings concerning the typically issues that SMEs address with key stakeholders in order to identify their needs (RQ3). The chapter concludes by examining the outcomes relating to the key areas of uncertainty that SMEs experience when undertaking CDS activities and identify needs and opportunities (RQ4).

1 Level Of Customer Involvement in SME Practices

The purpose of this section is to communicate the findings of the investigation into the degree of customer involvement within the CDS within the UK SME sample manufacturing companies. The reason for this section is to gain an insight into actual levels and frequency of customer involvement within the specific activities relating to the CDS in the SME sample. The rationale for this activity is to address the generic nature of other studies (Eisenberg (2011), Barczak et al. (2009)) which have highlighted the importance of customer involvement but, due to their focus, have not provided detailed information on what companies do, and in particular in the UK manufacturing sector. This section specifically addresses the importance of fulfilling customer needs to business success; the nature of customer involvement in the 'concept development stage'; the frequency of customer involvement and the key stakeholders typically involved (see figure 3 on page). These activities have helped to answer the research question (see pages 9-10).

The following sections will present findings through the use of summarised cross-tabulation format.

1.1 Importance Of Fulfilling Customer Needs To Business Success

The sample respondents were asked to rate the importance of fulfilling customer needs to their business success. The data generated was quantitative in nature. The results indicated that 90% of respondents specified that fulfilling customer needs was very important to achieving business success. The validity of this data is perceived to be strong due to a small standard deviation score. However this raises the question why the other 10% of the sample did not consider fulfilling customer needs as being critical to achieving business success?

Importance Of Fulfilling Customer Needs To Business Success	Mode (%)	Mean	Standard Deviation
	Very Important (86.7)	1.133	0.352
Scale: = 1 very important, 3 = neither important or unimportant, 5 = not at all important			

Table 30: Quantitative Data Summary - Importance Of Fulfilling Customer Needs To Business Success

1.2 Nature of Customer Involvement in the Key Activities

Each sample company was asked to indicate the nature of customer involvement within the 6 key CDS activities. They where asked specifically to indicate whether that input was formal or informal in nature. The objectives of this question was to help determine; (i) which activities within the CDS key stakeholders are typically involved with and (ii) the nature of that involvement (formally or informal). The data captured was quantitative. The overall picture that emerged was that the key areas of formal customer involvement related to rear-end activities. Specifically the activities with high formal customer involvement were: (i) testing & prototyping of new product ideas and (ii) evaluation of competing products and (iii) generating & selecting product design concepts. What was significant about the findings was that identifying and collecting user needs was rated as informal. This suggests business perceive that fulfilling customer needs is important to achieving business success but have low formal customer involvement in determining their needs. It therefore raises question are business actively attempting to accurately determine customer needs?

Nature of Customer Involvement	**Mode (%)**	**Mean**	**Standard Deviation**
(A) Identification & Collection of Customer Needs	3 = Informal (40)	2.4	1.056
(B) Establishing Target Markets	2 = Formal (40)	2.333	0.976
(C) Evaluation of Competing Products	**1 = Formal (40)**	**2.333**	**1.397**
(D) Generation of Product Design Requirements / Specifications	1-2=Formal (33.33)	2.133	1.06
(E) Generation & Selection of Product Design Concepts	**1 = Formal (33.33)**	**2.333**	**1.345**
(F) Testing & Prototyping of New Product Ideas	**1 = Formal (46.67)**	**2**	**1.254**
Scale: 1 = Formal; 3 = Informal; 5 = No Input			

Table 31: Quantitative Data Summary - Nature of Customer Involvement in the Key Activities

1.3 Frequency of Customer Involvement in the Key Activities

The sample where asked to indicate the frequency of customer involvement in relation to the 6 key CDS activities. The primary purpose was to help indicate how frequently key customers were involved. The data was quantitative in nature. The findings indicated that the frequency of customer involvement is commonly sporadic and infrequent in nature, with both multimodal and bimodal results appearing in core front-end activities (A and B). However, based on the low standard deviation scores, the ‘generation of product design requirements / specifications’ and ‘generation & selection of product design concepts’ appear to be the most accurate across the sample, even though they are irregular.

Frequency of Customer Involvement	Mode (%)	Mean	Standard Deviation
(A) Identification & Collection of Customer Needs	**1-2- 3 = Always – Sometimes (26.67)**	**2.467**	**0.471**
(B) Establishing Target Markets	2-3 = Sometimes (33.33)	2.667	1.113
(C) Evaluation of Competing Products	3 = Sometimes (40)	2.667	0.147
(D) Generation of Product Design Requirements / Specifications	3 = Sometimes (53.33)	2.667	0.053
(E) Generation & Selection of Product Design Concepts	3 = Sometimes (40)	2.6	0.538
(F)Testing & Prototyping of New Product Ideas	3 = Sometimes (40)	2.267	1.163
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 32: Quantitative Data Summary - Frequency of Customer Involvement in the Key Activities

1.4 Involvement of Stakeholders in Key Activities

ACTIVITIES

Identification & Collection of User Needs	Establishing Target Markets	Evaluation of Competing Products	Generation of Product Design Requirements / Specifications	Generation & Selection of Product Design Concepts	Testing & Prototyping of New Product Ideas
HIGH INPUT					
(1) management team(s) / functions, (2) purchasers	(1) management team(s) / functions, (2) distributors	(1) management team(s) / functions, (2) end users	(1) management team(s) / functions, (2) distributors	(1) management team(s) / functions, (2) distributors	(1) management team(s) / functions, (2) end users
LOW INPUT					
(1) workforce, (2) manufacturers / suppliers	(1) workforce, (2) installers / service engineers	(1) workforce, (2) manufacturers / suppliers	(1) workforce,	(1) workforce,	(1) retailers

Figure 14: Summary - Key Stakeholders Typically Involved in the Key Activities

The sample companies were asked to indicate which stakeholders (end users; purchasers; retailers; distributors; installers / service engineers; assemblers / workforce; management team(s) / functions; and manufacturers / suppliers) are typically involved in each of the 6 key CDS activities. The aim was to establish the frequency of stakeholder involvement. From the findings (see summary Figure 4) it emerged that the dominant and most frequent stakeholders within the activities were: (i) the management team and (ii) the distributors. The management involvement ratings can be seen as reliable as they achieve the lowest standard deviation in three out of six of the CDS activities (Identification & Collection of User Needs, Generation of Product Design Requirements / Specifications; and Generation & Selection of Product Design Concepts). See table 33. These findings suggest that business success appears to be based on buying in the best managers with the most appropriate understanding of market and customer needs. New business opportunities appear to be driven by a combination of management and distributor input. End users were only identified as being a contributing stakeholder in one key area: (i) generation and selection of product design concepts. In terms of low input, the workforce was the lowest in all but the testing and prototyping of new ideas. This then raises the question, are companies utilising their internal resources effectively or not?

Identification & Collection of User Needs	**Mode (%)**	**Mean**	**Standard Deviation**
• End users	2 = Sometimes (40)	2.4	1.121
• **Purchasers**	**1 = Always (33.33)**	**2.286**	**1.204**
• Retailers	4 = Never (33.33)	2.667	1.113
• Distributors	3 = Sometimes (40)	3.333	1.614
• Installers / service engineers	3 = Sometimes (33.33)	2.714	1.139
• Assemblers / workforce	3 = Sometimes (40)	3.214	1.311
• **Management team(s) / functions**	**1 = Always (46.67)**	**2.267**	**0.941**
• Manufacturers / suppliers	4 = Never (33.33)	3.267	1.387
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• End users	3 = Sometimes (40)	2.8	1.207
• Purchasers	3 = Sometimes (33.33)	2.929	1.269
• Retailers	3 = Sometimes (33.33)	3.083	1.782
• **Distributors**	**2= Sometimes (46.67)**	**2.083**	**1.084**
• Installers / service engineers	3 = Sometimes (40)	3.923	0.954
• Assemblers / workforce	5 = Never (46.67)	4.2	0.862
• **Management team(s) / functions**	**2= Sometimes (46.67)**	**2.133**	**1.302**
• Manufacturers / suppliers	5 = Never (33.33)	3. 533	1.457
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• End users	3 = Sometimes (33.33)	2.8	1.146
• Purchasers	3 = Sometimes (33.33)	3.071	1.269
• Retailers	3-5 = Sometimes/Never (33.33)	3.462	1.391
• Distributors	3 = Sometimes (33.33)	2.917	1.311
• Installers / service engineers	4 = Never (26.67)	3.462	1.266
• Assemblers / workforce	5 = Never (46.67)	4.133	0.99
• **Management team(s) / functions**	**2 = Always/Sometimes (40)**	**2.267**	**1.163**
• Manufacturers / suppliers	5 = Never (33.33)	3.467	1.457
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• End users	2- 3 = Sometimes (33.33)	2.933	1.163
• Purchasers	2 = Sometimes (26.67)	3.214	1.311
• Retailers	5 = Never (33.33)	3.583	1.379
• Distributors	3 = Sometimes (26.67)	2.615	1.261
• Installers / service engineers	4= Never (26.67)	3.333	1.231
• Assemblers / workforce	5 = Never (40)	3.8	1.32
• **Management team(s) / functions**	**1 = Always (53.33)**	**1.467**	**0.516**
• Manufacturers / suppliers	1-5 = Always -Never (26.67)	3	1.604
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation & Selection of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• **End users**	**2 = Always (46.67)**	**2.867**	**0.99**
• Purchasers	3 = Sometimes (46.67)	3.214	0.975
• Retailers	5 = Never (33.33)	3.583	1.443
• Distributors	3 = Sometimes (33.33)	2.5	1.314
• Installers / service engineers	3 = Sometimes (40)	3.615	0.961
• Assemblers / workforce	3 -5 = Sometimes /Never (40)	3.733	1.163
• **Management team(s) / functions**	**1 = Always (46.67)**	**1.733**	**0.884**
• Manufacturers / suppliers	1-4 = Always -Never (26.67)	3.133	1.506
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Testing & Prototyping of New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• End users	3 = Sometimes (46.7)	2.6	1.121
• Purchasers	3 = Sometimes (40)	3.286	0.994
• Retailers	5 = Never (40)	3.917	1.311
• **Distributors**	**2 = Sometimes (26.67)**	**2.917**	**1.505**
• Installers / service engineers	3 = Sometimes (40)	3.538	1.127
• Assemblers / workforce	3 = Sometimes (40)	3.4	1.404
• Management team(s) / functions	1-5 = Always - Never (**26.67**)	2.067	1.1
• Manufacturers / suppliers	1-4 = Always - Never (**26.67**)	3	1.558
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 33: Quantitative Data Summary - Key Stakeholders Typically Involved in the Key Activities

1.5 Answering the Research Question

ISSUES			
Importance Of Fulfilling Customer Needs To Business Success	**Key Areas Of Customer Involvement**	**Frequency Of Customer Involvement**	**Key Stakeholders Typically Involved**
Fulfilling customer needs is perceived to be very important to achieving business success	*High Input*: • testing & prototyping of new product ideas • generation of product design requirements / specifications *Low Input*: • identification & collection of user needs	*Frequent Input*: • testing & prototyping of new product ideas • identification & collection of user needs	• management team(s) / functions, • distributors

Figure 15: Summary of Customer Involvement in SME Practices

Analysing the importance, the nature (formal/informal) and the frequency of customer involvement (see Figure 14) within the concept development stage has enabled the triangulation of responses, the answering of the research question and the identification of several emerging trends.

The sample SMEs clearly believed that fulfilling customer needs are essential to achieving business success. However, their actions do not back up this view in terms of involving user with the key CDS activities. The data indicates that there is a tendency for a lack of formal and regular user input in determining their needs. The findings suggest that the concept development stage, in relation to this sample, is rear-end driven with more emphasis being placed involving stakeholders in testing procedures. There appears to be more frequent and formal use of *remote sources* of information for determining customer needs – i.e. lack of involvement of end users. The primary sources of data appear to originate from the management team(s) and distributors. Identifying new markets appears to be a problem area within the concept development stage for the SME sample.

2 Processes and Methods Undertaken to Collect Information from Stakeholders by SMEs

Section 2 investigates the processes and methods undertaken with stakeholders by the UK SME sample manufacturing companies within the CDS. More precisely it examines how frequently the sample SMEs undertake structured or unstructured information collection processes and whether they adopt formal or informal methods to collect the information. Also investigated in this section is who undertakes and has authority for the key CDS activities and in particular the role of the designer in the process. Again frequency is used as the metric and both quantitative and qualitative data is captured and analysed. In addition, section 2 explores what methods and tools UK SME manufacturing companies typically use to communicate and represent CDS issues internally. These activities have helped to answer both the research and hypothesis question (see chapter introduction).

As above, the following information will present the findings through the use of summarised cross-tabulation format.

2.1 Processes and Methods Used by SMEs to Collect Information

The companies were asked to indicate the nature and frequency of the processes and methods used within the key CDS activities. The purpose was to gain an insight into the nature of the activities and methods used to collect information. In addition, each respondent was asked to indicate whether or not they used a structured or unstructured process in relation to the aforementioned activities, and whether or not they used informal or formal methods/techniques. This process generated quantitative data. In order to

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
NATURE OF PROCESSES USED					
Unstructured process with informal techniques	Unstructured process with informal techniques	Structured process with informal techniques	Structured process with formal techniques	Structured process with formal techniques	Structured process with formal techniques

Figure 16: Summary - Processes and Methods Undertaken to Collect Information by SMEs

Identification & Collection of User Needs	Mode (%)	Mean	Standard Deviation
• A structured process	3 = Sometimes (40)	3.067	1.033
• **An unstructured process**	**2 = Mostly (40)**	**2.667**	**1.234**
• Formal techniques / methods	3-4 = Sometimes-Never (33.33)	3.2	0.941
• **Informal techniques / Methods**	**2-3 = Mostly/Sometimes (33.33)**	**2.933**	**1.163**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• A structured process	2-3 = Always/Sometimes (33.33)	2.667	1.113
• **An unstructured process**	**2 = Always (40)**	**2.733**	**1.033**
• Formal techniques / methods	4 = Never (33.33)	3.067	1.1
• **Informal techniques / Methods**	**3 = Sometimes (46.67)**	**2.933**	**0.884**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• **A structured process**	**1-3 = Always -Sometimes (26.67)**	**2.467**	**1.246**
• An unstructured process	3-4 = Sometimes-Never (26.67)	3.067	1.28
• Formal techniques / methods	2 = Mostly (26.67)	2.8	1.373
• **Informal techniques / Methods**	**2-3 = Mostly/Sometimes (33.33)**	**2.933**	**1.163**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• **A structured process**	**1 = Always (53.33)**	**2**	**1.363**
• An unstructured process	4 = Never (46.67)	3.267	1.335
• **Formal techniques / methods**	**1 = Always (33.33)**	**2.467**	**1.457**
• Informal techniques / Methods	4 = Never (33.33)	2.8	1.32
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation & Selection of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• **A structured process**	**3 = Sometimes (46.7)**	**2.533**	**1.407**
• An unstructured process	3 = Sometimes (33.33)	2.933	1.163
• **Formal techniques / methods**	**1 = Always (33.33)**	**2.533**	**1.457**
• Informal techniques / Methods	3 = Sometimes (46.7)	2.933	1.1
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Testing & Prototyping of New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• **A structured process**	**1 = Always (46.7)**	**1.867**	**1.125**
• An unstructured process	4-5 = Never (33.33)	3.867	1.125
• **Formal techniques / methods**	**1-2 = Always (33.33)**	**2.2**	**1.207**
• Informal techniques / Methods	3-4 = Sometimes-Never (33.33)	3.733	1.1
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 34: Quantitative Data Summary - Processes and Methods Undertaken to Collection Information by SMEs

determine the actual processes and methods used within each of the activities each respondent was asked to state what specific methods and tools they typically used. This provided qualitative data.

The findings indicated that the front-end activities relating to identifying and collecting user needs and establishing target markets were driven by unstructured and informal methods (see table 14). This is consistent with findings in section one. The findings also indicate that the SME sample was more confortable adopting structured and formal methods when addressing *hard issues* such as the evaluation of competing products; generation of product design requirements / specifications; generation & selection of product design concepts; and testing & prototyping of new product ideas. Again these findings suggest a predominantly rear-end driven approach.

The qualitative responses enabled the capture of the specific methods used to capture and collect information. The principle methods used for each activity are indicated in Figure 8.

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
METHODS USED					
Creativity methods User groups Market surveys Sales reports and feedback Distributor feedback Standards and regulations	Sales feedback Distributor feedback Exhibitions Formal bodies / standards and review bodies	Product reviews In-house product testing Field trials	Design cost Product design specification: - technical spec. - customer spec. - product innovations - product image / style Design specification / criteria Design reviews Benchmarking	Technical / specification driven Design input Market driven Internal evaluation	User testing (favourite customers) Standards and regulatory testing

Figure 17: Qualitative Summary - Processes and Methods Undertaken to Collection Information by SMEs

From analysing the data relating to the processes and methods undertaken to collect information the following findings emerge:

- That the CDS appears to be predominately rear-end driven focusing on test and specification driven activities (hard issues), which have clearly defined protocols set by standards and review bodies;

- That front-end activities, identification and collection of user needs and establishing target markets, (*soft issues*) are not addressed with the same rigour and are typically characterised by unstructured processes and the use of informal techniques;

- There appears to be a lack of user involvement in identifying and developing new target markets and this appears to be predominately driven by secondary data derived from sales and distributor feedback.

2.2 Communication and Representation Methods Used by the SMEs

ACTIVITIES

	Identified User Needs	Target Markets	Attributes of Competing Products	Product Design Requirements	Product Design Concepts	New Product Ideas
HIGH FREQUENCY	(1) memo's	(1) written reports (2) memo's	(1) written reports memo's	(1) formal presentations	(1) 2D visuals (2) 3D cad models	(1) formal presentations (2) reports (3) 3D cad models
LOW FREQUENCY	(1) formal presentations	(1) formal presentations	(1) formal presentations	(1) memo's		

Figure 18: Summary - Communication and Representation Methods Used

The sample SMEs were asked to indicate the type and frequency of method they used to communicate and represent ideas to either customers or internal functions (see table 16).

The overall picture that emerged in relation to the six key activities within the concept development stage was that the communication and representation of issues appeared to be predominantly done through *remote practices* specially memos and reports (see Figure 9). This is aligned with a general response from the unstructured interviews that revealed that too often, the functions within their organisation only communicated on a *needs must basis.* An interesting factor to emerge was the use of formal presentations to communicate product design requirements. The point of interest is that it is a formalised process but what factors are they basing those requirements on i.e., user needs.

Identified User Needs	Mode (%)	Mean	Standard Deviation
• Formal presentations	3 = Sometimes (40)	2.6	1.056
• Written report(s)	3 = Sometimes (40)	2.267	1.163
• **Memos'**	**2= Mostly (40)**	**2.533**	**1.06**
• 2D visuals	N/A	N/A	N/A
• 3D CAD models	N/A	N/A	N/A
• Appearance models / prototypes	N/A	N/A	N/A
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• Formal presentations	2= Mostly (26.67)	2.867	1.457
• **Written report(s)**	**2= Mostly (40)**	**2.6**	**1.121**
• **Memos'**	**2 - 3= Mostly-Sometimes (33.33)**	**2.571**	**1.089**
• 2D visuals	N/A	N/A	N/A
• 3D CAD models	N/A	N/A	N/A
• Appearance models / prototypes	N/A	N/A	N/A
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Attributes of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• Formal presentations	3 = Sometimes (33.33)	3.467	1.246
• **Written report(s)**	**3 = Sometimes (40)**	**3**	**1.134**
• **Memos'**	**2= Mostly (40)**	**3**	**1.069**
• 2D visuals	N/A	N/A	N/A
• 3D CAD models	N/A	N/A	N/A
• Appearance models / prototypes	N/A	N/A	N/A
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Product Design Requirements	**Mode (%)**	**Mean**	**Standard Deviation**
• **Formal presentations**	**1 = Always (26.67)**	**2.733**	**1.438**
• Written report(s)	2= Mostly (60)	1.867	0.99
• Memos'	2 - 3= Mostly-Sometimes (33.33)	2.357	1.082
• 2D visuals	N/A	N/A	N/A
• 3D CAD models	N/A	N/A	N/A
• Appearance models / prototypes	N/A	N/A	N/A
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• Formal presentations	3 = Sometimes (53.33)	2.667	1.291
• Written report(s)	2 - 3= Mostly-Sometimes (33.33)	2.267	1.1
• Memos'	2 - 3= Mostly-Sometimes (33.33)	2.467	1.125
• **2D visuals**	**2= Mostly (46.67)**	**2.6**	**0.986**
• **3D CAD models**	**2= Mostly (40)**	**3**	**1.069**
• Appearance models / prototypes	2 = Mostly (33.33)	2.33	1.175
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• **Formal presentations**	**2= Mostly (40)**	**2.8**	**1.146**
• **Written report(s)**	**2= Mostly (40)**	**2.4**	**1.121**
• Memos'	2 - 3= Mostly-Sometimes (33.33)	2.467	1.125
• 2D visuals	3 = Sometimes (40)	2.6	1.056
• **3D CAD models**	**2= Mostly (40)**	**3**	**1.069**
• Appearance models / prototypes	3 = Sometimes (33.33)	2.8	1.146
• Other	N/A	N/A	N/A
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 35: Quantitative Data Summary - Communication and Representation Methods Used

2.3 Individuals within the SMEs Who Typically Undertake Activities

ACTIVITIES

Identification & Collection of User Needs	Establishing Target Markets	Evaluation of Competing Products	Generation of Product Design Requirements/Specifications	Generation & Selection of Product Design Concepts	Selection of product design concepts	Testing & Prototyping of New Product Ideas
HIGH INPUT						
(1) senior management team (2) marketing manager	(1) senior management team (2) marketing manager	(1) design manager/ personnel (2) eng. /manufacturing personnel	(1) senior management team (2) design manager/ personnel	(1) senior management team (2) design manager	(1) senior management team (2) marketing manager (3) design manager	(1) design personnel (2) eng. /manufacturing personnel
LOW INPUT						
(1) eng. / manufacturing manager	(1) eng. / manufacturing manager/personnel (2) design manager/personnel	(1) marketing manager	(1) eng. / manufacturing manager	(1) eng. / manufacturing manager (2)marketing personnel	(1) eng. /manufacturing personnel	(1) design manager

Figure 19: Summary - Individuals within the SMEs Who Typically Undertake Activities

In order to gain an understanding of the background of the individuals who frequently undertake the 6 key activities. Each respondent was asked to indicate who (see table 17 for breakdown of the range of potential participants) undertook the key CDS activities within their company. They were specifically asked to indicate the frequency of involvement, generating quantitative data (see Table 35).

Figure 17 summarises the findings. The front-end CSD activities (Identification and Collection of User Needs; and Establishing Target Markets) appear to be dominated by the senior management team and marketing manager. Design and Engineering managers and personnel dominate in two key areas of evaluating competing products and testing and prototyping of new product ideas. Design again emerges in its traditional role generating product design concepts, overseen by senior management in the selection of product design concepts.

Overall senior management dominate over 70% of the activities. The function with the lowest involvement were the engineering / manufacturing manager/personnel. This implies that they typically perceive themselves to be closer to end user and market.

Identification & Collection of User Needs	Mode (%)	Mean	Standard Deviation
• **Member of senior management team**	**1 = Always (40)**	**2.214**	**1.311**
• **Marketing manager**	**2 = Mostly (33.33)**	**2.182**	**1.25**
• Marketing personnel	4 = Never (33.33)	2.364	1.12
• Engineering / manufacturing manager	4 = Never (33.33)	3.692	1.032
• Engineering / manufacturing personnel	4 = Never (33.33)	3.333	1.032
• Design manager	3 = Sometimes (26.67)	3.091	1.375
• Design personnel	2 = Mostly (26.67)	2.727	1.421
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• **Member of senior management team**	**1 = Always (60)**	**1.5**	**0.76**
• **Marketing manager**	**1 = Always (40)**	**1.636**	**0.809**
• Marketing personnel	1-3 = Always-Sometimes (26.67)	2.5	1.446
• Engineering / manufacturing manager	5= Never (40)	4	1.279
• Engineering / manufacturing personnel	5= Never (40)	4.083	1.24
• Design manager	4-5= Never (20)	3.4	1.578
• Design personnel	5 = Never (26.67)	3.636	1.362
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• Member of senior management team	1-3 = Always-Sometimes (33.33)	2.571	1.284
• Marketing manager	3 = Sometimes (26.67)	2.636	1.206
• Marketing personnel	2 = Mostly (33.33)	2.417	1.24
• **Engineering / manufacturing manager**	**1 = Always (26.67)**	**2.417**	**1.443**
• **Engineering / manufacturing personnel**	**1 = Always (33.33)**	**2.5**	**1.382**
• **Design manager**	**1 = Always (33.33)**	**1.909**	**1.221**
• **Design personnel**	**2 = Mostly (33.33)**	**2**	**1.183**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• **Member of senior management team**	**1 = Always (46.67)**	**1.929**	**1.072**
• Marketing manager	1-3-5 =Always-Sometimes-Never (26.67)	2.273	1.272
• Marketing personnel	3 = Sometimes (40)	2.583	1.24
• Engineering / manufacturing manager	3 = Sometimes (26.67)	2.583	1.379
• Engineering / manufacturing personnel	2-4 = Mostly- Sometimes (20)	2.273	1.348
• **Design manager**	**1 = Always (26.67)**	**2.5**	**1.508**
• **Design personnel**	**1 = Always (40)**	**2.154**	**1.281**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generating Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• **Member of senior management team**	**1 = Always (40)**	**2.5**	**1.508**
• Marketing manager	3 = Sometimes (33.33)	2.273	1.104
• Marketing personnel	4 = Never (26.67)	2.909	1.375
• Engineering / manufacturing manager	1-2 = Always –Mostly (20)	2.833	1.614
• Engineering / manufacturing personnel	2-4 = Mostly- Sometimes (20)	3	1.354
• **Design manager**	**2 = Mostly (33.33)**	**2**	**1.183**
• Design personnel	2 = Mostly (26.67)	2.667	1.557
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Selecting Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• **Member of senior management team**	**1 = Always (66.67)**	**1.533**	**0.834**
• **Marketing manager**	**1 = Always (40)**	**2.667**	**1.723**
• Marketing personnel	1 = Always (26.67)	2.583	1.564
• Engineering / manufacturing manager	1 = Always (33.33)	2.667	1.723
• Engineering / manufacturing personnel	5 = Never (26.67)	3.231	1.589
• **Design manager**	**1 = Always (40)**	**1.909**	**1.3**
• Design personnel	2 = Mostly (26.67)	2.583	1.443
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Testing & Prototyping of New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• Member of senior management team	3 = Sometimes (46.67)	3.231	0.832
• Marketing manager	1-2 = Always-Mostly (20)	2.545	1.368
• Marketing personnel	2-3 = Mostly- Sometimes (26.67)	2.727	1.104
• Engineering / manufacturing manager	2 = Mostly (26.67)	3	1.472
• **Engineering / manufacturing personnel**	**1-3 = Always-Sometimes (26.6)**	**2.308**	**1.109**
• Design manager	5 = Never (33.33)	2	1.054
• **Design personnel**	**1 = Always (33.33)**	**2.083**	**1.311**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 36: Quantitative Data Summary - Individuals within the SMEs Who Typically Undertake Activities

2.4 Individuals within the SMEs Who Typically Hold Authority for Activities

ACTIVITIES

	Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements/Specifications**	**Generation & Selection of Product Design Concepts**	**Selection of product design concepts**
HIGH RESPONSIBILITY	(1) marketing manager (2) member of senior management team	(1) chairman/ managing director (2) member of senior management team	(1) design manager (2) member of senior management team	(1) member of senior management team (2) design manager	(1) member of senior (2) marketing manager	(1) managing director (2) design manager
LOW RESPONSIBILITY	(1) eng. / manufacturing manager	(1) eng. / manufacturing manage (2) design manager	(1) eng. / manufacturing manager		(1) chairman/ managing director	(1) eng. / manufacturing manager

Figure 20: Summary - Individuals within the SMEs Who Typically Have Authority For Activities

Each respondent was asked to indicate which individuals (see Table 37 for list of individuals) typically hold the authority for key activities. Figure 20 indicates that authority for the activities is top down driven. Again engineering has low responsibility across the activities. The chairman/managing director adopts responsibility for the two strategic activities of establishing the target markets and selection of the product design concepts. Other key players to emerge are senior management team, the marketing manager and the design manager. This suggests that front-end activities are seen to be a marketing and design driven activity.

Identification & Collection of User Needs	Mode (%)	Mean	Standard Deviation
• Chairman/Managing Director	1-2 = Always-Mostly (26.67)	2.5	1.401
• **Member of senior management team**	**2 = Mostly (40)**	**2.143**	**1.292**
• **Marketing manager**	**1 = Always (40)**	**2**	**1.477**
• Engineering / manufacturing manager	4 = Never (26.67)	3.583	1.24
• Design manager	2 = Mostly (26.67)	3.167	1.528
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• **Chairman/Managing Director**	**1 = Always (53.33)**	**1.867**	**1.125**
• **Member of senior management team**	**2 = Sometimes (40)**	**2.077**	**1.382**
• Marketing manager	1 = Always (33.33)	1.923	1.115
• Engineering / manufacturing manager	5 = Never (46.67)	4.417	0.793
• Design manager	5 = Never (40)	3.917	1.379
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• Chairman/Managing Director	3 = Sometimes (33.33)	3	1.359
• **Member of senior management team**	**2 = Sometimes (40)**	**2.429**	**1.222**
• Marketing manager	1-2 = Always-Mostly (26.67)	2.385	1.387
• Engineering / manufacturing manager	3 = Sometimes (26.67)	2.833	1.337
• **Design manager**	**1 = Always (33.33)**	**2.25**	**1.485**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• Chairman/Managing Director	1 = Always (26.67)	2.786	1.477
• **Data Member of senior management team**	**1 = Always (40)**	**2.154**	**1.463**
• Marketing manager	1 = Always (33.33)	2.308	1.437
• Engineering / manufacturing manager	1 = Always (26.67)	2.75	1.545
• **Design manager**	**1 = Always (40)**	**2.333**	**1.67**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• Chairman/Managing Director	3 = Sometimes (33.33)	2.467	1.302
• **Member of senior management team**	**2 = Mostly (40)**	**2.133**	**1.187**
• **Marketing manager**	**1 = Always (33.33)**	**2.231**	**1.423**
• Engineering / manufacturing manager	1 = Always (26.67)	2.833	1.642
• **Design manager**	**1 = Always (33.33)**	**2.167**	**1.467**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Selection of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• Chairman/Managing Director	4 = Never (26.67)	3.462	1.266
• Member of senior management team	2 = Mostly (33.33)	2.538	1.391
• Marketing manager	5 = Never (26.67)	3	1.651
• **Engineering / manufacturing manager**	**2 = Mostly (33.33)**	**2.231**	**1.235**
• **Design manager**	**1 = Always (40)**	**1.917**	**1.24**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 37: Quantitative Data Summary - Individuals Who Have Authority for Activities

2.5 Answering the Research Question

ISSUES

Processes and Methods Used	**Communication and Representation Methods Used**	**Individuals Who Undertake Activities**	**Individuals How Have Authority for Activities**
• Front-end activities appear to be unstructured with the use of informal methods • Rear-end activities appear to be structured with use of formal methods • More formalised and structured processes and tools for capturing *hard issues*	• Remote practices are commonly used (non-face to face activities): - memo's - reports	• Senior management dominates 70% of the activities • Design and Engineering direct evaluating competing products and testing and prototyping of new product ideas. • Design again emerges in its traditional role generating product design concepts,	• Chairman/managing director adopts responsibility for the two strategic activities of establishing the target markets and selection of the product design concepts • Senior management team, the marketing manager and the design manager

Figure 21: Summary of the Processes and Methods Undertaken to Collect Information from Stakeholders by SMEs

Where a structured process and formalised methods have been used it has improved the process. However, it is apparent from the findings from sample SMEs, that most lack expertise and resources for undertaking front-end activities. This finding is validated by the over emphasis on rear-end activities that are operationalized through more structured and formalised methods. Contact with customers / users appears informal and unstructured in almost all cases.

Communication and representation of issues within the sample SMEs appears to be driven by the use of remote processes and methods.

The processes and activities are management driven with apparent lack of engineering and manufacturing input. However this might be attributed to fact that the emphasis of the study is on front-end CDS activities.

3 Types And Nature Of Issues Addressed With Stakeholders By SMES

The primary purpose of this section is establish the type and nature of issues the UK SME sample of manufacturing companies attempt to discuss with stakeholders. Second, it aims to determine the usefulness of the information they capture by attempting to verify the quality of information sought. Section 3 also establishes: (i) who is involved within the requirements capture process, (ii) what issues are discussed within each CDS activity and (iii) the specific or generic nature of the data sought. This section explores the metrics of frequency and usefulness. These activities have helped to answer both the research and hypothesis question (see chapter introduction).

3.1 Stakeholders Most Frequently Involved in Establishing Key Issues

ACTIVITIES

Identification & Collection of User Needs	Establishing Target Markets	Evaluation of Competing Products	Generation of Product Design Requirements / Specifications	Generation & Selection of Product Design Concepts	Testing & Prototyping of New Product Ideas
HIGH FREQUENCY					
(1) end users (1) management team(s)	**(1) management team(s)** (2) distributors / end users	**(1) management team(s)** (2) service eng. / installers/ end users	**(1) management team(s)** (2) end users	**(1) management team(s)** (2) distributors / end users	**(1) management team(s)** (2) end users
(equal %)	*(50% difference between 1 and 2)*	*(50% difference between 1 and 2)*	*(58% difference between 1 and 2)*	*(85% difference between 1 and 2)*	*(46% difference between 1 and 2)*
LOW FREQUENCY					
(1) workforce	(1) suppliers	(1) workforce	(1) workforce	(1) workforce	(1) purchasers (2) retailers

Figure 22: Qualitative Summary - Stakeholders Most Frequently Involved in Establishing Key Issues

In order to gain an insight into who were the most frequent stakeholders involved within requirements capture process. Each respondent was asked indicate how frequently were the following stakeholders involved with the six key activities: end users; purchasers; retailers; distributors; installers / service engineers; assemblers / workforce; management team(s) / functions; manufacturers / suppliers.

The most frequent and dominant stakeholder was the management team. This indicated by the percentage differences between first and second place positioning indicated in figure 22. It has to be stressed that end users were evident but the percentage difference between management team and user involvement was typically in excess of 50% greater in favour of management team. Again this helps to validate the concept that SMEs believe user involvement is important but do not involve users frequently enough for the altter's needs to be fully understood. An additional finding is that many of the SME sample are failing to utilise the internal knowledge and expertise of their workforce, as they are typically indicated to have low levels of involvement (see figure 22 – low frequency).

3.2 Types of Issues Discussed With Stakeholders within Key Activities

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
HIGH FREQUENCY					
(1) product usability / product performance, cost	(1) product performance (2) cost	(1) product performance (2) cost	(1) product performance (2) cost (3) product improvements	(1) product performance (2) product usability	(1) product performance (2) product usability (3) cost
LOW FREQUENCY					
(1) DFM/A*	(1) DFM/A*	(1) DFM/A*	(1) new product opportunities	(1) DFM aesthetics (2) aesthetics	(1) aesthetics*

Figure 23: Qualitative Summary - Types of Issues Discussed With Stakeholders Within Key Activities

* DFM/A = Design for Manufacture / Assembly

An important issue of the study has been to try to understand the types of issues that UK SME manufacturers discuss with stakeholders. The findings in this section help to contribute to new knowledge by being able to fulfil one of the studies central aims as described above. In order to unpack this issue the sample were asked to indicate the frequency that they discussed a series of key CDS issues (see Table 38 for detailed list).

Figure 17 summarises the findings. Again the findings reinforce the assertion that the sample SME activities are rear-end driven. From the findings the process appears to be driven by performance, cost and usability issues. Little or no emphasis is placed on 'design for manufacture' (even when evaluating competing products) or soft design issues such as aesthetics.

Identification & Collection of User Needs	**Mode (%)**	**Mean**	**Standard Deviation**
• **Aesthetics (form, colour, finishes, etc.)**	**1 = Always (60)**	**1.867**	**1.302**
• **Product Improvements**	**1 = Always (40)**	**2.067**	**1.163**
• **New Prod. Opps.** (either new to company or market)	**1 = Always (66.67)**	**1.733**	**1.28**
• **Product Usability**	**1 = Always (66.67)**	**1.667**	**1.175**
• **Product performance / specification**	**1 = Always (66.67)**	**1.667**	**1.175**
• Design for manufacture / assembly (DFM)	3 = Sometimes (33.33)	2.933	1.486
• **Cost / Price**	**1 = Always (53.33)**	**1.8**	**1.146**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• Aesthetics (form, colour, finishes, etc.)	1 = Always (33.33)	2.467	1.407
• Product Improvements	1 = Always (40)	1.867	0.834
• New Prod. Opps. (either new to company or market)	1 = Always (40)	1.857	0.864
• Product Usability*	1 = Always (40)	1.933	0.884
• **Product performance / specification**	**1 = Always (60)**	**1.667**	**0.9**
• Design for manufacture / assembly (DFM)	3 = Sometimes (40)	2.867	1.302
• **Cost / Price**	**1 = Always (53.33)**	**1.571**	**0.756**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• Aesthetics (form, colour, finishes, etc.)	1 = Always (40)	2.533	1.506
• Product Improvements	1 = Always (40)	2.067	1.335
• New Prod. Opps. (either new to company or market)	1 = Always (40)	2.467	1.356
• Product Usability	1 = Always (53.33)	1.733	1.1
• **Product performance / specification**	**1 = Always (66.67)**	**1.6**	**1.121**
• Design for manufacture / assembly (DFM/A)	3 = Sometimes (33.33)	2.733	1.387
• **Cost / Price**	**1 = Always (66.67)**	**1.6**	**1.121**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• Aesthetics (form, colour, finishes, etc.)	1 = Always (33.33)	2.4	1.298
• **Product Improvements**	**2 = Mostly (46.67)**	**2.133**	**0.743**
• New Prod. Opps. (either new to company or market)	3 = Sometimes (40)	2.133	0.834
• Product Usability*	1-3 = Always-Sometimes (33.33)	2	0.845
• **Product performance / specification**	**1 = Always (46.67)**	**1.667**	**0.724**
• Design for manufacture / assembly (DFM/A)	2 = Mostly (40)	2.6	1.121
• **Cost / Price**	**1 = Always (46.67)**	**1.733**	**0.799**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation & Selection of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• Aesthetics (form, colour, finishes, etc.)*	2-3 = Mostly-Sometimes (26.67)	2.667	1.234
• Product Improvements	2 = Mostly (40)	2.533	1.06
• New Prod. Opps. (either new to company or market)	3 = Sometimes (46.67)	2.333	0.976
• **Product Usability***	**1 = Always (33.33)**	**2.2**	**1.082**
• **Product performance / specification**	**1 = Always (46.67)**	**2**	**1.069**
• Design for manufacture / assembly (DFM/A)	3 = Sometimes (33.33)	2.6	1.183
• Cost / Price	2 = Mostly (40))	2	0.926
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Testing & Prototyping of New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• Aesthetics (form, colour, finishes, etc.)*	1-3 = Always-Sometimes (26.67)	2.8	1.424
• Product Improvements	1 = Always (40)	2	1
• New Prod. Opps. (either new to company or market)	2 = Mostly (33.33)	2.6	1.242
• **Product Usability**	**1 = Always (46.67)**	**1.867**	**0.915**
• **Product performance / specification**	**1 = Always (60)**	**1.533**	**0.743**
• Design for manufacture / assembly (DFM/A)	1 = Always (33.33)	2.467	1.407
• **Cost / Price**	**1 = Always (46.67)**	**1.933**	**1.163**
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 38: Quantitative Data Summary - Types of Issues Discussed With Stakeholders Within Key Activities

3.3 Information Sought Within Key Activities

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
INFORMATION SOUGHT					
mixed equally between specific and generic data	emphasis on specific data/information	mixed equally between specific and generic data	emphasis on specific data/information	emphasis on specific data/information	emphasis on specific data/information
frequency – mostly (2)	frequency – always (1)	frequency – always (1) and mostly (2)	frequency – always (1)	frequency – always (1)	frequency – always (1)

Figure 24: Summary - Information Sought Within Key Activities

The purpose of this section is to help determine nature of the information sought. More specifically the study aimed to determine whether the data and information sought was specific (i.e. focusing on exact and or precise needs) or generic (i.e. focussing on general needs) in nature. The data captured included both quantitative and qualitative data. Figure 18 summarises the findings. Specific data and information is most frequently sought in areas of establishing target markets (low standard deviation), generating product design requirements, generating and selecting product design concepts and testing and prototyping new product ideas. The most multimodal activity was in identifying and collecting user needs.

What is important to understand is not the nature of the data sought but also the specific focus and type of information that the sample typically attempts to capture. By capturing qualitative data within this section it enabled the identification of a series of interesting findings. Figure 18 summarises the qualitative responses, and this helps to illuminate some key points. The information sought, indicated in figure 24, is not ranked. What is apparent from the data analysis is that even when the sample SMEs talk to users about their needs, the information sought is typically functional and performance based. It is only during the generation of product design requirements / specifications and generation and selection of product design concepts that any *soft issues* (style, appearance, user needs) are typically discussed. Of significance is the discussion of user needs at generation and selection of product design concept stage. Unfortunately by this stage it would be difficult to address any fundamental differences as the product design specification has been established.

Identification & Collection of User Needs	**Mode (%)**	**Mean**	**Standard Deviation**
• Specific data / information	2 = Mostly (33.33)	2.214	1.122
• Generic data / information	2 = Mostly (33.33)	2.429	1.158
• Other	3 = Sometimes (33.33)	2.667	0.816
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Establishing Target Markets	**Mode (%)**	**Mean**	**Standard Deviation**
• **Specific data / information**	**1 = Always (46.67)**	**1.643**	**0.745**
• Generic data / information	2-3 = Mostly-Sometimes (33.33)	2.071	0.829
• Other	3 = Sometimes (26.67)	2	1.414
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Evaluation of Competing Products	**Mode (%)**	**Mean**	**Standard Deviation**
• **Specific data / information**	**1 = Always (46.67)**	**1.786**	**0.893**
• **Generic data / information**	**2 = Mostly (46.67)**	**2.5**	**0.941**
• Other	3 = Sometimes (40)	3	0.535
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation of Product Design Req. / Spec.	**Mode (%)**	**Mean**	**Standard Deviation**
• **Specific data / information**	**1 = Always (60)**	**1.643**	**1.008**
• Generic data / information	2 = Mostly (46.67)	1.692	0.63
• Other	3 = Sometimes (26.67)	2.333	1.033
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Generation & Selection of Product Design Concepts	**Mode (%)**	**Mean**	**Standard Deviation**
• **Specific data / information**	**1 = Always (53.33)**	**1.714**	**1.139**
• Generic data / information	1 = Always (33.33)	2.357	1.447
• Other	3 = Sometimes (20)	2.571	1.397
Scale: 1 = Always, 3 = Sometimes, 5 = Never			
Testing & Prototyping of New Product Ideas	**Mode (%)**	**Mean**	**Standard Deviation**
• **Specific data / information**	**1 = Always (53.33)**	**1.714**	**1.139**
• Generic data / information	2 = Mostly (33.33)	2.385	1.446
• Other	3 = Sometimes (20)	2.667	1.506
Scale: 1 = Always, 3 = Sometimes, 5 = Never			

Table 39: Quantitative Summary - Information Sought Within Key Activities

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
INFORMATION SOUGHT					
Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Functionality Performance price/cost Features Quality	Features Style Function Performance Cost Volume	User needs Appearance Technical specifications Cost versus volume / demand	Functionality Technical feasibility Performance Appeal/style

Figure 25: Qualitative Summary - Information Sought Within Key Activities

3.4 Quality of the Information Captured Within Key Activities

The sample companies were asked to indicate the usefulness of the information they captured relating to the key CDS activities. The descriptive statistics helped significantly in analysing and decoding the findings. Table 40 summarises the finding. By using a combination of the mean and standard deviation it is possible rank the usefulness of the data sought by the SME sample. The most agreed upon factor, by mode (60%) and standard deviation (0.64), is that information sought in relation to establishing target markets was preceived to be most useful (providing value - i.e. user need and or serving a purpose – i.e. feedback on competing product).

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
POSITIONING IN TERMS OF USEFULNESS					
3rd Equal	1st	2nd	3rd Equal	4th	3rd Equal

Figure 26: Qualitative Summary - Quality of Information Captured Within Key Activities

By analysing the response from the sample it was possible to identify the following pattern was emerging:

- The establishing target markets is perceived to be of most use followed by evaluation of competing products.
- Capturing information relating to the testing new product ideas emerged as an area were the sample felt most confident and the information captured was perceived to be very useful.

Quality of the Information Captured	Mode (%)	Mean	Standard Deviation
(A) Identification & Collection of Customer Needs	1 – 2= Very useful to mostly useful (46.67)	1.667	0.816
(B) Establishing Target Markets	**2 = mostly useful (60)**	**2.133**	**0.64**
(C) Evaluation of Competing Products	**1 = Very useful (53.33)**	**1.867**	**1.187**
(D) Generation of Product Design Requirements / Specifications	1 = Very useful (46.67)	1.8	0.941
(E) Generation & Selection of Product Design Concepts*	1 – 2= Very useful to mostly useful (33.33)	2.067	0.961
(F)Testing & Prototyping of New Product Ideas	1 = Very useful (46.67)	1.8	0.941
Scale: 1 = very useful, 3= neither useful nor un-useful, 5 = no use			

Table 40: Quantitative Summary - Quality of the Information Captured Within Key Activities

3.5 Answering the Research Question

ISSUES

Most Frequent Stakeholders Involved	**Types of Issues Discussed**	**Information Sought**	**Quality of Information Captured**
management team distributors	**High Frequency** • performance • cost • usability **Low Frequency** • design for manufacture • aesthetics	• target markets • product design requirements • performance and usability	**Rated By Usefulness:** 1st identification & collection of user needs 2nd generation of product design requirements / specifications 3rd testing & prototyping of new product ideas

Figure 27: Summary of Type & Nature of Issues Addressed

Again, the sample SMEs clearly understands the importance of understanding user needs but fail to action greater user involvement within their processes nor seek to capture information about their needs. For example, product appeal (aesthetics) appears to be a critical factor sought but one of least frequent issues discussed with stakeholders.

However, the findings indicate that the most frequently involved stakeholders are the management teams, closely followed by distributors. Section three reinforces the findings that the sample SME are rear-end driven. The type of issues that they typically attempt to discuss with the stakeholders, frequently relate to performance, cost and usability.
The main source of information driving the sample SMEs front-end CDS appears to be derived from management teams. The emerging requirements capture process appears to be too remote from the use environment to provide useful insights into the user needs.

Information relating to customer needs is perceived to be of the highest use but it is apparent that contact with customers is not undertaken sufficiently frequently or in a structured and formalised manner.

4 Key Areas Of Uncertainty That SMEs Experience

Section 4 concludes the findings. It primary focus is on exploring the levels and reasons for uncertainty that the sample of UK SME manufacturing companies experience when undertaking the CDS activities and issues. The measures used in this section focus on levels of uncertainty (see pages 9 and 10 for definition) and success. The exploratory survey tool deploys both quantitative and qualitative approaches in order to better triangulate and enhance the validity of the responses. The combination of descriptive statistics and qualitative thematic coding analysis enabled rigorous comparative analysis of sample responses, the statistical analysis revealed a series of trends that were not evident at first glance and were substantiated via reference to the qualitative responses. In addition, section 4 also investigates the type of issues discussed with stakeholders that generate greater levels uncertainty. Finally, section 4 explores the reasons for success and failure when undertaking the CDS activities in sample of UK SME manufacturing companies. These activities have helped to answer both the research and hypothesis question (see chapter introduction).

4.1 Level of Uncertainty SMEs Experience With the Key Activities

The sample companies were asked to indicate the level of uncertainty that they experienced within the 6 key CDS activities. Combining both quantitative and qualitative parameters enabled a more accurate picture to emerge from the findings. By analysing the standard deviation scores this helped to indicate the comparative closeness of the responses to mean. This helped to verify the validity of the overall response, supported by triangulation of the responses through thematic coding analysis, and enabled a truer picture to emerge of what they actual do in practice, not just what the perceive takes place (see section 4.2).

ACTIVITIES

Identification & Collection of User Needs **LEVEL OF UNCERTAINTY**	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
Neither High nor Low	**Bimodal: Low and High level of uncertainty**	Low level of uncertainty	Moderate level of uncertainty	Low level of uncertainty	Very low level of uncertainty

Figure 28: Summary - Level of Uncertainty SMEs Experience Within the Key Activities

The findings represented in Figure 28 indicate that the *rear-end activities* (hard issues - performance, functionality etc.) generate lower levels of uncertainty. This is validated by fact that testing and prototyping of new product ideas has the lowest standard deviation (0.76), imply that all participants are close to the mean in terms of their individual responses. *Front-end* activities (soft issues) again appear to experience the higher levels of uncertainty. This observation can be derived from fact that both the activities of establishing target markets (1.158) and identifying and collecting user needs (1.122) suggesting a much wider range of practices. Establishing target markets is also bimodal indicating mixed levels of uncertainty.

Level of Uncertainty	**Mode (%)**	**Mean**	**Standard Deviation**
(A) Identification & Collection of User Needs	3= Neither High nor Low (40)	2.786	1.122
(B) Establishing Target Markets*	**2 – 4 = Low - High level of uncertainty (26.67)**	**2.571**	**1.158**
(C) Evaluation of Competing Products	1 = Low level of uncertainty (46.67)	2	1.24
(D) Generation of Product Design Requirements / Specifications	2 = Low level of uncertainty (33.3)	2.214	1.051
(E) Generation & Selection of Product Design Concepts	2-3= Neither High nor Low (33.3)	2.071	0.829
(F)Testing & Prototyping of New Product Ideas	1 = Low level of uncertainty (60)	1.5	0.76
Scale: 1 = Low level of uncertainty, 3= Neither High nor Low, 5 = High level of uncertainty			

Table 41: Quantitative Summary – Level of Uncertainty SMEs Experience Within the Key Activities

4.2 Reasons for Uncertainty that SMEs Experience Within the Key Activities

In order to gain an insight into the reasons why they experienced uncertainty, each respondent was asked to indicate the reasons for uncertainty within the 6 key CSD activities. At first glance at the quantitative results it appears that the SME sample experience lows levels of uncertainty across all CDS activities.

ACTIVITIES

Identification & Collection of User Needs	**Establishing Target Markets**	**Evaluation of Competing Products**	**Generation of Product Design Requirements / Specifications**	**Generation & Selection of Product Design Concepts**	**Testing & Prototyping of New Product Ideas**
REASONS FOR UNCERTAINTY					
reliability of data	**lack of knowledge of new markets**	inability to access competitor data / products	subjective processes	subjective processes	None
wide range of users	**low risk strategies**	lack of expertise / resources	lack of in-depth detailed data	lack of new ideas	
lack of knowledge of processes used	**insufficient resources committed**	validity of data captured or given	lack of new ideas	do not undertake process enough	
lack of expertise to undertake process			lack of user / customer involvement		
lack of appropriate resources					

Figure 29: Summary - Reasons for Uncertainty that SMEs Experience Within the Key Activities

However, the qualitative responses helped to illuminate the emerging issues that the SME sample typically face. Figure 29 summarises the reasons for uncertainty. Section 2 previously established that the front-end practices where typically driven by unstructured processes and informal methods. A lack of expertise in being able to undertake the processes (Identification & Collection of User Needs) and the subjectivity of the processes undertaken (Generation of Product Design Requirements / Specifications and Generation & Selection of Product Design Concepts) have been cited as key reasons for uncertainty. This then appears to result in data that is either lacking in-depth or is unreliable. Section 1 looked to establish the frequency of activities with stakeholder involvement. The finding in Section 1 that the frequency of stakeholder involvement is irregular ('sometimes'- metric) is supported by the qualitative findings in Figure 20 that indicate a lack of user / customer involvement. A key finding is that the sample companies indicate that they do not develop enough new ideas and subsequently do not undertake the process enough to become more competent (Generation & Selection of Product Design Concepts).

The bimodal nature of the responses relating to establishing a target market, combined with the qualitative reasons for uncertainty (illustrated in Figure 27) suggest a potential area weakness for the SME sample. Three factors emerged that contribute to uncertainty in this area relating to knowledge, resources and approach. The sample cite a lack of knowledge of new markets, insufficient resources committed to achieved the desired level of results, and most worryingly, an over emphasis on low risk strategies.

4.3 Levels of Uncertainty that SMEs Experience When Discussing Key Issues

Each sample company was asked to indicate the level of uncertainty they experienced when discussing CDS issues with stakeholders (see Table 42 for detailed breakdown of the key issues).

ISSUES

Aesthetics	**Product Improvements**	**New Product Opportunities**	**Product Usability**	**Product Performance Specification**	**Design for Manufacture**	**Costs**
LEVELS OF UNCERTAINTY						
Low level of uncertainty	Low level of uncertainty	**Low of level uncertainty**	Low level of uncertainty	**Very Low level of uncertainty**	**Low level of uncertainty**	Low level of uncertainty

Figure 30: Summary – Levels of Uncertainty that SMEs Experience When Discussing Key Issues

Consistent with section 4.1 the 'hard' issues (product improvement, performance and specifications related issues) raise lowest levels of uncertainty. Also consistent with the findings in section 4.1 was the bimodal nature of identifying new product opportunities.

Issues: Levels of Uncertainty	Mode (%)	Mean	Standard Deviation
• Aesthetics (form, colour, finishes, etc.)	1 = Low level of uncertainty (33.33)	2.267	1.1
• **Product Improvements**	**2 = Low level of uncertainty (33.3)**	**1.933**	**0.704**
• New Prod. Opps. (either new to company or market)	2 – 4 = Low - High level of uncertainty (33.33)	2.733	1.1
• Product Usability	1 = Low level of uncertainty (40)	2	1.069
• **Product performance / specification**	**1 = Low level of uncertainty (46.67)**	**1.667**	**0.724**
• **Design for manufacture / assembly**	**2 = Low level of uncertainty (33.33)**	**2.267**	**0.884**
• Cost / Price	2 = Low level of uncertainty (66.67)	2.267	1.033
Scale: 1 = Low level of uncertainty, 3= Neither High nor Low, 5 = High level of uncertainty			

Table 42: Quantitative Summary –Levels of Uncertainty that SMEs Experience When Discussing Key Issues

4.4 Reasons for Uncertainty that SMEs Experience When Discussing Key Issues

In order to gain an understanding of the reasons for uncertainty, each respondent was asked to indicate the reason attributed to uncertainty in relation to each of the CDS issues (see Figure 31). Again, at first glance at the quantitative findings they suggest that the sample faces low levels of uncertainty across the whole range of CDS issues. By triangulating the quantitative and qualitative findings a number of trends start to emerge. Figure 31 summarises the reasons for uncertainty.

ISSUES: REASONS FOR UNCERTAINTY

Aesthetics	**Product Improvements**	**New Product Opportunities**	**Product Usability**	**Product Performance Specification**	**Design for Manufacture**	**Costs**
Lack of internal expertise Differing markets / taste Familiarity with product / market	Low risk incremental strategies Lack of resource Lack of expertise	Determining markets size Lack of appropriate market research Not developing enough new ideas Low risk strategies	Lack of user testing Incremental product improvement (**already know answer syndrome**)	Familiarity with core technology	Not enough time spent on front-end activities Having to spend time getting product right during production	Not hitting deadlines Actual cost not properly defined

Figure 31: Summary – Reasons for Uncertainty that SMEs Experience When Discussing Key Issues

A lack of appropriate expertise and resources again emerges as a key driver of uncertainty. Symptomatic of a lack of appropriate expertise and resources is the finding that the SME sample did not spend enough time on front- end activities. Another reoccurring theme is that of ‘low risk’ strategies. However this time it is combined with the ‘familiarity syndrome’, impacting on aesthetics, product usability and product performance specifications (technology) based issues. This implies that the sample SMEs did not either prioritise or place sufficient effort in exploring activities and or issues that they felt (rightly or wrongly) they were familiar with.

4.5 Levels of Success & Failure that SMEs Achieve When Undertaking Key Activities

To comprehend the factors attributed to success and failure each respondent was asked to indicate their perceived level of success the typically achieved in relation to the ten related CDS activities (see Figure 32). From the quantitative data the following trends were identified:

- Determining product price points generated the lowest levels of perceived success.

- Findings indicate that the sample perceive themselves successful at developing aesthetically pleasing products and evaluating competing products. This appears to contradict the findings in section 3.3 where aesthetics appears to be an issue that is less frequently discussed

- Evaluating a static scenario appears to be an area that the sample appears most successful at (evaluating competing products).

ISSUES

Identifying Customer / User Needs	Establishing Target Markets	Evaluating Competing Products	Determining & Introducing Product Improvements	Introducing New Products	Establishing Product Desig Req. / Specs.	Selecting Product Design Concepts	Developing Aesthetically Pleasing Products	Developing Functional Acceptable Products	Determining Product Price Points
LEVELS OF SUCCESS OR FAILURE									
Moderately Successful	Moderately Successful	**Successful**	Moderately Successful	Moderately Successful	Moderately Successful	Moderately Successful	**Successful**	Moderately Successful	Neither Successful Nor Unsuccessful

Figure 32: Summary - Levels of Success & Failure that SMEs Achieve When Undertaking Key Activities

Levels of Success & Failure	Mode (%)	Mean	Standard Deviation
(A) Identification & Collection of User Needs	2 = moderately successful (53.33)	2.267	1.1
(B) Establishing Target Markets*	**2 = moderately successful (33.33)**	**2.467**	**1.06**
(C) Evaluation of Competing Products	1 = successful (40)	2.067	1.1
(D) Determining and Introducing Product Improvements	2 = moderately successful (53.33)	2.267	0.799
(E) Introducing New Products*	**2 = moderately successful (40)**	**2.8**	**1.146**
(F) Establishing Product Design Requirements / Specifications	2 = moderately successful (33.33)	2.333	1.113
(G) Selecting Product Design Concepts	2 = moderately successful (46.67)	2.6	0.986
(H) Developing Aesthetically Pleasing Products	1 = successful (40)	1.933	0.961
(I) Functionally Acceptable Products (Operation & Use)	2 = moderately successful (46.67)	1.733	0.704
(J) Determining Product Price Points	**3 = neither successful nor unsuccessful (40)**	**2.333**	**0.9**
Scale: 1 = successful, 3 = neither successful nor unsuccessful, 5 = unsuccessful			

Table 43: Quantitative Summary – Levels of Success & Failure that SMEs Achieve When Undertaking Key Activities

4.6 Reasons For Success that SMEs Achieve When Undertaking Key Activities

ISSUES

Identifying Customer / User Needs	**Establishing Target Markets**	**Evaluating Competing Products**	**Determining & Introducing Product Improvements**	**Introducing New Products**	**Establishing Product Design Req. / Specs.**	**Selecting Product Design Concepts**	**Developing Aesthetically Pleasing Products**	**Developing Functional acceptable Products**	**Determining Product Price Points**
Staff Expertise	Easily definable markets	Expertise in product testing	Familiarity with market and user needs	Detailed understanding of key market sectors	Well defined technical specification and requirements	Understanding customer base	Staff expertise	Testing and prototyping	Market knowledge
Good communication		committed resources	TQM processes and procedures	Focused organisation and processes	identifiable expertise within organisation	Well defined markets	Strong corporate image	Technical sustainability	Ability to bring product to market at right cost
Knowledge & understanding of key market sectors		Commitment to process	Specific expertise and resources	Good communication		Well defined technical specification and requirements	Ability to identify the need for external involvement		
Generating usable data		Understanding and knowledge of specific market sectors							
Close contact with users / customers		Easily definable sectors							

Figure 33: Qualitative Summary - Reasons For Success that SMEs Achieve When Undertaking Key Activities

In order to qualify success, the sample UK SME manufacturing companies were asked to indicate against the ten related CDS activities what factors contributed to success. Figures 33 summarises the qualitative success factor responses. No ranking has been applied to the order of responses.

By evaluating the frequency of responses, the number of times a response appears across all 10 issues indicated in figure 33, the following factors emerged as highly important for the sample:

- Staff expertise
- Good communication
- Usable data
- Close contact with users / customers
- Knowledge and understanding of markets
- Well defined objectives (market, technical)
-

4.7 Reasons For Failure that SMEs Achieve When Undertaking Key Activities

An important issue was to also understand what factors contribute to failure. The sample where therefore asked to indicate the reasons for failure when undertaken the ten core CDS related activities. Figure 34 summarises the reasons for failure and from those finding several key trends attributed to failure emerged:

- Lack of expertise (front-end activities)
- Slow response to change
- Lack of contact with end users
- Do not undertake process enough (stop start process)
- Lack of thoroughness in undertaking process (developing ideas properly)
- Low risk / incremental strategies
- Not enough new ideas

ISSUES

Identifying Customer / User Needs	Establishing Target Markets	Evaluating Competing Products	Determining & Introducing Product Improve-ments	Introducing New Products	Establishing Product Design Req. Specs.	Selecting Product Design Concepts	Developing Aesthetically Pleasing Products	Developing Functional Acceptable Products	Determining Product Price Points
Lack of resources Not enough end user contact Do not undertake process enough	Low risk / incremental strategies lack of resource / expertise lack of appropriate d market data Being too familiar with own market Do not undertake process enough	Market sectors continually changing	Slow response tim	Late to marke Limited manpower and resource Incomplete data	Engineering driven Not understandin g user needs Insufficient data lack of thoroughness in addressing key issues	Real needs not identified and explored Not enough new ideas not enough time spent of developing ideas properly Lack of expertise	Achieving success by accident not by design Lack of expertise		Do not undertake process enough Manufacturin g costs too high Defining internal cost

Figure 34: Qualitative Summary - Reasons for Failure

4.8 Answering the Research Question

Again, the sample SMEs clearly understand the importance of being able to identify the factors that contribute to success and failure; and their impact on uncertainty. Repeatedly the sample stated that they did not spend enough time on front- end activities and believed undertaking the process more frequently would reduce uncertainty.

5 Summary of Findings

This chapter set out to communicate the key findings derived from the survey tool and answer the four key research questions. It concludes by summarising the key emergent issues linked to the findings.

5.1 Level of Customer Involvement In SME Practices

The findings indicated that 90% of respondents specified that fulfilling customer needs was very important to achieving business success. However, the nature of customer involvement in the key CDS activities, in terms of frequency, can at worst be described as sporadic and at best infrequent in nature. It emerged, from the use of unstructured interviews with a random selection of the sample, that more emphasis was typically placed on customer input in situations where the product was new to the company and or market.

The most dominant and frequent stakeholders within the CDS activities were the management team and its distributors. The lowest input was from the workforce, in all but the testing and prototyping of new ideas. It is not surprising that the primary sources of data appear to originate from the management team and distributors. The activities with high formal stakeholder involvement related to testing & prototyping of new product ideas; the evaluation of competing products; and the generating & selecting product design concepts. The pattern that emerged was that the SME practices were rear-end driven. A key observation to emerge is that the identification of new market opportunities appears to be a major problem area within the concept development stage for the SME sample.

5.2 Processes & Methods Undertaken to Collect Information From Stakeholders

The findings indicated that the front-end activities relating to identifying and collecting user needs and establishing target markets were driven by unstructured and informal methods. It was apparent from the findings, that the SME sample was more comfortable adopting structured and formal methods when addressing *hard issues* such as the evaluation of competing products; generation of product design requirements / specifications; generation & selection of product design concepts; and testing and prototyping of new product ideas. Internally the communication and representation of issues appeared to be predominantly serviced through *remote practices* specifically memo's and reports. This supported a general response, from the unstructured interviews, that revealed that too often functions within the organisations only communicated on a *needs must basis.*

In determining who typically undertakes the capture of information in the CDS activities, it became clear that the front-end CSD activities (identification and collection of user needs; and establishing target markets) were dominated by the senior management team and marketing manager functions. Design and engineering managers and related personnel only had control in two key areas (evaluating competing products and testing and prototyping of new product ideas). Design emerged highly in its traditional role of generating product design concepts, overseen by senior management in the selection of product design concepts. Authority for the activities resided in three areas. The chairman/managing director typically adopted responsibility for the two strategic activities of establishing the target markets and selection of the product design concepts. Other key players to emerge were the senior management team, the marketing manager and the design manager.

Therefore the pattern that emerged in the SME sample was that processes and methods used to collect information regarding customer needs were typically unstructured and informal in nature and did not directly connect with users or customers in the majority of the six key CDS activities. Stakeholder involvement far too frequently appears to rely on internal players, plus distributors.

5.3 Types of Issues Discussed With Stakeholders within Key Activities

Stakeholders most frequently involved in establishing key issues were the management team. User involvement was evident but the percentage difference between management team and user involvement was typically in excess of 50% greater in favour of management team. Again the findings relating to the type and nature of issues addressed reinforced the assertion that the sample SME activities appear to be rear-end driven. From the findings the process of identifying needs in the SME sample appears to be driven by performance, cost and usability issues.

In terms of seeking specific data and information in CDS activities, the most frequently sought information areas related to establishing target markets (low standard deviation), generating product design requirements, generating and selecting product design concepts and testing and prototyping new product ideas. Capturing information linked to the generation of requirements and product design specifications and testing new product ideas emerged as key areas were the sample felt most confident and the information captured was perceived to be useful to them.

The sample SMEs clearly understood the importance of identifying and collecting user needs. However, many failed to action greater user involvement within their processes, or seek to capture information about their needs. This was highlighted again when it was established that the most frequently involved stakeholders were the management teams, closely followed by distributors, from which information is typically sought.

It is therefore possible to state that information relating to customer needs is perceived to be of the highest value to the SME sample, but was not demonstrated in day-to-day practices. It is clear from the findings that direct contact with customers and or users is not undertaken frequently enough, nor is it undertaken in a structured or formalised manner.

5.4 Key Areas of Uncertainty that SMEs Experience

Figure 35 has been developed in order to help visualise the reasons for uncertainty derived from the qualitative responses relating to uncertainty in the main study. It helps to bring to life the emerging patterns from the findings and aid subsequent discussion in this section.

Uncertainty in the SMEs sample was lower in the *rear-end CDS activities* (hard issues - performance, functionality etc.). This trend was repeated when discussing CDS issues. ‘Hard’ related issues (product improvement, performance and specifications related issues) raised the lowest levels of uncertainty.

A key reason for uncertainty when undertaking CDS activities was attributed to data. This related to two specific factors – (i) lack of availability of appropriate data and (ii) the validity of data collected and or given. This issue of data uncertainty was associated with three principle activities within the CDS: (i) Identification & Collection of User Needs; (ii) Evaluation of Competing Products and (iii) Generation of Product Design Requirements / Specifications. Connected to the front-end activities of ‘Identification & Collection of User Needs’ and ‘Establishing Target Markets’, uncertainty was ascribed to a lack of knowledge and understanding of key market sectors. It therefore helps to explain why for many of the SME sample, establishing new opportunities is a key area of concern. It implies that the SME sample does not have appropriate data from which to make decisions. A worrying factor to emerge relating to uncertainty in rear end activities of generating product design requirements / specifications and the generation and selection of product design concepts was the presence of subjective processes. When seen in the context of whom are the typical stakeholders involved in those activities (see Figure 37) we start to see sense in the finding, as the customary stakeholders appear to be predominantly the management teams and functions. It is therefore possible to suggest that a lack external involvement can lead to subjective approaches. An additional related factor emerged – this is described as the ‘familiarity syndrome’. This issue was linked directly to several key aspects such as aesthetic; product usability and product performance specifications (technology) based issues. The ‘familiarity syndrome’ supports the finding of a lack of thoroughness in undertaking activities.

A common recurring underlying theme associated with uncertainty was linked to a lack of appropriate expertise and resources. Repeatedly, the sample stated that they did not spend enough time on front- end activities.

An emerging signal to arise from the findings was that the sample companies believed that they did not develop enough new ideas (Generation & Selection of Product Design Concepts). This can be attributed to lack of appropriate data and knowledge and understanding of key market sectors. This dilemma can often result in the adoption of low risk strategies. This was identified as a reason for uncertainty within the CDS activity of establishing target markets.

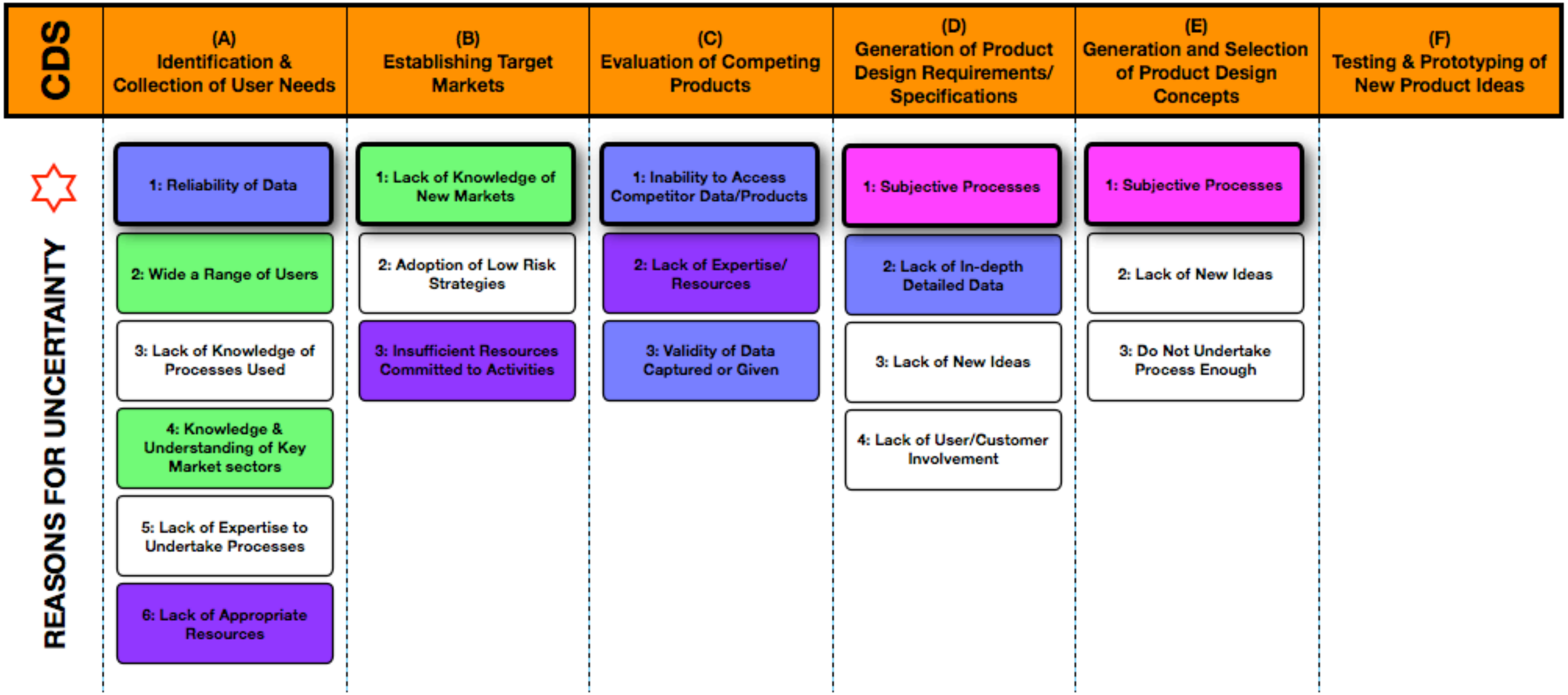

Figure 35: Reasons for Uncertainty in the CDS

5.5 Factors Impacting on Success and Failure

A key objective of the study was to determine what factors contribute to success and failure in achieving greater user involvement in the quest to identify and satisfying their needs. It has been possible to identify several important factors that contribute to success and failure. These factors were derived from analysing the qualitative responses from the main study. Figure 36 helps to aid the discussion in this section by bringing to life the emerging patterns from the findings.

Success in the SME sample was linked to three factors: (i) staff expertise (being the strongest factor); (ii) easily definable market sectors based on knowledge of the market; and (iii) good communication. Staff expertise was connected to all but establishing target markets and generating and selecting of product design concepts. When seen in conjunction with factors attributed to failure, these two activities are associated with having a lack of expertise and resources; it helps to explain why the two key activities have not been included. Staff expertise is seen as a key success parameter, particularly in the identification and collection of user needs, evaluation of competing products and prototyping and testing of new product ideas where it was ranked first in the qualitative responses.

Easily definable market sectors is a success factor, within the sample, that is strongly linked to the associated activities of establishing target markets and generating product design requirements and specifications (ranked first). It is also a prevailing factor, when seen in conjunction with knowledge of the market, which is attributed with all but the testing and prototyping of new product ideas.

The other highly rated success factor that was directly related to generating and selecting product design concepts was that of having well defined technical specifications and requirements (ranked first).

Reasons for failure in the SME sample can be attributed to six specific factors (see figure 35). Three factors were embedded across all the six CDS activities: (i) lack of resources – activities A, B and E ; (ii) user needs not being properly identified and explored – activities A,B and E; and (iii) not undertaking the process enough (expertise) – again activities A, B and E. The additional factors were: ‘low risk/incremental strategies’ specifically linked to establishing target markets; being ‘engineering driven’ in relation to generating product

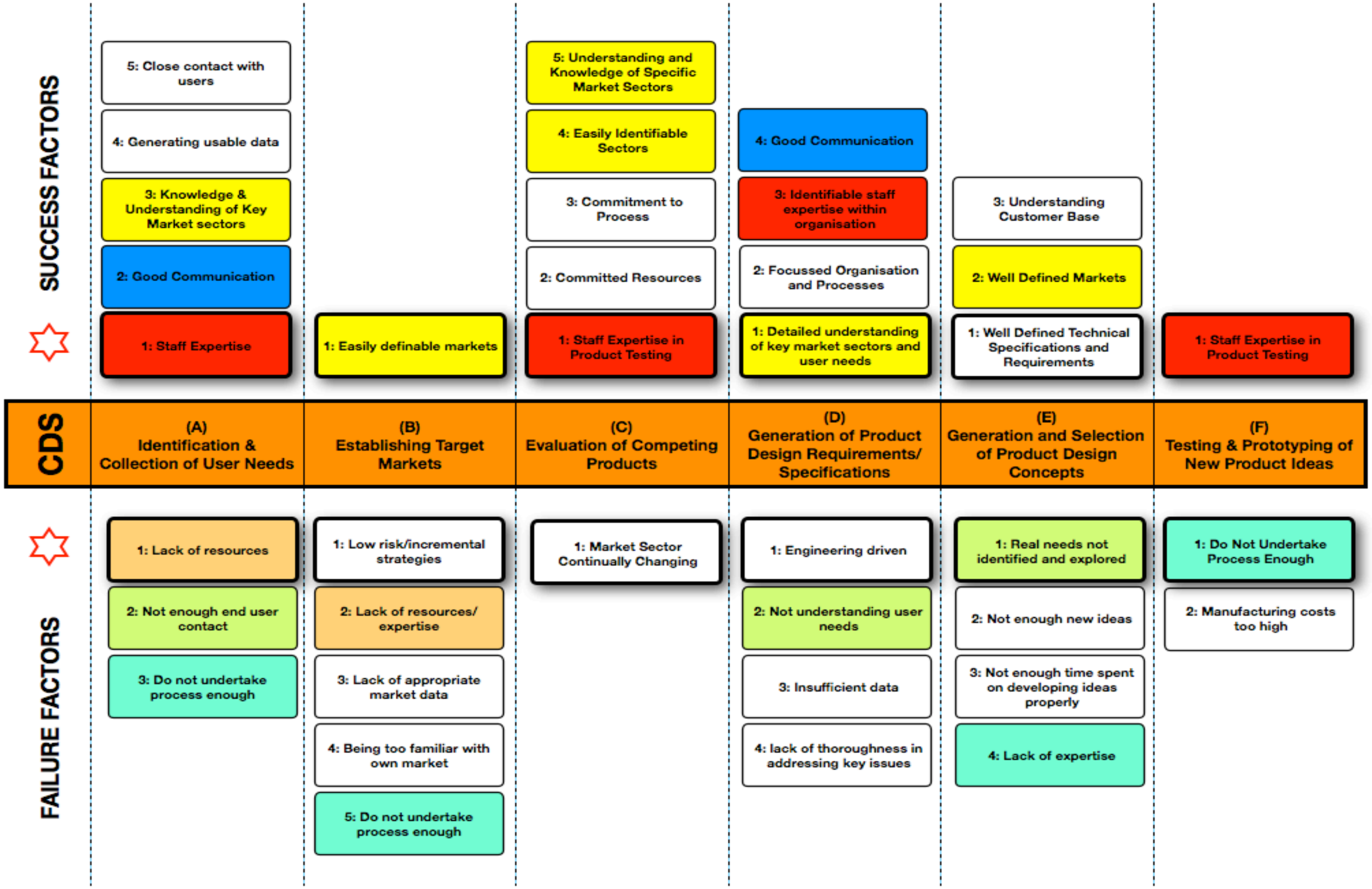

Figure 34: Factors Impacting on Success and Failure Within the CDS

design specifications; and ‘not undertaking the process enough’ connected to testing and prototyping of new product ideas. Being engineering driven helps to explain why the sample states that a key failure facture is associated with ‘real needs not being identified and properly explored’.

These findings help to answer one of the fundamental questions of why are SMEs not adopting practices that will help the competitiveness of their businesses. In simple terms they do not have the necessary expertise or resources to undertake the activities – this results in them not undertaking the process enough. Another prominent factor that contributes to failure is linked to having insufficient data when trying to establish target markets.

From the findings it appears that the SME sample clearly struggle in undertaking front-end CDS activities and in particular, establishing new market opportunities and knowing how to engage with users to identify their needs.

5.6 Reflections of the Findings

To conclude, this section will reflect on what the emerging issues from the findings mean in practice. To support this analysis and synthesis, a model (see figure 37: ‘what, how and who reflections’) has been created. Derived from the qualitative data captured in the main study, the responses have been ranked in terms of frequency (i.e. how many times an issue was mentioned in the qualitative data).

A linear discussion of each question in relation to the CDS activities has been outlined in the previous text within this section. The following information will seek to make sense of the emerging themes from a cross category (vertical) perspective (i.e. the interrelationship of issues between categories). The analysis is framed through three questions, what information is sought and discussed; how is the information collected; and who are the typical stakeholders involved in the key CDS activities.

Product usability drives the information sought and discussed when attempting to identify and collect user needs. This concurs with best practice approaches in principle, but is let down when seen in the context of who the key stakeholders are and how they commonly collect the information. The primary stakeholders are internal management teams and the predominant approach to collecting user needs information is via creative methods. This implies that SMEs within the sample typically bring together the management teams and function to brainstorm user needs without typically involving them in that process. This makes sense of some of the key areas and uncertainty (see figure 35) and reason for failure (see figure 36).

When seeking to establish new target markets the SME sample typically seek to understand usability. This is linked to product performance and cost as the key issues discussed. Again weaknesses emerge when it is recognised that the primary mode of collecting information is through sales feedback and the key actors are management teams and distributors.

The evaluation of competing products follows conventional practices of seeking to understand functionality, discussing product performance through product reviews. This is where end users are consulted but not frequently enough and is again dominated by management teams/functions.

Following a similar pattern to establishing target markets and evaluating competing products, emphasis is again placed on understanding the features of product performance when attempting to generate product design requirements and specifications. The primary information sought relates to design costs driven by input from management teams and distributors.

A glimmer of hope emerges in relation to generating and selecting of product design concepts. User needs are expressed as the key information sought, however the primary information typically discussed however relates to product performance. It could be argued that the second driver is product usability that connects with user needs. The predominant approach to collecting information is driven by technical and performance specifications: this is common practice across the sample, but again is undermined by the fact that the prime input is from management teams and distributors.

User involvement, via favourite customers, is strongest in the testing and prototyping of new product ideas. As would be expected emphasis is placed on discussing product performance with input from management teams and end users.

The overall dominant issues discussed across the CDS activities are product performance and cost, followed by product usability (‘what’ question). This supports the findings that the SME sample does not define real needs enough and the processes are too engineering driven. This can be correlated by understanding how the sample typically attempts to (a) collect information and (b) with whom. Understanding which stakeholders are typically involved in the capture of information helps to inform the emerging themes of this study. The primary stakeholders involved across all the CDS activities were the management team/functions, followed by distributors. End users are only typically involved in two activities: (i) establishing target markets; and (ii) testing and prototyping of new product ideas. It is important to reiterate that the average difference between the first and second stakeholder was 50%. The primary methods of collection are from sales feedback (not direct contact with users) and technical specifications. It therefore becomes easier and clearer to understand the reasons for uncertainty (see figure 35) and failure (see figure 36) in the sample.

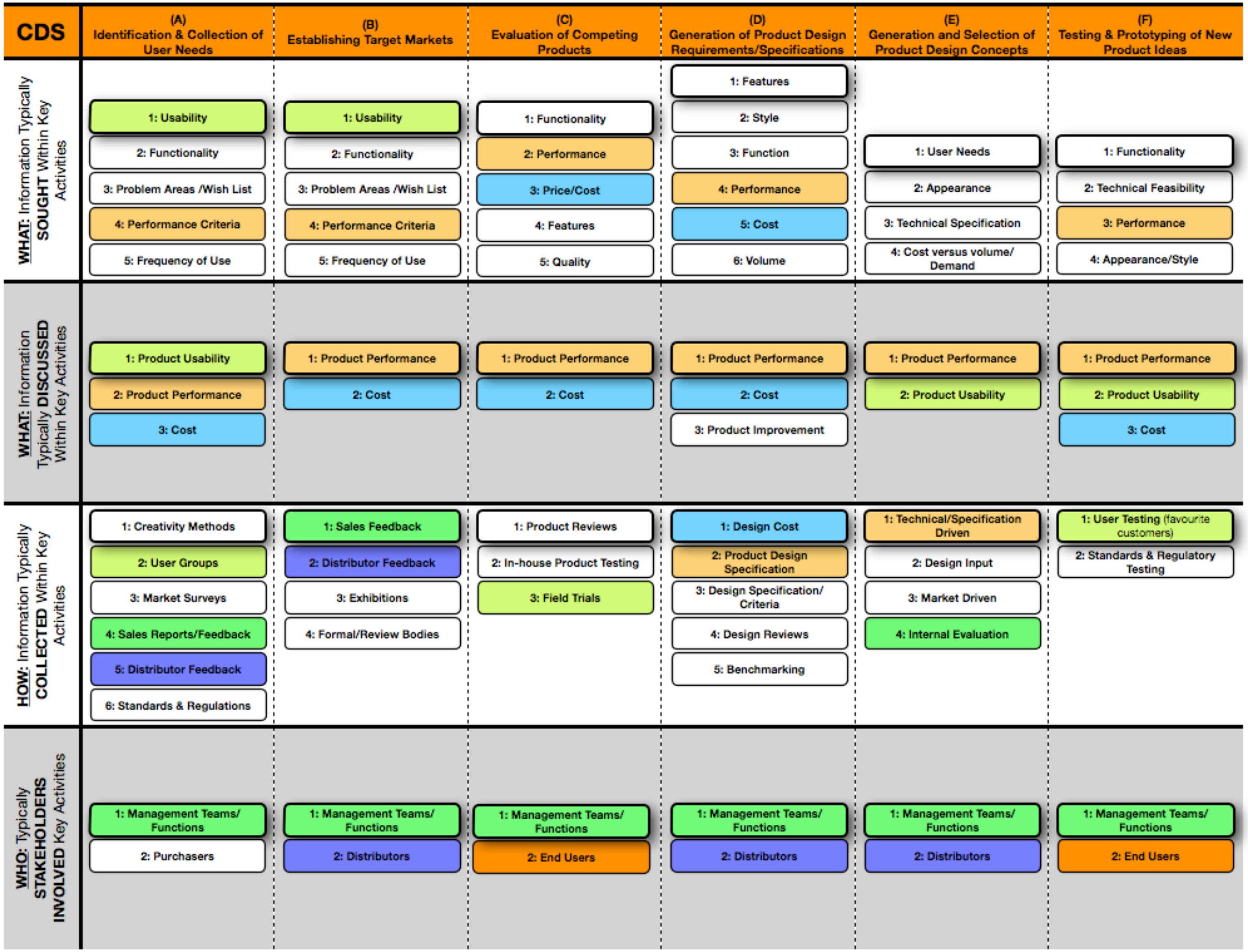

Figure 35: What, How and Who Reflections Within the CDS

Discussion

The purpose of this chapter is to discuss in more detail the emergent themes from the results and to discuss if they are consistent with previously published theory, knowledge and commentary on the topic. The discussion will suggest that the SME sample understand the importance of customer involvement to achieving business success in front-end activities, but it will suggest that the sample typically focus more on rear-end related activities because they experience more uncertainty with respect to identifying and collecting of user needs and establishing new target markets. These activities are typically undertaken in an unstructured and informal manner that leads to uncertainty. Hubbard's definitions of uncertainty and risk, with uncertainty being the lack of complete certainty, that is, the existence of more than one possibility (2010: 763-764). He also defines risk as a state of uncertainty, where some possibilities involve a loss, or other undesirable outcomes.

1 Level of Customer Involvement In SME Practices

Many of the organisations that advocate the importance of customer involvement such as the Design Council and the research studies illustrated in the literature (Eisenberg (2011), Barczak et al. (2009)) only provide useful insights into generic best practice. However this study is designed to examine and understand what levels customer involvement that actually take place; and what activities and methods do UK SME manufacturing companies adopt and what factors contributed to success and failure.

From the literature a number issues were identified as being important. The over reliance of basing new products specifications on a combination of the best single features observed in available competitive products is no longer sufficient for long term success. Souder and Moenaert (1992) established that many companies experience uncertainty when attempting to identify user needs. Although many formal user centred tools for product development have been designed (von Hippell, 2001) the awareness and usage of them is still infrequent (Hanna et al., 1995; Nijssen and Lieshout, 1995).

Importance to Business Success

It has been established that companies who continually report product design and development success achieve this by reaching out to their customers and users directly in order to tap into what matters most to the people who will purchase and use their products and services (Eisenberg, 2011). The DTI, Design Council and NESTA also endorse this view. However this insight is not new. Walsh *et al* (1992) suggest that the correct analysis and interpretation of market needs is critical to achieving success. The sample respondents supported (90%) this notion by indicating that fulfilling customer needs was very important to achieving business success. However this begs the question, why was it not important to the other 10%? These findings support the work of Cooper and Kleinschmidt (1994) that *building in* the voice of the customer is one of the crucial factors in achieving business success. A key conclusion to be drawn is that the majority of sampled UK SME manufacturing companies perceive fulfilling customer needs as being very important to achieving business success, but this raises the question do they and can they achieve this in practice? The answer appears that they do not achieve this in practice. Understanding why they do not achieve this in practice can be traced to their response to who are their dominant stakeholders. The findings from the UK SME manufacturing sample indicated that the dominant stakeholders within their activities were: (a) the management team and (b) the distributors. From these findings it appears that business success appears to be based on buying in the best managers with the most appropriate understanding of market and customer needs. End users were only identified as being a contributing stakeholder in 2 areas: (a) evaluating competing products and (b) testing & prototyping of new product ideas. The findings from the sample of UK SME manufacturing companies indicate that the sample does not adopt two of the principle concepts related to *requirements capture* and *user centred design:* (1) that users / customers are the best source of ideas (Herstatt & von Hippell (1992)); and (2) identifying user needs is an integral part of the product designs and development process (Ulrich and Eppinger (1995))

Nature and Frequency

Ulrich and Eppinger's (1995) well-established view is that *user needs* are an integral part of the product design and development process, and that the information generated is closely related to concept generation, concept selection, competitive benchmarking and establishing product specifications. These views have been embraced and adopted into the practices of many of the leading design groups in the world such as IDEO and FROG Design. However, the overall picture that emerged from the sample was that the key areas of customer involvement related to rear-end activities. This appears to contradict best practice advice that customer involvement is essential in the front-end activities in order gain an accurate understanding of *user needs* (Herstatt & von Hippell (1992)). Specifically the activities with high formal stakeholder involvement were: (rated 1st) testing & prototyping of new product ideas and (rated 2nd) evaluation of competing products.

What was significant about the findings was that identifying and collecting user needs had the lowest and most mixed levels of customer involvement rating. It therefore raises the question ‘are businesses customer driven’ and ‘what is the customer king of?’ This suggests that UK SME manufacturing company sample perceive fulfilling customer needs as important to achieving business success but have difficulty in undertaking and capturing customer requirements. However this does not answer the question of why are customers not involved in front-end activities?

The findings relating to the nature and frequency of user involvement are consistent with those relating to the level of customer involvement. They indicate that stakeholders are more frequently involved with the rear-end activities. Specifically the nature of user involvement focuses on the evaluation of competing products and in testing and prototyping of new product ideas. However the findings did highlight an anomaly. The findings suggest that customer involvement takes place when identifying and collecting customer needs, but when analysing the type of users typically involved it appears to be predominantly associated with the management function and purchasers. This supports the findings relating to the nature of customer involvement that indicates that they are only sometimes involved. This front-end anomaly appears consistent with the findings of Page and Rosenbaum (1992), which indicates that little market research is done in the early stages of the process. This then raises two issues: (1) that companies perceive fulfilling customer needs as important to achieving business success, but (2) in practice have low formal input from customers in the process of identifying their needs. This suggests that the findings of Robert’s (1995) to be correct that European firms have been identified as being less involved with their customers compared to US or Japanese companies. The key question to be answered in relation to the frequency of customer involvement is what are the reasons for the lack of involvement?

2 Processes & Methods Undertaken to Collect Information From Stakeholders

Processes and Methods Used

Direct contact with customers and end users has been identified as one of the best sources of information about new product ideas and that experiencing the *use environment* of a particular product, function or task is a prerequisite for generating high quality information (Yeaple (1992), Herstatt & von Hippell (1992), Ulrich and Eppinger (1995)). More recently organisations such as IDEO have demonstrated how direct contact with users and consumers helps organisations innovate. However the findings discussed in section 1 relating to customer involvement clearly indicate that the UK manufacturing company sample perceive customer involvement to be important, but the majority of the sample indicated they have little formal contact with them. The literature review identified the following key methods and players to emerge within the requirements capture process have been Hauser, Clausing and Griffin (Quality Function Deployment); Akao, Urban, Hersatt and von Hippel (Lead User Method); Page and Rosenbaum (Beta Testing). Quality function deployment (QFD) (Akao (1990) Hauser + Clausing (1988) Bossett (1991) Griffin and Hauser, (1993)) is the dominating approach. One of the key questions to emerge from the review process: "what processes and methods do UK manufacturing companies actually use?"

The findings indicate that the rear-end activities appear to be driven by some form of structured process underpinned by formal techniques. But what is significant and relates to the nature and frequency of customer involvement is that the front-end activities (identification & collection of user needs; establishing target markets) are undertaken with an emphasis on unstructured processes with the apparent use of informal techniques. The CDS activities within the sample appears to be predominately rear-end driven focusing on test and specification driven activities (hard issues), which have clearly defined protocols set by standards and review bodies. The front-end activities, identification & collection of user needs and establishing target markets, (soft issues) appear not to be addressed with the same rigour and are typically characterised by unstructured processes and the use of informal techniques. In addition there is an apparent lack of user involvement in identifying and developing new target markets ad appears to be predominately driven by secondary data derived from sales and distributor feedback.

The principle formal methods used emerged as:

- *QFD: Competitor benchmarking* - Assessing individual properties of competing products
- *Surveys / questionnaires* - Assessing a range of alternatives when the product type is known to those being surveyed
- *Focus groups*- Exploring common perceptions of requirements and reacting to product concepts
- *Interviews* - Exploring purposes, anxieties and cost/benefit issues
- *Usability trials* -Testing early prototypes

The findings suggest that the majority of the processes and methods adopted by the sampled UK SME manufacturing companies appear to be based around standard activities. This suggests that the sampled UK manufacturers are not adopting the principle methods developed by the key players within the field of requirements capture (Akao; Ulrich and Eppinger; Hauser, Clausing and Griffin; Urban, Hersatt and von Hippell; Page and Rosenbaum). This then poses the question: "why are they not adopting best practice?"

What also emerged from the use of unstructured interviews with a random selection of the sample was that they indicated that the newer the product to the market or the company more emphasis is placed on customer input. Although it was expressed that this level of input did not tend to carry on once the product was launched and the new market was entered.

Communication

The overall picture that emerged in relation to the six key activities within the concept development stage was that the communication and representation of issues appeared to be done through *remote practices* (remote practice refers to non personal communication practices) especially memos and reports. This supported a general response from the workshop sessions that too often, the functions within their organisation only communicated on a *needs must basis.*

Responsibility and Authority

What is not clear in many of studies identified in the literature review is *who* collects the information, and therefore a better understanding of who typically collects user information would enable a greater insight into how to develop the *requirements capture* process. Historically, Walsh and Roy (1985) have suggested that the designer should be given more *responsibility* for assembling the necessary information required to undertake the design process. Fleischer and Liker (1992) suggest that the designers should have greater responsibility for linking with external groups. However Bailetti and Livtva (1995) have identified an apparent weakness in the designer's ability to transform *user requirements* and suggest that there is a need to develop a better understanding of the process by which designers *transform information* into the final product design specification in order to achieve greater success. More recently Brown (2009) and Esslinger (2009) have suggested the importance of design in a more strategic role.

Despite the apparent enthusiasm in recent years, the UK SME manufacturing company sample appears not to be listening. The key players who have high involvement were: senior management team, marketing manager and design manager. The individuals that had low involvement were the engineering / manufacturing manager/personnel. One of the possible reasons why engineers might have a low involvement may relate to Yeaple's (1992) findings that the majority of the product development engineers and engineering managers surveyed reported that they only *speak with customers* either once or twice a year or not at all about product design related issues. It is clear from the findings that front-end product development activities in SMEs appear not to be cross disciplinary in nature, with engineering appearing to be focussed on delivery based issues and activities. This supports Cox's (2005) recommendations to the British Government, that for UK businesses to remain competitive there was a need to breakdown silos and integrate design, management and engineering activities in order to innovate.

The contemporary research undertaken by Roy (1990) appears to still be valid thirty years on, indicating that many managers (the problem setters) are not aware of the role of design and that some managers are hardly aware that design decisions are made and who is responsible for them. The reason for making this statement is based on the findings from the sample which clearly indicated that it was senior management, in particular the managing director

(MD), who consistently have responsibility for the activities within the CDS. The MD also appears to be supported by marketing and design managers within the organisations.

What appears unusual is that there is no apparent area were engineering or manufacturing has any authority in front-end activities. This contradicts findings illustrated in section 4.4 (reasons for success and failure) where being engineering driven is cited as one of the reasons attributed to failure. This raises the question: are engineers doing the marketing?

3 Type & Nature of Issues Addressed

One of the reasons for undertaking the study was to determine whether or not companies were learning from previous research outcomes. Two factors appear to have remained constant in the last 10 years: (1) that the design process relies too heavily on the production of ideas based on assumptions generated or verified by the problem setting process which is *guided by* business and manufacturing parameters (Hubel and Lusson (1984)); and that (2) the user and the designer often only communicate through the product itself (Norman 1988). This can be supported by the findings that the key stakeholders most frequently involved in the process were the management teams followed by distributors. But what must be pointed out is the percentage difference between management and end user involvement was above 50%. The findings do indicate that there is some evidence of user involvement although this appears to contradict the finding illustrated in section 1.4. of the findings chapter.

These findings clearly indicate that the requirements capture process within the CDS is a management driven procedure. Not a user needs driven process.

Types of Issues Discussed With Stakeholders within Key Activities

The issues emerging from sections 1 and 2 of the findings chapter (relating to nature of customer involvement and the activities undertaken) clearly indicate that the process is rear-end driven with little formal customer involvement. It then raises the question of what issues do they therefore attempt to discuss? The picture that emerges is that of a process being clearly driven by performance, cost and usability issues. In addition there is little or no emphasis placed on 'design for manufacture' or soft design issues such as aesthetics. This supports the findings of Veryer (1993) that there has been relatively little investigation of the *influence of aesthetic aspects* of products on the preferences or evaluations formed by the perceivers of the products. These findings are to be expected if companies put more effort and resources into rear-end activities.

Research undertaken by Eason (1992) indicates that within the notion of *user information capture and analysis* three types of information are captured: *user tasks*, *user characteristics* and *context of use.* However, this level of sophistication does not appear to exist in UK SME sample manufacturing companies. The initial response appears to be no. What is becoming apparent is that in the general manufacturing sectors there is little evidence that companies are adopting best practice requirements capture techniques. Predominantly the information the sample attempted to capture was performance and usability driven. The distinct lack of soft issues questions the usefulness and usability of techniques outlined by March (1994) focusing on usability testing to encompass the cognitive aspects of using a product, such as how logical and natural a product is to use and how people feel about using it. The majority of the sample is still only grappling with the use of basic techniques (see section 2.1. of the findings chapter). However it is important to note that user centred tools are important and needed in specialist areas such as computer-based design (Diangelo and Petrun, 1995)

What did emerge was that the newer the product to the company or to the market the more user testing and involvement is undertaken. This suggests that high risk factors that create greater the levels of uncertainty are key factors in stimulating SMEs to undertake user testing and involvement. However, this appears still to be infrequent.

Usefulness of Information Captured

One of the issues to emerge from reviewing *information capture methods* was that the literature frequently failed to indicate the quality of information captured by the relevant methods. Therefore one of aims of this study was to attempt to determine the quality of the information UK manufacturing companies captured. This study has defined quality within this context as information's usefulness in developing product design concepts.

The notion that customer involvement is essential in order gain an accurate understanding of *user needs* (Herstatt & von Hippell (1992)) is well known and the sample perceived the identification and collection of user needs is to be of most use. However this is not substantiated in terms of frequency of input and levels of success achieved (illustrated in sections 1.4 and 4.5 of the findings chapter).

Capturing information relating to the generation of requirements and product design specifications and testing new product ideas emerged as areas where the sample felt confident and the information captured was perceived to be useful. This substantiates the findings in section 1 and 2 of the findings chapter, which clearly indicate that the CDS is rear-end driven. Generating quality information for identifying new target markets emerged as the most difficult.

4 Key Areas of Uncertainty that SMEs Experience

Activities and Issues

The results of the study indicate that this sample was representative of other manufacturing companies. This point is supported by the findings of Souder and Moenaert (1992) that established that many companies experience uncertainty when attempting to identify user needs. This raises the question how can we reduce uncertainty?

In attempting determine the principle areas of uncertainty within the 6 key CDS activities and issues, the sample helped to verify the fact that the CDS is rear-end driven. What emerged from the findings was that the rear-end activities (hard issues - performance, functionality etc.) generated low levels of uncertainty where as front-end activities (soft issues) generated the highest levels of uncertainty. The reasons for uncertainty were identified as relating to: (1) lack of appropriate expertise and resources; (2) not enough time spent on front-end activities; (3) low risk / short term incremental strategies; and (4) the *familiarity syndrome*.

An apparent trend within the sample suggests, that many might be missing market opportunities through doing what they feel most comfortable with rather than doing what needs to be done. This has previously been referred to as the *familiarity syndrome* (see findings section 4.4).

The study established that the key reasons for uncertainty when undertaking the 6 CDS key activities related to: (1) a lack of expertise and appropriate resources (experience, processes and methods); and (2) sample companies not developing enough new ideas and subsequently not undertake CDS process enough.

Success & Failure

Hard issues emerged as the perceived most successful areas relating to developing functional acceptable products which supports the findings from section 4.6 and 4.7. This factor is not surprising when one considers that the key strengths associated with current product design models are based on: prescriptive tasks and stages to be undertaken; supporting design and project management issues; encouraging the realisation of performance requirements and encouraging the evaluation of best practice (Pugh 1982, March 1984, French 1985, Cross 1988, Pahl and Beitz 1988, Holt 1990).

A major contradiction emerged within the results of the findings relating to areas of success. The sample indicated that they perceive themselves to be successful at developing aesthetically pleasing products. This appears to be at odds with the findings in section 3.2, which clearly indicates that aesthetics is an element that is less frequently discussed with key stakeholders. The reasons why it is difficult area becomes apparent when discussing the reasons associated with failure within this section.

One area where one might have considered companies to be achieving considerable success would be introducing product improvements. This notion could be based on factors outlined in many NPD studies discussing the role and use incremental product innovation strategies (Craig & Hart (1992)). What emerged from this study was that the sampled UK manufacturing companies where achieving moderate levels of success. When seen in conjunction with establishing product design requirements / specifications it raises ‘ ‘are companies asking the right questions?’

The reasons attributed to success within the sample related to: (1) good communication; (2) usable data; (3) close contact with users / customers; (4) appropriate resources; and (5) knowledge and understanding of markets. These findings support the notions advanced by Sanders (1993) and Keeley (1993) that success cannot be achieved without introducing multiple information sources, particularly in relation to business and manufacturing issues. These findings also support issues identified with new product development research (Craig

& Hart (1992)). But they also pose the question ‘why are companies still not adopting proven best practices?’

Sanders (1994) raises an important question by asking why do so many products still fail despite the widespread use of market and usability testing. The point being raised here is that there exists today a wealth of knowledge associated with best practices and most importantly proven tools that can be used to implement best practice issues. But the question still remains why are companies, and in particular UK companies, are still not adopting proven best practices? To emphasise this point further, this statement can be clearly substantiated by referring to studies identified in the literature review for example Hopkins (1981); Cooper & Kleinschmidt (1987), DTI (1991)); Craig & Hart (1992)); Cooper and Kleinschmidt (1994). The following issues to be discussed in the remainder of the chapter should help to cast light on why these practices and tools are not being widely adopted in UK manufacturing companies.

The principles reason associated with failure within the sample in relation to the CDS process are attributed to: (i) a slow response to change; (ii) a lack of contact with end users; (iii) companies do not undertake process enough (stop start process); (iv) a lack of thoroughness in undertaking process; (v) adopting low risk / incremental strategies; (vi) being engineering driven; and (vii) a lack of expertise (front-end activities + soft issues). The lack of expertise has been recently highlighted by CBI (2011), which states that many UK businesses are reporting skill shortages.

The results also indicate that the sampled UK SME manufacturing companies specifically considered them to be unsuccessful in identifying new markets, selecting product design concepts, and introducing new products. Slappendel (1994) may have identified a generic condition. Her research found that where generic tools and methods are deployed they are dependent on issues such as, the level of expertise the company possesses, the availability of resources, and degree of competition within the core markets. This appears to be consistent with the finding of this study.

Conclusions

The study set out to answer four principle research questions (see introduction and findings). The purpose of answering these research questions was to develop a more in-depth understanding of UK SME manufacturing company practices, via the sample, in order to: (i) determine the actual level and frequency of activities that the SME sample typically use to identify and fulfil customer needs in front-end product development activities; (ii) establish concretely the processes and methods they regularly use to collect information from stakeholders; (iii) determine specifically the types of issues the SME sample normally discuss with stakeholders to identifying their needs; and (iv) identify the precise areas of uncertainty they routinely experience when trying to identify and fulfil customer needs in front-end product development activities. The intention of this study was to build upon existing research and to provide a level of granularity that would contribute new knowledge and help identify new insights of how to bridge the gap between theory (known value) and practice (adoption and use).

The validity and reliability of the study can be reasoned due the alignment of its key findings with previous studies. For example, the sampled UK SME manufacturing companies confirmed that they experience uncertainty when attempting to identify user needs, supporting the work of Souder and Moenaert (1992). They also agreed that the correct analysis and interpretation of market needs was critical to achieving success, which aligned with Walsh *et al* (1992) findings. However the SME sample indicated that little market research was done in the early stages of the process, which is consistent with the findings of Page and Rosenbaum (1992). Alarmingly, still after twenty nine years, the sample corroborated that the production of ideas was still guided by business and manufacturing parameters, supporting findings of the contemporary study by Hubel and Lusson (1984).

The findings from the SME sample also highlighted the gap between theory and practice. The analysis of the results indicated that the sample where not adopting two principle concepts relating to: (i) that users / customers are the best source of ideas (Herstatt & von Hippell, 1992); and (ii) that identifying user needs is an integral part of the product designs and development process (Ulrich and Eppinger, 1995). These two principle concepts underpin user centric design and contemporary new product development approaches. This then raises the question why?

Answering the question why is part of the contribution to new knowledge that this study makes. The following information will highlight several divisible contributions to new knowledge that this exploratory study (please see limitations) makes to the field, in relation to studies four key research questions. The following information will articulate the emergent contributions within the context of the six key CDS activities (A- F). Please see figure 38.

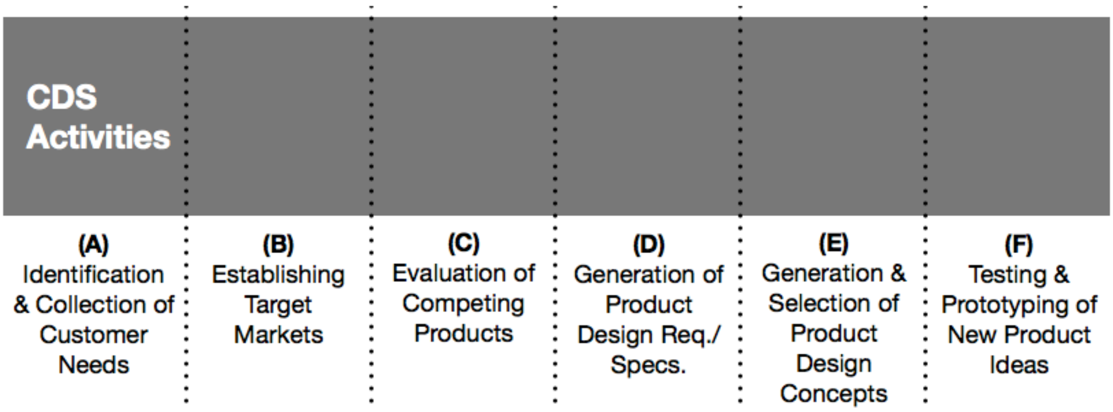

Figure 38 CDS Activities, Author

Firstly, the study set out to determine the actual level and frequency of activities that the SME sample typically uses to identify and fulfil customer needs in front-end product development activities. This study has specifically identified that the sample SMEs typically achieve high levels of customer involvement in activities F and E (rear end) and low customer involvement in activity A (front end). In addition, the areas with most frequent customer involvement (stakeholders) in the sample SMEs were found to be F and A. On further investigation, this finding only served to highlight the gap between theory and practice. When unpacking the nature of the stakeholders involved in activity A, the data indicated that the stakeholders typical involved were actually management team(s)/functions and distributors, not users or customers. These findings help to confirm that the sample SME activities are rear end driven. This insight may also help to contribute to understanding why SMEs typically place more emphasis on incremental innovation rather than new market product development.

Secondly, the investigation aimed to establish concretely the processes and methods that the sample SMEs regularly uses to collect information from stakeholders. The findings from this study have established that their front end activities (A-C) appear to be unstructured and driven by the use of informal methods, compared to rear end activities (D-F) which tend to be structured and utilising formal methods. These insights indicate that the capture of hard issues (i.e. performance, cost and usability) are driven by more formalised and structured processes and tools, and that rear end activities (D-F) are more established practices within the SME sample.

Thirdly, the study embarked on determining specifically the types of issues the SME sample normally discuss with stakeholders to identifying their needs. The findings support other studies (as previously discussed), that the identification and collection of user needs was perceived to be of most use by the sample, but in practice they typically focussed on discussing performance, cost and usability. This is highlighted by the finding that the most frequent stakeholders involved in discussion on needs, appears to be the management teams and distributors, not users or customers. This insight is a key contribution that this study makes. Again, this finding reinforces the assertion that more emphasis is consciously or unconsciously being placed on rear end activities. The following information on uncertainty will help to shed light on whether this occurrence is consciously or unconsciously taking place.

Fourthly, the objective was to identify the precise areas of uncertainty that the SME sample routinely experience when trying to identify and fulfil customer needs in front-end product development activities. This study has identified the emergence of two distinct areas of uncertainty relating to both front and rear end activities. In relation to front end activities (A-C) uncertainty relates to several factors: (i) a lack of resources and expertise, (ii) not enough end user contact, (iii) the adoption of low risk/incremental strategies, (iv) being too familiar with market, and (v) not undertake process enough. Uncertainty relating to rear end activities is attributed to; (i) being too engineering driven, (ii) a lack of expertise, (iii) not understanding user needs, (iv) not spending enough time on developing ideas properly, (v) manufacturing costs too high, and (vi) not undertake process enough. Identifying the causes of uncertainty is a key contribution that this study makes. Even though rear end activities appear to generate lower levels of uncertainty, three common areas of uncertainty bridge both front and rear end activities. These specifically relate to: (i) a lack of expertise (internal), (ii) a lack of understanding of user needs (contact), and (iii) not undertaking the process enough (time spent – experience). From these insights it is possible to assert that these key areas of uncertainty (lack of internal expertise, and experience; lack of contact with end users; and a lack of time spent on activities) are potential factors that impact on the innovation capabilities of SMEs.

These high levels of uncertainty combined with lower levels activity in the front end stages are key factors that impact on delivering success for SMEs in identifying and fulfilling customer needs in front-end product development activities. The 'uncertainty activity impact model' (UAI) has been developed in order to help to visualise the core findings from the study. The core findings are that the SME sample experience higher levels of uncertainty when undertaking front-end activities (A-C) in the search for soft issues; and (ii) they experience low levels of uncertainty when exploring hard issues. It also services to illustrate that sample SMEs CDS activities are rear end driven (D-F).

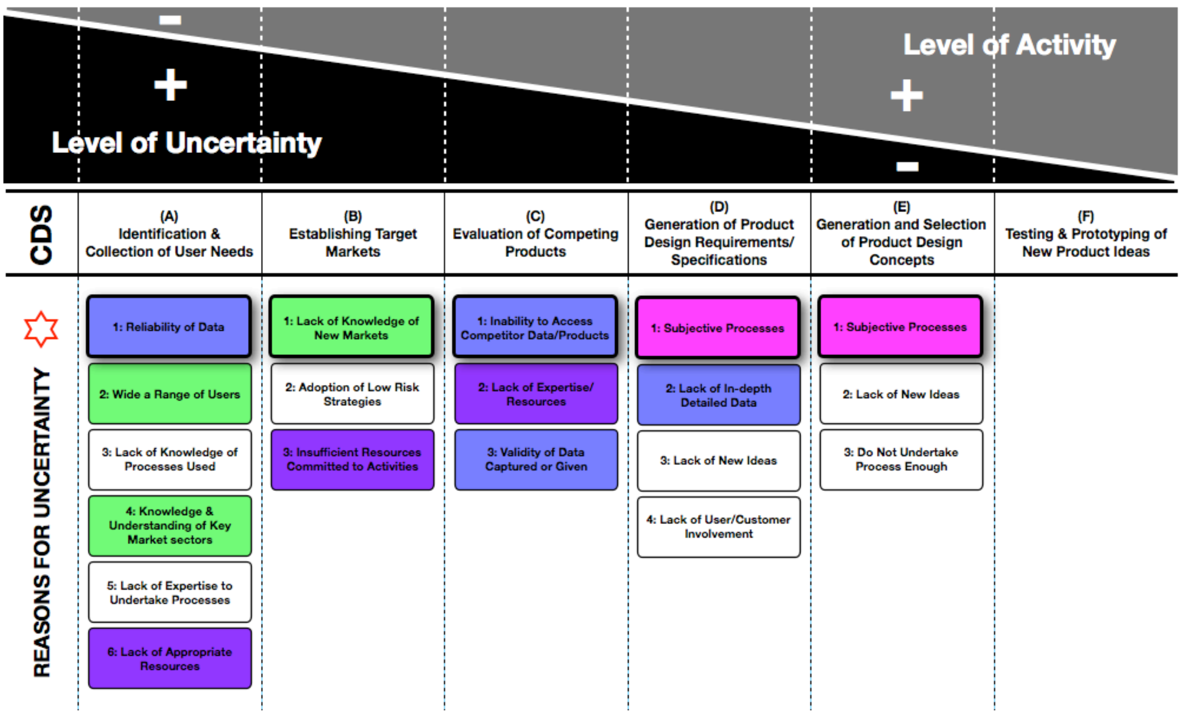

Figure 39 Uncertainty Activity Impact Model, Author

The UAI model has the potential to be developed into a positioning tool for SMEs (see figure 39). Its primary focus would be to help SMEs identify where their current practice emphasis lies and establish how to introduce new skills and expertise into their process to achieve more balance between front and rear-end activities. It can also help them to understand and address the typical reasons for uncertainty when undertaking key activities within the CDS.

Limitations

The study adopted a self-completion sample survey method. The disadvantages according to Robson (2011) of self-administered sample surveys are that they typically have low response rates, but he suggests that the advantages are that they encourage frankness when sensitive areas are being explored. In addition, the exploratory nature of the study's design could also be influenced sample size. The part-time nature of the study raises the cross-sectional design nature issue of time and relevancy at the point in which data is captured.

Three factors potentially impact on this study's findings: (i) validity, (ii) reliability and (iii) replication. Lecompte and Goets (1982) suggest that there are two forms of validity in relation to qualitative research; (i) internal validity - i.e. the effect between researcher's observation and the theoretical ideas being develop, and (ii) external validity – i.e. the amount of generalization of the findings.

This study has been designed around a self-completion sample survey method. This method is typically associated with low response rates (Robson, 2011) and could potentially impact on the validity and reliability of the findings if not properly considered in the design of the study. However, Robson (2011) suggests that the use of self-completion sample survey methods help to offset the typical disadvantages of interview surveys where data maybe affected by the characteristics of the interviewer and the interaction between the respondent and the researcher – reducing internal validity.

Guba and Lincoln (1994) propose two key criteria for assessing validity in qualitative studies: (i) credibility – relating to the believability and transferability of the findings, and (ii) applicability of the findings to other contexts. To address potential limitations of transferability and applicability, the study was designed to adopt a focussed, deep and detailed approach rather than broad and shallow study.

It could therefore be suggested that a limitation of this study is that it generalised. However, by developing a focussed study, based on a deep dive approach and underpinned by a triangulation strategy, it has generaterated findings that are transferable and applicable to other similar contexts – i.e., it is replicable (Guba and Lincoln, 1994). This study has developed indicative not definitive results that have contributed to the identification of the factors that contribute to uncertainty in front-end product development activities (CDS) in UK SMEs.

Future Research

On completion of the study, it was possible to identify the two key areas of uncertainty relating to: (1) involving users in the identification and collection of their needs; and (2) establishing target markets. Further research opportunities exist in a developing framework tools that can help SMEs introduce user centred design activities into the CDS practices (see Figure 40).

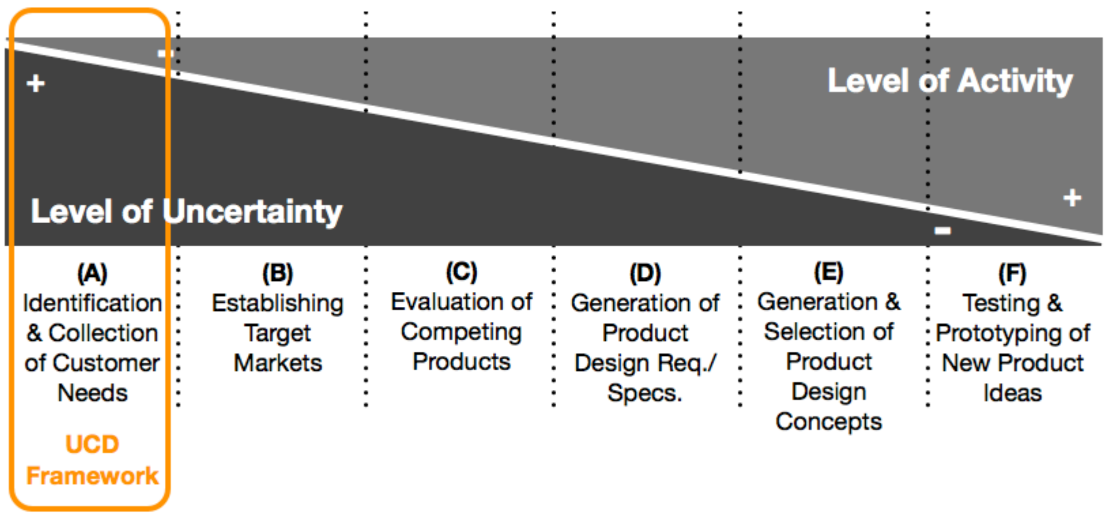

Figure 40: Potential Future Research Opportunities within the CDS (Author)

The current study has identified three key factors important to helping SMEs position user centred design activities more effectively. These issues could form the basis of further research and to help SMEs to better: (i) determine nature of user involvement within a product development project (design for (indirect), design with (participatory) and design by (co-creation)); (ii) decide upon the level of segmentation of the user profiles (segmented or semi-segment, un-segmented user profiles; e.g. same social group, same income bracket, same geographical location versus mixed or random); and (iii) establish the level of structure and formality within the processes and activities (unstructured/informal to formal/structured). These three parameters have the potential to help to locate and orientate product design and development projects in relation to core UCD information capture activities: (a) establishing customer needs; (b) determining the desired customer experiences; and (c) identifying the established expected technical standards of excellence.

A draft user centred decision (UCD) framework has been developed as a possible starting point (see Figure 41). The framework brings to life the point raised above and aims to help SMEs make choices in relation to: (i) level of user involvement, (ii) the level of customer segmentation, and (iii) project structure and formality of methods (see Figure 41). These decision are influenced by factors indicated in figure 24, specifically by staff expertise, knowledge and understanding of key market sectors, level of close contact with users / customers and the ability to establish easily definable markets.

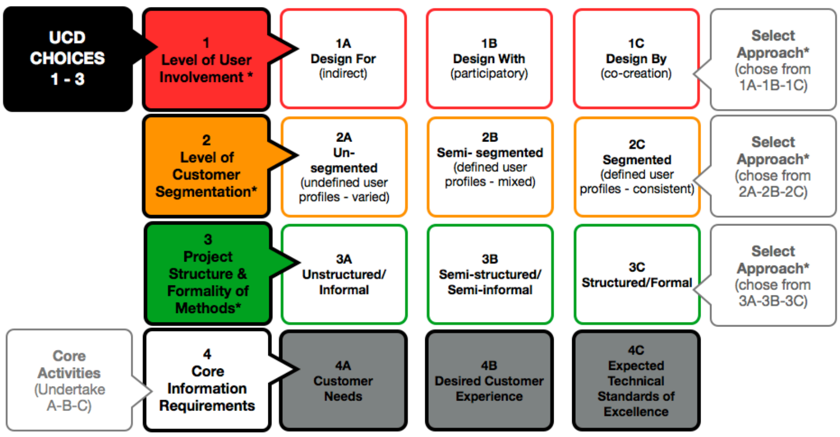

Figure 41: Draft User Centred Decision Making Framework for Reducing Uncertainty in the CDS Activities (Author)

The emphasis within the UCD framework is intended to be placed on helping the SME understand the interrelationship between internal expertise, the level of contact and access to users and their (the SMEs) ability to identify new market opportunities. However, the third factor is probably a study in itself. This interrelationship, or more importantly the SMEs capabilities to undertake these activities, influences the choices the SME makes. The objective of the UCD framework is to help SMEs move away from an over reliance on internal views (management teams) on the needs of user and market, and the use of unstructured and informal processes in their front-end activities. In order to illustrate the notion of choice, figure 42 helps to demonstrate the selection of choices that have then the potential to support the core information capture activities.

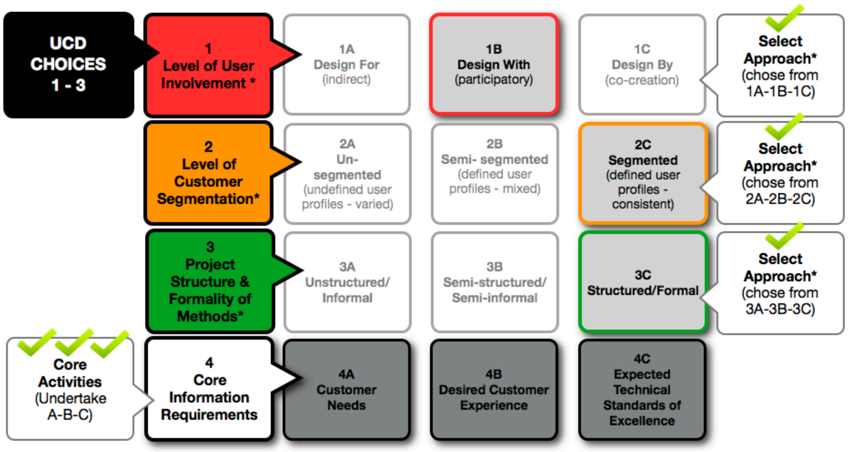

Figure 42: Example of Selected UCD Choices within UCD Framework, Author

To conclude, the study successfully answered the four key research questions. In the process of systematically investigating and resolving these questions it has highlighted a number of important factors that not only help fill current gaps in knowledge (i.e. what do SMEs actually do in practice) but also contributes to explaining why certain issues are taking place (i.e. what we can learn from those findings).

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Appendix 1

Research Questionnaire

Manchester Metropolitan University
Centre for International Business and Innovation
Business School: Management Division

Research Questionnaire

Establishing 'Best Practice' in identifying and developing 'Customer Needs' into 'Product Opportunities' in UK Manufacturing Companies

Company Information

Key Product Areas:________________________________

Company Name:________________ Parent / Division:________________

Name:________________ Position:________________

Department:________________ Date:________________

Date Company established:________________________________

Number of Employees:________________________________

Sales Turnover:________________________________

Annual Average sales Growth Over Last Three Years:________________

Name of Key Competitors:________________________________

EXAMPLE QUESTION

(X) PLEASE INDICATE THE <u>NATURE OF THE PROCESSES & METHODS USED</u> TO COLLECT INFORMATION WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs

• a structured process	1	2	3	4	5
• Informal techniques / Methods	1	2	3	4	5

Please describe briefly your current process (es) and method(s):

use of focus groups with key customers, sales and marketing brainstorming sessions

SECTION 1: CUSTOMER INVOLVEMENT

1.1 PLEASE INDICATE HOW IMPORTANT IS FULFILLING CUSTOMER NEEDS TO YOUR BUSINESS SUCCESS?

Scale: 1 = very important, 3 = neither important or unimportant, 5 = not at all important

1 2 3 4 5

1.2 PLEASE INDICATE THE CURRENT NATURE OF CUSTOMER INVOLVEMENT WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Formal; 3 = Informal; 5 = No Input

(A)	Identification & Collection of Customer Needs	1	2	3	4	5
(B)	Establishing Target Markets	1	2	3	4	5
(C)	Evaluation of Competing Products	1	2	3	4	5
(D)	Generation of Product Design Requirements / Specifications	1	2	3	4	5
(E)	Generation & Selection of Product Design Concepts	1	2	3	4	5
(F)	Testing & Prototyping of New Product Ideas	1	2	3	4	5

1.3 PLEASE INDICATE THE FREQUENCY OF CUSTOMER INVOLVEMENT WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A)	Identification & Collection of Customer Needs	1	2	3	4	5
(B)	Establishing Target Markets	1	2	3	4	5
(C)	Evaluation of Competing Products	1	2	3	4	5
(D)	Generation of Product Design Requirements / Specifications	1	2	3	4	5
(E)	Generation & Selection of Product Design Concepts	1	2	3	4	5
(F)	Testing & Prototyping of New Product Ideas	1	2	3	4	5

1.4 PLEASE INDICATE WHICH STAKEHOLDERS ARE TYPICALLY INVOLVED WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs

•	end users	1	2	3	4	5
•	purchasers	1	2	3	4	5
•	retailers	1	2	3	4	5
•	distributors	1	2	3	4	5
•	installers / service engineers	1	2	3	4	5
•	assemblers / workforce	1	2	3	4	5
•	management team[s] / functions	1	2	3	4	5

• manufacturers / suppliers	1 2 3 4 5

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(B) Establishing Target Markets

• end users	1 2 3 4 5
• purchasers	1 2 3 4 5
• retailers	1 2 3 4 5
• distributors	1 2 3 4 5
• installers / service engineers	1 2 3 4 5
• assemblers / workforce	1 2 3 4 5
• management team[s] / functions	1 2 3 4 5
• manufacturers / suppliers	1 2 3 4 5

(C) Evaluation of Competing Products

• end users	1 2 3 4 5
• purchasers	1 2 3 4 5
• retailers	1 2 3 4 5
• distributors	1 2 3 4 5
• installers / service engineers	1 2 3 4 5
• assemblers / workforce	1 2 3 4 5
• management team[s] / functions	1 2 3 4 5
• manufacturers / suppliers	1 2 3 4 5

(D) Generation of Product Design Requirements / Specifications

• end users	1 2 3 4 5
• purchasers	1 2 3 4 5
• retailers	1 2 3 4 5
• distributors	1 2 3 4 5
• installers / service engineers	1 2 3 4 5
• assemblers / workforce	1 2 3 4 5
• management team[s] / functions	1 2 3 4 5
• manufacturers / suppliers	1 2 3 4 5

(E) Generation & Selection of Product Design Concepts

• end users	1 2 3 4 5
• purchasers	1 2 3 4 5
• retailers	1 2 3 4 5
• distributors	1 2 3 4 5
• installers / service engineers	1 2 3 4 5
• assemblers / workforce	1 2 3 4 5
• management team[s] / functions	1 2 3 4 5
• manufacturers / suppliers	1 2 3 4 5

(F) Testing & Prototyping of New Product Ideas

• end users	1	2	3	4	5
• purchasers	1	2	3	4	5
• retailers	1	2	3	4	5
• distributors	1	2	3	4	5
• installers / service engineers	1	2	3	4	5
• assemblers / workforce	1	2	3	4	5
• management team[s] / functions	1	2	3	4	5
• manufacturers / suppliers	1	2	3	4	5

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.1 PLEASE INDICATE THE NATURE OF THE PROCESSES & METHODS USED TO COLLECT INFORMATION WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs

• a structured process	1	2	3	4	5
• an unstructured process	1	2	3	4	5
• Formal techniques / methods	1	2	3	4	5
• Informal techniques / Methods	1	2	3	4	5

Please describe briefly your current process (es) and method(s):

....

(B) Establishing Target Markets

• a structured process	1	2	3	4	5
• an unstructured process	1	2	3	4	5
• Formal techniques / methods	1	2	3	4	5
• Informal techniques / Methods	1	2	3	4	5

Please describe briefly your current process (es) and method(s):

....

(C) Evaluation of Competing Products

• a structured process	1	2	3	4	5
• an unstructured process	1	2	3	4	5
• Formal techniques / methods	1	2	3	4	5
• Informal techniques / Methods	1	2	3	4	5

Please describe briefly your current process (es) and method(s):

....

(D) Generation of Product Design Requirements / Specifications

• a structured process	1	2	3	4	5
• an unstructured process	1	2	3	4	5
• Formal techniques / methods	1	2	3	4	5
• Informal techniques / Methods	1	2	3	4	5

Please describe briefly your current process (es) and method(s):

....

(E) Generation & Selection of Product Design Concepts

• a structured process	1	2	3	4	5

- an unstructured process 1 2 3 4 5
- Formal techniques / methods 1 2 3 4 5
- Informal techniques / Methods 1 2 3 4 5

Please describe briefly your current process (es) and method(s):

....

(F) Testing & Prototyping of New Product Ideas

- a structured process 1 2 3 4 5
- an unstructured process 1 2 3 4 5
- Formal techniques / methods 1 2 3 4 5
- Informal techniques / Methods 1 2 3 4 5

Please describe briefly your current process (es) and method(s):

....

2.2 PLEASE INDICATE THE TYPE OF FORMATS CURRENTLY USED TO <u>COMMUNICATE AND REPRESENT</u> THE FOLLOWING ISSUES TO EITHER CUSTOMERS OR OTHER INTERNAL FUNCTIONS:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identified User Needs

- formal presentations 1 2 3 4 5
- written report[s] 1 2 3 4 5
- memos' 1 2 3 4 5
- 2D visuals N/A
- 3D CAD models N/A
- appearance models / prototypes N/A
- other

....

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(B) Target Markets

- formal presentations 1 2 3 4 5
- written report[s] 1 2 3 4 5
- memos' 1 2 3 4 5
- 2D visuals N/A
- 3D CAD models N/A
- appearance models / prototypes N/A
- other

....

(C) Attributes of Competing Product

- formal presentations 1 2 3 4 5
- written report[s] 1 2 3 4 5
- memos' 1 2 3 4 5

• 2D visuals	N/A				
• 3D CAD models	N/A				
• appearance models / prototypes	N/A				
• other					

(D) Product Design Requirements

• formal presentations	1	2	3	4	5
• written report[s]	1	2	3	4	5
• memos'	1	2	3	4	5
• 2D visuals	N/A				
• 3D CAD models	N/A				
• appearance models / prototypes	N/A				
• other					

(E) Product Design Concepts

• formal presentations	1	2	3	4	5
• written report[s]	1	2	3	4	5
• memos'	1	2	3	4	5
• 2D visuals	1	2	3	4	5
• 3D CAD models	1	2	3	4	5
• appearance models / prototypes	1	2	3	4	5
• other					

(F) New Product Ideas

• formal presentations	1	2	3	4	5
• written report[s]	1	2	3	4	5
• memos'	1	2	3	4	5
• 2D visuals	1	2	3	4	5
• 3D CAD models	1	2	3	4	5
• appearance models / prototypes	1	2	3	4	5
• other					

2.3 PLEASE INDICATE <u>WHO UNDERTAKES THE FOLLOWING TASKS</u> WITHIN YOUR COMPANY:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs					
• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(B) Establishing Target Markets					
• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(C) Evaluation of Competing Products					
• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(D) Generation of Product Design Req. / Specs					
• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(E) Generation of Product Design Concepts

• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(F) Selection of Product Design Concepts

• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

(G) Testing & Prototyping of New Product Idea

• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• marketing personnel	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• engineering / manufacturing personnel	1	2	3	4	5
• design manager	1	2	3	4	5
• design personnel	1	2	3	4	5
• other					

2.4 PLEASE INDICATE WHO HAS THE <u>RESPONSIBILITY AND AUTHORITY</u> WITHIN THE COMPANY FOR THE FOLLOWING ACTIVITIES :

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs

• chairman / managing director	1	2	3	4	5
• member of senior management team	1	2	3	4	5
• marketing manager	1	2	3	4	5
• engineering / manufacturing manager	1	2	3	4	5
• design manager	1	2	3	4	5
• other					

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(B) Establishing Target Markets

• chairman / managing director	1 2 3 4 5
• member of senior management team	1 2 3 4 5
• marketing manager	1 2 3 4 5
• engineering / manufacturing manager	1 2 3 4 5
• design manager	1 2 3 4 5
• other	

(C) Evaluation of Competing Products

• chairman / managing director	1 2 3 4 5
• member of senior management team	1 2 3 4 5
• marketing manager	1 2 3 4 5
• engineering / manufacturing manager	1 2 3 4 5
• design manager	1 2 3 4 5
• other	

(D) Generation of Product Design Req. / Spec

• chairman / managing director	1 2 3 4 5
• member of senior management team	1 2 3 4 5
• marketing manager	1 2 3 4 5
• engineering / manufacturing manager	1 2 3 4 5
• design manager	1 2 3 4 5
• other	

(E) Generation & Selection of Product Design Concepts

• chairman / managing director	1 2 3 4 5
• member of senior management team	1 2 3 4 5
• marketing manager	1 2 3 4 5
• engineering / manufacturing manager	1 2 3 4 5
• design manager	1 2 3 4 5
• other	

(F) Testing & Prototyping of New Product Ideas

• chairman / managing director	1 2 3 4 5
• member of senior management team	1 2 3 4 5
• marketing manager	1 2 3 4 5
• engineering / manufacturing manager	1 2 3 4 5
• design manager	1 2 3 4 5
• other	

SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

PLEASE INDICATE WHO ARE YOUR MOST FREQUENTLY USED STAKEHOLDERS IN YOUR REQUIREMENTS CAPTURE PROCESS:

Key : 1 = end users; **2** = purchasers; **3** = retailers; **4** = distributors; **5** = installers / service engineers; **6** = assemblers / workforce; **7** = management team[s] / functions; **8** = manufacturers / suppliers

(A)	Identification & Collection of Customer Needs	1	2	3	4	5	6	7	8
(B)	Establishing Target Markets	1	2	3	4	5	6	7	8
(C)	Evaluation of Competing Products	1	2	3	4	5	6	7	8
(D)	Generation of Product Design Req./ Specifications	1	2	3	4	5	6	7	8
(E)	Generation & Selection of Product Design Concepts	1	2	3	4	5	6	7	8
(F)	Testing & Prototyping of New Product Ideas	1	2	3	4	5	6	7	8

3.1 PLEASE INDICATE THE TYPES OF ISSUES DISCUSSED WITH STAKEHOLDERS WITHIN THE FOLLOWING ACTIVITIES:

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Need					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5
• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5
(B) Establishing Target Markets					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5
• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5
(C) Evaluation of Competing Products					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5

• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5
(D) Generation of Product Design Requirements / Specifications					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5
• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5
(E) Generation & Selection of Product Design Concepts					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5
• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5
(F) Testing & Prototyping of New Product Ideas					
• Aesthetics *[form, colour, finishes, etc.]*	1	2	3	4	5
• Product Improvements	1	2	3	4	5
• New Product Opportunities [either new to company or market]	1	2	3	4	5
• Product Usability	1	2	3	4	5
• Product performance / specification	1	2	3	4	5
• Design for manufacture / assembly	1	2	3	4	5
• Cost / Price	1	2	3	4	5

3.2 PLEASE INDICATE THE <u>TYPE OF INFORMATION SOUGHT</u> WITHIN THE FOLLOWING ACTIVITIES:

example:

- specific data / information - relates to actual data relating to specific requirements, issues or ideas
- generic data / information - relates to general feedback about requirements, issues or ideas

Scale: 1 = Always, 3 = Sometimes, 5 = Never

(A) Identification & Collection of User Needs					
• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

(B) Establishing Target Markets

• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

(C) Evaluation of Competing Products

• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

(D) Generation of Product Design Requirements / Specifications

• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

(E) Generation & Selection of Product Design Concepts

• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

(F) Testing & Prototyping of New Product Ideas

• specific data / information	1	2	3	4	5
• generic data / information	1	2	3	4	5
• other	1	2	3	4	5

Please describe briefly the typical information obtained

....

3.3 PLEASE INDICATE THE <u>QUALITY OF THE INFORMATION CAPTURED</u> WITHIN EACH OF THE FOLLOWING ACTIVITIES:

Scale: 1 = very useful, 3= neither useful nor un-useful, 5 = no use

(A)	Identification & Collection of User Needs	1	2	3	4	5
(B)	Establishing Target Markets	1	2	3	4	5
(C)	Evaluation of Competing Products	1	2	3	4	5
(D)	Generation of Product Design Requirements / Specifications	1	2	3	4	5
(E)	Generation & Selection of Product Design Concepts	1	2	3	4	5
(F)	Testing & Prototyping of New Product Ideas	1	2	3	4	5

SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

Many companies often feel unskilled and inexperienced in undertaking 'requirements capture processes' thus leading to uncertainty.

4.1 PLEASE INDICATE THE LEVEL OF UNCERTAINTY THAT YOUR COMPANY EXPERIENCES WHEN UNDERTAKING THE FOLLOWING ACTIVITIES:

Scale: 1 = Low level of uncertainty, 3= Neither High nor Low, 5 = High level of uncertainty

(A) Identifying & Collecting User Needs 1 2 3 4 5
Reasons for Uncertainty

....

(B) Establishing Target Markets 1 2 3 4 5
Reasons for Uncertainty

....

(C) Evaluating Competing Products 1 2 3 4 5
Reasons for Uncertainty

....

(D) Generating Product Design Requirements / Specifications 1 2 3 4 5
Reasons for Uncertainty

....

(E) Generating & Selecting Product Design Concepts 1 2 3 4 5
Reasons for Uncertainty

....

(F) Testing & Prototyping of New Product Ideas1 2 3 4 5

Reasons for Uncertainty

4.2 PLEASE INDICATE THE <u>LEVEL OF UNCERTAINTY</u> THAT YOU EXPERIENCE WHEN DISCUSSING THE FOLLOWING ISSUES:

Scale: 1 = Low level of uncertainty, 3= Neither High nor Low, 5 = High level of uncertainty

(A) Aesthetics [form, colour, finishes etc.] 1 2 3 4 5

Reasons for Uncertainty

(B) Product Improvements 1 2 3 4 5

Reasons for Uncertainty

(C) New Product Opportunities [either new to company or market] 1 2 3 4 5

Reasons for Uncertainty

(D) Product Usability 1 2 3 4 5

Reasons for Uncertainty

(E) Product performance / specification 1 2 3 4 5

Reasons for Uncertainty

(F) Design for manufacture / assembly 1 2 3 4 5

Reasons for Uncertainty

(G) Costs 1 2 3 4 5

Reasons for Uncertainty

(H) Any other Issues:

4.3 PLEASE INDICATE THE LEVEL OF SUCCESS YOU FEEL YOUR EXISTING COMPANY PRACTICES ACHIEVE IN:

Scale: 1 = successful, 3 = neither successful nor unsuccessful, 5 = unsuccessful

(A) Identifying Customer / User Needs 1 2 3 4 5

Reasons for Success/ Failure

(B) Establishing Target Markets 1 2 3 4 5

Reasons for Success/ Failure

(C) Evaluating Competing Products 1 2 3 4 5

Reasons for Success/ Failure

(D) Determining and Introducing Product Improvements 1 2 3 4 5

Reasons for Success/ Failure

(E) Introducing New Products [either new to company or market] 1 2 3 4 5

Reasons for Success/ Failure

(F) Establishing Product Design Requirements / Specifications 1 2 3 4 5

Reasons for Success/ Failure

(G) Selecting Product Design Concepts 1 2 3 4 5

Reasons for Success/ Failure

(H) Developing Aesthetically Pleasing Products 1 2 3 4 5

[form, colour, finishes etc.]

Reasons for Success/ Failure

(I) Functionally Acceptable Products [Operation & Use] 1 2 3 4 5

Reasons for Success/ Failure

(J) Determining Product Price Points 1 2 3 4 5

Reasons for Success/ Failure

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE. I HOPE THAT YOU FOUND IT OF INTEREST. A SUMMARY OF OUR FINDINGS WILL BE SENT TO YOU ON COMPLETION OF THE STUDY.

SIMON BOLTON

Appendix 2

Data Book

		13	15	2	3	1	4	5	6	12	7	8	9	10	11	14
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		M	M	M	M	G	G	G	G	G	SP	SP	SP	SP	SP	SP
X1	Y	101	35	25	20	30	50	15	31	33	110	79	109	22	32	10
X2	E	1200	65	51	180	20	45	28	550	18	70	80	318	170	150	120
X3	T	200	2.5	9.5	16	3	3.5	1.8	60	0.75	6	3.5	32	20	12	9.5
X4	%	15	6	12.5	2.5	8	M50	8	17	6	5	5	11	0	0	12
1.1		1	2	1	1	1	2	1	1	1	1	1	1	1	1	1
1.2a		2	5	1	2	2	2	3	1	3	3	2	3	3	1	3
1.2b		3	3	1	2	1	2	4	1	2	3	2	4	3	2	2
1.2c		1	5	1	3	2	2	4	1	1	3	1	4	4	2	1
1.2d		1	4	1	1	2	2	4	1	3	2	1	2	3	3	2
1.2e		1	5	1	1	2	3	3	1	5	2	3	3	2	2	1
1.2f		1	2	1	1	3	4	3	1	5	2	1	2	2	1	1
1.3a		2	5	2	3	1	3	4	1	2	3	2	3	4	1	1
1.3b		2	5	1	3	3	3	4	1	2	3	2	2	4	2	3
1.3c		2	5	1	3	2	3	4	2	1	3	3	3	3	4	1
1.3d		3	5	3	3	1	3	3	1	3	2	2	3	3	4	1
1.3e		2	5	3	3	2	3	3	1	1	2	3	2	4	3	2
1.3f		1	5	3	3	2	3	3	1	3	2	1	1	3	2	1
1.4A1		1	5	2	3	1	2	4	1	2	3	3	2	3	2	2
1.4A2		2	4	1	3	1	2	3	1	1	1	4	3	4	2	0
1.4A3		2	5	5	5	1	5	3	1	0	2	3	0	5	3	0
1.4A4		2	5	1	3	1	1	1	0	0	2	3	3	3	2	1
1.4A5		4	3	3	3	1	4	2	1	3	3	2	2	5	0	2
1.4A6		3	3	3	4	1	5	3	1	3	4	3	2	5	5	0
1.4A7		1	1	1	2	1	2	1	1	1	3	2	2	4	3	2
1.4A8		3	5	4	4	1	5	3	1	4	2	2	2	5	4	4
1.4B1		1	5	1	3	3	2	4	3	3	2	4	1	3	4	3
1.4B2		3	5	1	3	3	2	4	3	1	2	3	4	5	2	0
1.4B3		2	5	5	5	1	5	3	1	0	2	2	0	5	1	0
1.4B4		2	5	1	3	1	2	2	0	0	2	2	0	2	1	2
1.4B5		3	5	3	4	3	5	3	5	3	4	3	5	5	0	0
1.4B6		4	5	4	4	3	5	5	5	3	3	3	5	5	5	4
1.4B7		1	1	1	2	1	2	2	5	1	3	2	2	5	2	2
1.4B8		4	5	1	4	1	5	5	3	3	2	2	4	5	4	5
1.4C1		2	5	1	3	3	2	4	3	1	3	4	2	3	4	2
1.4C2		3	5	1	4	3	2	4	3	1	3	4	2	5	3	0
1.4C3		3	5	5	5	3	5	2	1	0	3	3	3	5	2	0
1.4C4		3	5	5	3	3	3	2	0	0	3	2	0	4	1	1
1.4C5		4	5	5	5	2	4	2	1	4	3	3	4	3	0	0
1.4C6		3	5	5	5	5	5	4	4	4	3	3	2	5	5	4
1.4C7		1	5	3	3	2	2	3	4	1	2	1	2	1	2	2
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1.4D2		4	5	3	4	5	2	4	2	1	2	3	3	5	2	0
1.4D3		4	5	5	5	2	5	3	2	0	2	3	0	5	2	0
1.4D4		3	5	1	4	2	3	2	0	0	2	3	3	4	1	1
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1.4D7		1	1	1	2	1	2	2	1	1	2	2	1	1	2	2

1.4D8	1	5	1	4	1	5	4	1	3	2	2	5	3	3	5
1.4E.1	2	5	3	4	4	4	2	2	3	2	2	2	3	3	2
1.4E.2	3	5	3	4	2	4	3	2	3	3	3	3	5	2	0
1.4E.3	4	5	5	5	2	5	3	1	0	3	3	0	5	2	0
1.4E.4	3	5	1	4	2	3	1	0	0	3	3	0	3	1	1
1.4E.5	3	5	5	4	3	3	3	3	2	4	3	4	5	0	0
1.4E.6	3	5	5	5	3	5	3	3	3	3	2	2	5	5	4
1.4E.7	1	1	1	2	1	2	2	3	1	2	1	4	1	2	2
1.4E.8	3	5	1	4	1	5	4	1	4	3	1	4	3	3	5
1.4F1	2	5	3	3	1	3	2	3	4	1	3	1	3	3	2
1.4F2	4	5	3	3	2	3	2	3	4	4	3	2	5	3	0
1.4F3	4	5	5	5	2	5	2	5	0	4	3	0	5	2	0
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1.4F5	4	5	5	3	2	5	3	5	3	2	3	3	3	0	0
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1.4F7	1	1	5	2	2	2	3	1	1	2	2	1	3	2	3
1.4F8	1	3	1	3	1	5	4	1	4	2	2	4	5	4	5
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2.1A3	3	5	3	4	2	2	3	3	4	2	2	4	4	3	4
2.1A4	2	5	3	3	1	4	2	3	2	3	5	4	2	3	2
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2.1B2	2	1	5	2	2	4	2	3	4	3	3	3	2	2	3
2.1B3	2	5	1	3	2	2	4	4	2	4	3	4	4	3	3
2.1B4	3	1	3	3	2	4	2	3	4	3	4	4	2	3	3
2.1C1	1	5	1	4	1	2	4	3	3	3	2	1	2	2	3
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2.1C4	4	5	5	2	1	4	2	3	2	2	3	2	3	3	3
2.1D1	1	5	1	1	1	4	3	1	2	1	1	1	4	2	2
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2.1D4	4	1	5	4	1	2	2	3	2	4	4	2	1	3	4
2.1E.1	2	5	1	2	1	4	4	1	3	1	2	2	5	2	3
2.1E.2	4	1	5	4	1	2	3	3	2	4	3	4	3	2	3
2.1E.3	2	5	1	2	1	4	4	1	3	1	2	3	5	1	3
2.1E.4	4	1	5	4	1	2	3	3	2	4	3	3	3	3	3
2.1F1	2	3	1	2	1	5	2	1	1	2	1	1	3	1	2
2.1F2	3	3	5	4	1	4	4	3	5	4	3	5	5	5	4
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2.2A3	2	5	3	3	1	4	2	3	1	3	2	3	2	2	2
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2.2A5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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2.2B1	1	5	3	3	2	4	2	5	5	2	2	1	3	1	4
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2.2B3	1	5	3	3	2	0	2	3	1	4	2	2	3	3	2
2.2B4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
2.2B5	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2.2B6	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0

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2.2C3	2	5	3	3	2	5	4	3	2	4	2	3	2	3	2
2.2C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2C6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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2.2D2	1	5	1	2	2	1	2	1	2	2	2	2	2	2	1
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2.2D4	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0
2.2D5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.2D6	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
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2.3B5	5	5	0	5	4	0	0	5	3	4	4	1	5	5	3
2.3B6	2	5	0	5	4	0	0	1	0	3	4	1	5	4	0
2.3B7	2	5	0	5	4	0	0	3	3	3	4	1	5	5	0
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2.3C4	5	5	0	2	2	0	0	1	2	3	3	1	1	3	1
2.3C5	4	5	0	2	2	0	0	1	4	3	3	1	1	3	1
2.3C6	2	5	0	3	2	1	0	1	0	2	2	1	1	1	0
2.3C7	1	5	0	3	2	0	0	1	2	2	2	1	1	2	0
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2.3E.4	5	5	0	3	2	0	0	1	5	3	2	1	1	4	2
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2.3E.6	2	5	0	2	2	1	0	1	0	2	2	1	1	3	0
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2.3F6	1	5	0	3	1	1	0	1	0	2	3	1	1	2	0
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2.4A3	2	5	1	2	1	0	0	1	5	2	2	1	1	1	0
2.4A4	4	5	0	4	3	0	0	1	5	4	3	2	3	5	4
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2.4B4	5	5	0	5	3	0	0	5	5	4	4	3	5	5	4
2.4B5	3	5	0	5	5	2	0	1	5	4	4	3	5	5	0
2.4B6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2.4C1	5	5	3	4	3	2	0	1	1	2	3	3	5	2	3
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2.4C5	1	5	0	3	1	2	0	1	5	3	2	1	2	1	0
2.4C6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
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2.4D3	2	5	1	2	2	3	0	1	5	3	3	1	1	1	0
2.4D4	3	5	0	4	4	0	0	1	3	2	3	1	1	5	1
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2.4E.5	1	5	0	2	1	2	0	1	5	2	3	1	1	2	0
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2.4F3	3	5	1	5	3	0	0	5	5	2	3	1	2	1	0

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2.4F6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
3.0A	1	7	7	1	1	1	1	1	1	2	4	1	1	3	1	2	7	4
3.0B	1	7	7	7	3	1	4	3	1	2	3	1	4	4	1	2	7	7
3.0C	1	7	7	7	3	2	1	7	1	7	3	7	5	7	1	5	7	3
3.0D	1	7	7	7	2	7	4	1	1	7	7	7	1	3	1	0	0	5
3.0E	1	7	7	7	3	7	4	7	1	7	7	7	7	4	6	0	0	7
3.0F	1	7	7	7	7	2	1	6	1	1	7	1	1	4	1	5	7	3
3.1A1	1	5	1	1	1	3	2	1	2	1	1	1	3	1	4			
3.1A2	1	5	3	1	1	2	2	1	2	1	2	1	3	1	1			
3.1A3	1	5	3	1	2	2	3	1	1	2	3	1	3	2	1			
3.1A4	1	5	1	1	1	4	1	1	1	2	2	1	3	1	1			
3.1A5	1	5	1	1	1	3	2	1	1	2	1	1	3	1	1			
3.1A6	3	5	3	1	5	5	2	1	2	3	3	1	5	3	2			
3.1A7	2	5	1	1	1	2	2	1	1	3	3	1	1	1	2			
3.1B1	1	5	1	2	3	5	3	1	2	2	3	1	3	1	4			
3.1B2	1	2	3	1	1	2	3	1	2	2	3	1	3	1	2			
3.1B3	1	2	3	1	1	0	2	1	3	2	3	1	3	2	1			
3.1B4	1	3	1	1	3	3	2	1	3	2	2	1	3	1	2			
3.1B5	1	3	1	1	3	2	1	1	3	2	1	1	3	1	1			
3.1B6	3	4	3	1	5	5	4	1	3	3	2	1	3	3	2			
3.1B7	1	3	1	2	1	1	1	1	3	2	0	1	2	1	2			
3.1C1	1	5	1	3	2	4	3	1	5	3	1	1	3	1	4			
3.1C2	1	5	5	3	2	2	2	1	2	2	1	1	1	1	2			
3.1C3	1	5	5	3	2	3	4	1	2	2	2	1	1	3	2			
3.1C4	1	5	1	3	1	2	2	1	1	2	2	1	1	1	2			
3.1C5	1	5	1	3	1	2	1	1	1	2	2	1	1	1	1			
3.1C6	1	5	5	3	3	2	4	1	3	2	3	1	4	3	1			
3.1C7	1	5	1	3	1	1	1	1	1	2	2	1	2	1	1			
3.1D1	2	5	3	3	1	3	2	1	4	2	3	1	1	1	4			
3.1D2	2	3	3	3	1	3	2	1	3	2	2	1	2	2	2			
3.1D3	2	2	3	3	2	1	3	1	3	1	3	1	2	3	2			
3.1D4	1	3	3	3	1	2	2	1	3	2	2	1	3	1	2			
3.1D5	1	2	3	3	1	2	2	1	2	2	2	1	1	1	1			
3.1D6	2	4	5	3	3	2	2	1	3	2	2	1	4	3	2			
3.1D7	1	3	1	3	1	2	2	1	2	2	3	1	1	1	2			
3.1E.1	2	5	3	3	3	4	3	1	4	2	2	1	2	1	4			
3.1E.2	2	5	3	3	3	4	2	1	3	2	2	1	2	2	3			
3.1E.3	2	3	3	3	3	4	3	1	3	1	2	1	2	1	3			
3.1E.4	1	3	1	3	3	4	2	1	4	2	2	1	2	1	3			
3.1E.5	1	3	1	3	3	4	2	1	3	2	1	1	1	1	3			
3.1E.6	1	3	5	3	3	4	2	1	3	2	2	1	4	3	2			
3.1E.7	1	3	1	3	3	4	2	1	2	2	2	1	2	1	2			
3.1F1	3	3	1	3	1	4	4	5	5	2	3	1	1	2	4			
3.1F2	2	3	1	3	1	4	2	1	1	2	3	1	1	2	3			
3.1F3	2	3	1	3	2	4	4	5	1	2	3	1	2	2	4			
3.1F4	1	3	1	3	1	2	1	1	2	2	3	1	3	1	3			
3.1F5	1	3	1	3	1	2	1	1	2	2	1	1	2	1	1			
3.1F6	1	3	5	3	4	3	1	1	2	2	2	1	5	3	1			
3.1F7	1	3	1	3	1	1	2	5	3	2	2	1	2	1	1			
3.2A1	1	5	3	2	2	0	3	3	1	2	1	1	3	2	2			
3.2A2	1	5	3	2	2	0	2	3	4	2	3	1	2	3	1			

3.2A3	0	0	3	0	0	0	0	3	3	3	3	1	0	0	0
3.2B1	1	2	1	2	3	0	2	1	1	1	1	1	3	2	2
3.2B2	1	2	3	2	3	0	2	1	3	2	2	1	3	3	1
3.2B3	0	2	3	0	3	0	0	1	0	3	3	1	0	4	0
3.2C1	1	2	1	2	3	0	3	1	1	2	1	3	3	1	1
3.2C2	2	2	1	2	3	0	2	3	5	2	2	3	3	3	2
3.2C3	0	2	3	0	3	0	0	3	0	3	3	3	0	4	0
3.2D1	1	3	1	2	2	0	3	1	4	1	1	1	1	1	1
3.2D2	1	3	1	2	2	0	2	1	2	2	2	1	0	2	1
3.2D3	0	3	1	0	0	0	0	1	0	3	3	3	0	0	0
3.2E.1	1	5	1	2	2	0	3	1	1	1	1	1	2	1	2
3.2E.2	2	5	1	2	1	0	3	1	5	2	2	1	4	3	1
3.2E.3	0	5	1	0	0	0	0	1	0	3	3	2	0	3	0
3.2F1	1	5	1	2	2	0	2	3	1	1	1	1	1	1	2
3.2F2	2	5	1	2	1	0	2	3	5	2	2	1	0	4	1
3.2F3	0	5	1	0	0	0	0	3	0	3	3	1	0	0	0
3.3A	1	4	1	1	2	2	2	2	1	1	1	1	2	2	2
3.3B	2	3	3	2	2	2	3	2	2	1	2	1	3	2	2
3.3C	1	5	1	3	1	2	3	2	1	2	1	1	3	1	1
3.3D	2	4	1	3	1	2	2	1	1	1	3	1	2	1	2
3.3E	2	3	1	3	3	4	2	1	3	1	2	1	2	2	1
3.3F	1	2	1	3	3	4	2	1	2	2	2	1	1	1	1
4.1A	3	5	1	2	1	3	4	3	3	2	4	2	0	3	3
4.1B	3	4	1	2	1	2	4	3	4	2	4	1	0	3	2
4.1C	1	4	1	2	1	2	2	1	4	3	1	1	0	4	1
4.1D	4	2	1	2	2	1	3	3	4	2	1	1	0	3	2
4.1E	3	2	1	2	3	1	3	3	2	2	1	2	0	3	1
4.1F	2	1	1	2	1	1	3	1	1	3	1	2	0	1	1
4.2A	1	5	1	2	3	1	4	3	4	2	1	2	3	1	3
4.2B	3	3	1	2	2	3	2	2	2	2	2	1	2	1	1
4.2C	4	3	1	2	2	2	4	4	3	2	4	1	3	4	2
4.2D	3	4	1	2	1	1	2	2	2	3	2	1	4	1	1
4.2E	2	2	1	2	1	1	2	2	2	3	1	1	3	1	1
4.2F	3	3	1	2	2	3	2	2	2	3	1	1	4	2	3
4.2G	2	2	1	2	2	2	2	5	4	3	2	1	2	2	2
4.2H	0	0	1	2	0	0	0	0	0	0	0	0	0	3	0
4.3A	2	5	1	2	2	3	4	1	2	2	2	1	2	3	2
4.3B	4	3	1	2	1	3	4	2	4	2	3	2	1	3	2
4.3C	1	4	1	3	2	4	2	1	2	3	1	2	3	1	1
4.3D	2	3	3	2	3	2	3	1	2	2	2	1	4	2	2
4.3E	3	3	1	2	2	2	4	2	5	2	3	2	5	3	3
4.3F	4	2	3	2	2	1	4	2	2	3	1	1	4	1	3
4.3G	3	5	3	2	2	2	3	2	2	3	1	2	4	3	2
4.3H	1	2	1	2	2	1	3	1	4	2	3	1	3	2	1
4.3I	2	2	3	2	1	1	2	1	1	2	2	2	3	1	1
4.3J	3	3	1	2	1	2	2	3	4	2	3	1	2	3	3

7	3	4	7	4	7	2	5	6	7	2	4	7	4	7	0
0	0	7	7	2	7	8	0	0	0	2	4	7	4	7	0
4	7	7	0	0	0	0	2	7	8	5	0	0	4	6	7
7	3	4	7	4	7	0	2	5	6	6	7	0	4	7	0
8	0	0	0	0	0	0	2	7	0	7	0	0	7	6	7
4	5	7	7	6	7	0	5	7	0	4	7	0	4	6	7

Appendix 3

SPSS Data

1.1 IMPORTANCE OF FULFILLING CUSTOMER NEEDS TO YOUR BUSINESS SUCCESS

Value	Frequency	Percentage
1	13	86.7
2	2	13.3

Mean	St. Deviation	Skewness
1.133	0.352	2.405

1.2 CURRENT NATURE OF CUSTOMER INVOLVEMENT

a) Identification & Collection of User Needs

Value	Frequency	Percentage
1	3	20
2	5	33.3
3	6	40
5	1	6.7
Mean	St. Deviation	Skewness
2.4	1.056	0.723

b) Establishing Target Markets

Value	Frequency	Percentage
1	3	20
2	6	40
3	4	26.7
4	2	13.3
Mean	St. Deviation	Skewness
2.333	0.976	0.276

c) Evaluation of Competing Products

Value	Frequency	Percentage
1	6	40
2	3	20
3	2	13.3
4	3	20
5	1	6.7
Mean	St. Deviation	Skewness
2.333	1.397	0.577

d) Gen. of Prod. Design Req. / Spec.

Value	Frequency	Percentage
1	5	33.3
2	5	33.3
3	3	20
4	2	13.3
Mean	St. Deviation	Skewness
2.133	1.06	0.531

e) Gen. & selection of Prod. Design Concepts

Value	Frequency	Percentage
1	5	33.3
2	4	26.7
3	4	26.7
5	2	13.3
Mean	St. Deviation	Skewness
2.333	1.345	0.918

f) Testing & Prototyping of New Prod. Ideas

Value	Frequency	Percentage
1	7	46.67
2	4	26.67
3	2	13.33
4	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
2	1.254	1.255

1.3 FREQUENCY OF CUSTOMER INVOLVEMENT

a) Identification & Collection of User Needs

Value	Frequency	Percentage
1	4	26.67
2	4	26.67
3	4	26.67
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.467	1.246	0.471

b) Establishing Target Markets

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	5	33.33
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.667	1.113	0.412

c) Evaluation of Competing Products

Value	Frequency	Percentage
1	3	20.00
2	3	20.00
3	6	40.00
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.667	1.175	0.147

d) Gen. of Prod. Design Req. / Spec.

Value	Frequency	Percentage
1	3	20.00
2	2	13.33
3	8	53.33
4	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
2.667	1.113	0.053

e) Gen. & selection of Prod. Design Concepts

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	6	40.00
4	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
2.6	1.056	0.538

f) Testing & Prototyping of New Prod. Ideas

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	6	40.00
4	1	6.67
Mean	Std. Deviation	Skewness
2.267	1.163	0.659

1.4 KEY STAKEHODERS TYPICALLY INVOVLED

a) Identification & Collection of User Needs

1 End Users			2 Purchasers			3 Retailers			4 Distributors
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
1	3	20	1	5	33.33	1	2	13.33	1
2	6	40	2	3	20.00	2	2	13.33	2
3	4	26.67	3	3	20.00	3	3	20.00	3
4	1	6.67	4	3	20.00	5	5	33.33	5
5	1	6.67	M	1	6.67	M	3	20.00	M
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.4	1.121	0.814	2.286	1.204	0.283	3.333	1.614	-0.184	2.154

c) Evaluation of Competiting Products

1 End Users			2 Purchasers			3 Retailers			4 Distributors
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
1	2	13.33	1	2	13.33	1	1	6.67	1
2	4	26.67	2	2	13.33	2	2	13.33	2
3	5	33.33	3	5	33.33	3	5	33.33	3
4	3	20.00	4	3	20.00	5	5	33.33	4
5	1	6.67	5	2	13.33	M	2	13.33	5
			M	1	6.67				M
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.8	1.146	0.118	3.071	1.269	-0.153	3.462	1.391	-0.126	2.917

e) Generation & Selection of Product Concepts

1 End Users			2 Purchasers			3 Retailers			4 Distributors
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
2	7	46.67	2	3	20.00	1	1	6.67	1
3	4	26.67	3	7	46.67	2	2	13.33	2
4	3	20.00	4	2	13.33	3	3	20.00	3
5	1	6.67	5	2	13.33	4	1	6.67	4
			M	1	6.67	5	5	33.33	5
						M	3	20.00	M
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.867	0.99	0.808	3.214	0.975	0.67	3.583	1.443	-0.417	2.5

		5 Installars/ Service Engineers			6 Assemblers / workforce			7 Management team's / functions		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
5	33.33	1	2	13.33	1	2	13.33	1	7	46.67
3	20.00	2	4	26.67	2	1	6.67	2	5	33.33
4	26.67	3	5	33.33	3	6	40.00	3	2	13.33
1	6.67	4	2	13.33	4	2	13.33	4	1	6.67
2	13.33	5	1	6.67	5	3	20.00			
					M	1	6.67			
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.214	0.979	2.714	1.139	0.29	3.214	1.311	-0.219	1.8	0.941	1.044

		5 Installars/ Service Engineers			6 Assemblers / workforce			7 Management team's / functions		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
2	13.33	1	1	6.67	2	1	6.67	1	4	26.67
2	13.33	2	2	13.33	3	3	20.00	2	6	40.00
5	33.33	3	3	20.00	4	4	26.67	3	3	20.00
1	6.67	4	4	26.67	5	7	46.67	4	1	6.67
2	13.33	5	3	20.00				5	1	6.67
3	20.00	M	2	13.33						
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.311	0.181	3.462	1.266	-0.481	4.133	0.99	-0.808	2.267	1.163	0.973

		5 Installars/ Service Engineers			6 Assemblers / workforce			7 Management team's / functions		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
4	26.67	2	1	6.67	2	2	13.33	1	7	46.67
1	6.67	3	6	40.00	3	6	40.00	2	6	40.00
5	33.33	4	3	20.00	4	1	6.67	3	1	6.67
1	6.67	5	3	20.00	5	6	40.00	4	1	6.67
1	6.67	M	2	13.33						
3	20.00									
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.314	0.288	3.615	0.961	0.28	3.733	1.163	-0.03	1.733	0.884	1.317

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	2	13.33
4	5	33.33
5	3	20.00
Mean	Std. Deviation	Skewness
3.267	1.387	-0.365

b) Establishing Target Karkets

1
End Users

Value	Frequency	Percentage
1	3	20
2	2	13.33
3	6	40
4	3	20
5	1	6.67
Mean	Std. Deviation	Skewness
2.8	1.207	-0.124

2
Purchasers

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	5	33.33
4	2	13.33
5	2	13.33
M	1	6.67
Mean	Std. Deviation	Skewness
2.929	1.269	0.153

3
Retailers

Value
1
2
3
5
M
Mean
3.083

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	2	13.33
2	2	13.33
3	3	20.00
4	3	20.00
5	5	33.33
Mean	Std. Deviation	Skewness
3.467	1.457	-0.483

d) Generation of Product Design Requirements / Specifications

1
End Users

Value	Frequency	Percentage
1	1	6.67
2	5	33.33
3	5	33.33
4	2	13.33
5	2	13.33
Mean	Std. Deviation	Skewness
2.933	1.163	0.461

2
Purchasers

Value	Frequency	Percentage
1	1	6.67
2	4	26.67
3	3	20.00
4	3	20.00
5	3	20.00
M	1	6.67
Mean	Std. Deviation	Skewness
3.214	1.311	0.019

3
Retailers

Value
2
3
4
5
M
Mean
3.583

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	4	26.67
3	4	26.67
4	4	26.67
5	3	20.00
Mean	Std. Deviation	Skewness
3.133	1.506	-0.404

f) Testing & Prototyping of New Ideas

1
End Users

Value	Frequency	Percentage
1	3	20.0
2	3	20.0
3	7	46.7
4	1	6.7
5	1	6.7
Mean	Std. Deviation	Skewness
2.6	1.121	0.239

2
Purchasers

Value	Frequency	Percentage
2	3	20.0
3	6	40.0
4	3	20.0
5	2	13.3
M	1	6.7
Mean	Std. Deviation	Skewness
3.286	0.994	0.425

3
Retailers

Value
2
3
4
5
M
Mean
3.917

		4 Distributors			5 Installars/ Service Engineers			6 Assemblers / workforce		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
3	20.00	1	3	20.00	3	6	40.00	3	4	26.67
3	20.00	2	7	46.67	4	2	13.33	4	4	26.67
1	6.67	3	1	6.67	5	5	33.33	5	7	46.67
5	33.33	5	1	6.67	M	2	13.33			
3	20.00	M	3	20.00						
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.782	0.082	2.083	1.084	1.866	3.923	0.954	0.173	4.2	0.862	-0.433

		4 Distributors			5 Installars/ Service Engineers			6 Assemblers / workforce		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
4	26.67	1	3	20.00	1	1	6.67	1	1	6.67
2	13.33	2	3	20.00	2	2	13.33	2	2	13.33
1	6.67	3	4	26.67	3	3	20.00	3	2	13.33
5	33.33	4	2	13.33	4	4	26.67	4	4	26.67
3	20.00	5	1	6.67	5	2	13.33	5	6	40.00
		M	2	13.33	M	3	20.00			
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.379	-0.083	2.615	1.261	0.283	3.333	1.231	-0.416	3.8	1.32	-0.868

		4 Distributors			5 Installars/ Service Engineers			6 Assemblers / workforce		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
3	20.00	1	2	13.33	2	2	13.33	1	2	13.33
1	6.67	2	4	26.67	3	6	40.00	2	1	6.67
2	13.33	3	2	13.33	4	1	6.67	3	6	40.00
6	40.00	4	1	6.67	5	4	26.67	4	1	6.67
3	20.00	5	3	20.00	M	2	13.33	5	5	33.33
		M	3	20.00						
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.311	-0.69	2.917	1.505	0.36	3.538	1.127	0.301	3.4	1.404	-0.3

7
Management team's / functions

Value	Frequency	Percentage
1	5	33.33
2	7	46.67
3	1	6.67
5	2	13.33
Mean	Std. Deviation	Skewness
2.133	1.302	1.511

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	2	13.33
2	2	13.33
3	2	13.33
4	4	26.67
5	5	33.33
Mean	Std. Deviation	Skewness
3.533	1.457	-0.635

7
Management team's / functions

Value	Frequency	Percentage
1	8	53.33
2	7	46.67
Mean	Std. Deviation	Skewness
1.467	0.516	0.149

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	3	20.00
4	2	13.33
5	4	26.67
Mean	Std. Deviation	Skewness
3	1.604	0

7
Management team's / functions

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	2	13.33
5	4	26.67
	3	20.00
Mean	Std. Deviation	Skewness
2.067	1.1	1.339

8
Manufactureres / suppliers

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	2	13.33
4	4	26.67
5	3	20.00
Mean	St. Deviation	Skewness
3	1.558	-0.131

2.1 Nature of the Processes and Methods Used

a) Identification & Collection of User Needs

Structured Process

Value	Frequency	Percentage
2	5	33.33
3	6	40.00
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
3.067	1.033	0.749

Unstructured Process

Value	Frequency	Percentage
1	2	13.33
2	6	40.00
3	4	26.67
4	1	6.67
5	2	13.33
Mean	St. Deviation	Skewness
2.667	1.234	0.74

Formal tech. / methods

Value	Frequency	Percentage
2	4	26.67
3	5	33.33
4	5	33.33
5	1	6.67
Mean	St. Deviation	Skewness
3.2	0.941	0.142

Informal tech. / methods

Value	Frequency	Percentage
1	1	6.67
2	5	33.33
3	5	33.33
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
2.933	1.163	0.461

b) Establishing Target Markets

Structured Process

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	5	33.33
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.667	1.113	0.412

c) Evaluation of Competiting Products

Structured Process

Value	Frequency	Percentage
1	4	26.67
2	4	26.67
3	4	26.67
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.467	1.246	0.471

Unstructured Process

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	4	26.67
4	4	26.67
5	2	13.33
Mean	St. Deviation	Skewness
3.067	1.28	-0.141

Formal tech. / methods

Value	Frequency	Percentage
1	3	20.00
2	4	26.67
3	3	20.00
4	3	20.00
5	2	13.33
Mean	St. Deviation	Skewness
2.8	1.373	0.222

Informal tech. / methods

Value	Frequency	Percentage
1	1	6.67
2	5	33.33
3	5	33.33
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
2.933	1.163	0.461

d) Generation of Product Design Requiremen

Structured Process

Value	Frequency	Percentage
1	8	53.33
2	3	20.00
3	1	6.67
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2	1.363	1.172

e) Generation & Selection of Product Concepts

Structured Process

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	2	13.33
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
2.533	1.407	0.631

Unstructured Process

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	5	33.33
4	4	26.67
5	1	6.67
Mean	St. Deviation	Skewness
2.933	1.163	-0.168

Formal tech. / methods

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	3	20.00
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
2.533	1.457	0.483

Informal tech. / methods

Value	Frequency	Percentage
1	2	13.33
2	2	13.33
3	7	46.67
4	3	20.00
5	1	6.67
Mean	St. Deviation	Skewness
2.933	1.1	-0.224

f) Testing & Prototyping of New Ideas

Structured Process

Value	Frequency	Percentage
1	7	46.67
2	5	33.33
3	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
1.867	1.125	1.684

Unstructured Process			Formal tech. / methods			Informal tech. / methods		
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
1	1	6.67	1	1	6.67	1	1	6.67
2	6	40.00	2	4	26.67	2	3	20.00
3	5	33.33	3	4	26.67	3	7	46.67
4	2	13.33	4	5	33.33	4	4	26.67
5	1	6.67	5	1	6.67			
Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
2.733	1.033	0.616	3.067	1.1	-0.148	2.933	0.884	-0.574

nts / Specifications

Unstructured Process			Formal tech. / methods			Informal tech. / methods		
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
1	2	13.33	1	5	33.33	1	3	20.00
2	3	20.00	2	4	26.67	2	4	26.67
3	1	6.67	3	2	13.33	3	2	13.33
4	7	46.67	4	2	13.33	4	5	33.33
5	2	13.33	5	2	13.33	5	1	6.67
Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
3.267	1.335	-0.563	2.467	1.457	0.635	2.8	1.32	-0.009

Unstructured Process			Formal tech. / methods			Informal tech. / methods		
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
1	1	6.67	1	5	33.33	1	1	6.67
3	4	26.67	2	5	33.33	3	5	33.33
4	5	33.33	3	3	20.00	4	5	33.33
5	5	33.33	4	1	6.67	5	4	26.67
			5	1	6.67			
Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
3.867	1.125	-1.091	2.2	1.207	0.967	3.733	1.1	-0.878

Methods Used To Communicate the Follwing Issues

a) Identified User Needs

1 Formal Presentations

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	6	40.00
4	1	6.67
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.6	1.056	0.538

2 Written report[s]

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	6	40.00
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.267	1.163	0.659

3 Memo's

Value	Frequency	Percentage
1	2	13.33
2	6	40.00
3	5	33.33
4	1	6.67
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.533	1.06	0.73

4 2D Visuals

Value	Frequency	Percentage
1	1	6.67
2	1	6.67
M	13	86.67
Mean	**Std. Deviation**	**Skewness**
1.5	0.707	

5 3D Cad Models

Value	Frequency	Percentage
1	1	6.67
M	14	93.33
Mean	**Std. Deviation**	**Skewness**
0.333	0.577	1.732

6 Appearence mo

Value
1
2
3
M
Mean
2

c) Attributes of Competiting Products

1 Formal Presentations

Value	Frequency	Percentage
1	1	6.67
2	2	13.33
3	5	33.33
4	3	20.00
5	4	26.67
Mean	**Std. Deviation**	**Skewness**
3.467	1.246	-0.296

2 Written report[s]

Value	Frequency	Percentage
1	1	6.67
2	4	26.67
3	6	40.00
4	2	13.33
5	2	13.33
Mean	**Std. Deviation**	**Skewness**
3	1.134	0.339

3 Memo's

Value	Frequency	Percentage
2	6	40.00
3	5	33.33
4	2	13.33
5	2	13.33
Mean	**Std. Deviation**	**Skewness**
3	1.069	0.809

4 2D Visuals

Value	Frequency	Percentage
M	15	100.00
Mean	**Std. Deviation**	**Skewness**

5 3D Cad Models

Value	Frequency	Percentage
M	15	100.00
Mean	**Std. Deviation**	**Skewness**

6 Appearence mo

Value
M
Mean

e) Product Design Concepts

1 Formal Presentations

Value	Frequency	Percentage
1	4	26.67
2	1	6.67
3	8	53.33
5	2	13.33
Mean	**Std. Deviation**	**Skewness**
2.667	1.291	0.264

2 Written report[s]

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	5	33.33
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.267	1.1	0.878

3 Memo's

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	5	33.33
4	1	6.67
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.467	1.125	0.616

4 2D Visuals

Value	Frequency	Percentage
1	1	6.67
2	7	46.67
3	5	33.33
4	1	6.67
5	1	6.67
Mean	**Std. Deviation**	**Skewness**
2.6	0.986	0.971

5 3D Cad Models

Value	Frequency	Percentage
2	6	40.00
3	5	33.33
4	2	13.33
5	2	13.33
Mean	**Std. Deviation**	**Skewness**
3	1.069	0.809

6 Appearence mo

Value
1
2
3
4
5
Mean
2.33

b) Target Markets

dels / prototypes

Frequency	Percentage
1	6.67
1	6.67
1	6.67
12	80.00
Std. Deviation	Skewness
1	0

1
Formal Presentations

Value	Frequency	Percentage
1	3	20.00
2	4	26.67
3	3	20.00
4	2	13.33
5	3	20.00
Mean	Std. Deviation	Skewness
2.867	1.457	0.264

2
Written report[s]

Value	Frequency	Percentage
1	2	13.33
2	6	40.00
3	4	26.67
4	2	13.33
5	1	6.67
Mean	Std. Deviation	Skewness
2.6	1.121	0.589

3
Memo's

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	5	33.33
4	1	6.67
5	1	6.67
M	1	6.67
Mean	Std. Deviation	Skewness
2.571	1.089	0.62

4
2D Visuals

Value	Frequency	Percentage
1	1	6.67
M	14	93.33
Mean	Std. Deviation	Skewness
1		

5
3D Cad Models

Value	Frequency
1	1
M	14
Mean	Std. Deviation

d) Product Design Requirements

dels / prototypes

Frequency	Percentage
15	100.00
Std. Deviation	Skewness

1
Formal Presentations

Value	Frequency	Percentage
1	4	26.67
2	3	20.00
3	3	20.00
4	3	20.00
5	2	13.33
Mean	Std. Deviation	Skewness
2.733	1.438	0.206

2
Written report[s]

Value	Frequency	Percentage
1	5	33.33
2	9	60.00
5	1	6.67
Mean	Std. Deviation	Skewness
1.867	0.99	2.335

3
Memo's

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	5	33.33
5	1	6.67
M	1	6.67
Mean	Std. Deviation	Skewness
2.357	1.082	0.855

4
2D Visuals

Value	Frequency	Percentage
2	1	6.67
3	1	6.67
M	13	86.67
Mean	Std. Deviation	Skewness
2.5	0.707	

5
3D Cad Models

Value	Frequency
M	15
Mean	Std. Deviation

f) New Product Ideas

dels / prototypes

Frequency	Percentage
4	26.67
5	33.33
4	26.67
1	6.67
1	6.67
Std. Deviation	Skewness
1.175	0.767

1
Formal Presentations

Value	Frequency	Percentage
1	1	6.67
2	6	40.00
3	5	33.33
4	1	6.67
5	2	13.33
Mean	Std. Deviation	Skewness
2.8	1.146	0.775

2
Written report[s]

Value	Frequency	Percentage
1	3	20.00
2	6	40.00
3	4	26.67
4	1	6.67
5	1	6.67
Mean	Std. Deviation	Skewness
2.4	1.121	0.814

3
Memo's

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	5	33.33
4	1	6.67
5	1	6.67
Mean	Std. Deviation	Skewness
2.467	1.125	0.616

4
2D Visuals

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	6	40.00
4	1	6.67
5	1	6.67
Mean	Std. Deviation	Skewness
2.6	1.056	0.538

5
3D Cad Models

Value	Frequency
2	6
3	5
4	2
5	2
Mean	Std. Deviation
3	1.069

6
Appearence models / prototypes

Percentage	Value	Frequency	Percentage
6.67	1	1	6.67
93.33	3	1	6.67
	M	13	86.67
Skewness	Mean	Std. Deviation	Skewness
	2	1.414	

6
Appearence models / prototypes

Percentage	Value	Frequency	Percentage
100.00	3	1	6.67
	M	14	93.33
Skewness	Mean	Std. Deviation	Skewness

6
Appearence models / prototypes

Percentage	Value	Frequency	Percentage
40.00	1	2	13.33
33.33	2	4	26.67
13.33	3	5	33.33
13.33	4	3	20.00
	5	1	6.67
Skewness	Mean	Std. Deviation	Skewness
0.809	2.8	1.146	0.118

2.3 Individuals / Functions that Undertake Key Tasks

a) Identification & Collection of User Needs

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing manager			5 Engineering / manu. personnel			6 Design manage
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
1	6	40.00	1	4	26.67	1	2	13.33	2	2	13.33	1	1	6.67	1
2	2	13.33	2	3	20.00	2	5	33.33	3	3	20.00	2	1	6.67	2
3	4	26.67	3	3	20.00	3	3	20.00	4	5	33.33	3	4	26.67	3
4	1	6.67	4	1	6.67	4	1	6.67	5	3	20.00	4	5	33.33	4
5	2	13.33	5	4	26.67	5	4	26.67	M	2	13.33	5	1	6.67	5
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.214	1.311	0.736	2.182	1.25	1.088	2.364	1.12	1.199	3.692	1.032	-0.344	3.333	1.073	-0.804	3.091

c) Evaluation of Competiting Products

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing manager			5 Engineering / manu. personnel			6 Design manage
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
1	5	33.33	1	2	13.33	1	4	26.67	1	4	26.67	1	5	33.33	1
2	2	13.33	2	3	20.00	2	5	33.33	2	3	20.00	2	3	20.00	2
3	5	33.33	3	4	26.67	3	4	26.67	3	3	20.00	3	4	26.67	3
4	2	13.33	4	1	6.67	4	1	6.67	4	2	13.33	4	2	13.33	4
5	1	6.67	5	1	6.67	5	1	6.67	5	3	20.00	5	1	6.67	5
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.571	1.284	0.197	2.636	1.206	0.446	2.417	1.24	0.743	2.417	1.443	0.852	2.5	1.382	0.372	1.909

e) Generation of Product Concepts

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing manager			5 Engineering / manu. personnel			6 Design manage
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
1	6	40.00	1	4	26.67	1	2	13.33	1	3	20.00	1	2	13.33	1
2	2	13.33	2	1	6.67	2	3	20.00	2	3	20.00	2	3	20.00	2
3	2	13.33	3	5	33.33	3	1	6.67	3	2	13.33	3	3	20.00	3
4	3	20.00	4	1	6.67	4	4	26.67	4	1	6.67	4	3	20.00	5
M	2	13.33	M	4	26.67	5	1	6.67	5	3	20.00	5	2	13.33	M
						M	4	26.67	M	3	20.00	M	2	13.33	
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
2.5	1.508	0.669	2.273	1.104	-0.108	2.909	1.375	-0.086	2.833	1.586	0.325	3	1.354	0	2

g) Testing & Prototyping of New Ideas

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing manager			5 Engineering / manu. personnel			6 Design manage
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value
2	2	13.33	1	3	20.00	1	1	6.67	1	2	13.33	1	4	26.67	1
3	7	46.67	2	3	20.00	2	4	26.67	2	4	26.67	2	3	20.00	2
4	3	20.00	3	2	13.33	3	4	26.67	3	2	13.33	3	4	26.67	3
5	1	6.67	4	2	13.33	4	1	6.67	4	2	13.33	4	2	13.33	4
M	2	13.33	5	1	6.67	5	1	6.67	5	3	20.00	M	2	13.33	M

			M	4	26.67	M	4	26.67	M	2	13.33				
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean
3.231	0.832	0.528	2.545	1.368	0.456	2.727	1.104	0.654	3	1.472	0.185	2.308	1.109	0.143	2

›er		7 Design personnel		
Frequency	Percentage	Value	Frequency	Percentage
2	13.33	1	2	13.33
1	6.67	2	4	26.67
4	26.67	3	2	13.33
2	13.33	4	1	6.67
2	13.33	5	2	13.33
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.375	-0.196	2.727	1.421	0.586

b) Establishing Target Markets

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing ma	
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency
1	9	60.00	1	6	40.00	1	4	26.67	1	1
2	3	20.00	2	3	20.00	2	2	13.33	3	3
3	2	13.33	3	2	13.33	3	4	26.67	4	2
5	1	6.67	M	4	26.67	5	2	13.33	5	6
						M	3	20.00	M	3
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation
1.5	0.76	1.229	1.636	0.809	0.847	2.5	1.446	0.649	4	1.279

›er		7 Design personnel		
Frequency	Percentage	Value	Frequency	Percentage
5	33.33	1	4	26.67
4	26.67	2	5	33.33
1	6.67	3	1	6.67
1	6.67	4	1	6.67
4	26.67	5	4	26.67
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.221	1.818			
		2	1.183	1.771

d) Generation of Product Design Requirements / Specifications

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing ma	
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency
1	7	46.67	1	4	26.67	1	4	26.67	1	3
2	2	13.33	2	2	13.33	2	3	20.00	2	3
3	4	26.67	3	4	26.67	3	6	40.00	3	4
4	1	6.67	4	1	6.67	4	1	6.67	5	2
5	1	6.67	5	4	26.67	5	1	6.67	M	3
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation
1.929	1.072	0.598	2.273	1.272	0.804	2.583	1.24	0.287	2.583	1.379

›er		7 Design personnel		
Frequency	Percentage	Value	Frequency	Percentage
4	26.67	1	3	20.00
5	33.33	2	4	26.67
1	6.67	3	2	13.33
1	6.67	5	3	20.00
4	26.67	M	3	20.00
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.183	1.771	2.667	1.557	0.668

f) Selection of Product Concepts

1 Member of Senior management team			2 Marketing manager			3 Marketing personnel			4 Engineering / manufacturing ma	
Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency
1	10	66.67	1	6	40.00	1	4	26.67	1	5
2	2	13.33	2	3	20.00	2	3	20.00	2	1
3	3	20.00	3	1	6.67	3	1	6.67	3	2
			5	1	6.67	4	2	13.33	4	1
			M	4	26.67	5	2	13.33	5	3
						M	3	20.00	M	3
Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation
1.533	0.834	1.159	2.667	1.723	0.365	2.583	1.564	0.499	2.667	1.723

›er		7 Design personnel		
Frequency	Percentage	Value	Frequency	Percentage
4	26.67	1	5	33.33
3	20.00	2	4	26.67
2	13.33	3	1	6.67
1	6.67	4	1	6.67
5	33.33	5	1	6.67

		M	3	20.00
Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
1.054	0.712	2.083	1.311	1.27

nager	5 Engineering / manu. personnel			6 Design manager			7 Design personnel		
Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
6.67	1	1	6.67	1	2	13.33	1	1	6.67
20.00	3	2	13.33	2	1	6.67	2	1	6.67
13.33	4	3	20.00	3	1	6.67	3	3	20.00
40.00	5	6	40.00	4	3	20.00	4	2	13.33
20.00	M	3	20.00	5	3	20.00	5	4	26.67
Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
-1.251	4.083	1.24	-1.558	3.4	1.578	-0.62	3.636	1.362	-0.641

nager	5 Engineering / manu. personnel			6 Design manager			7 Design personnel		
Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
20.00	1	5	33.33	1	4	26.67	1	6	40.00
20.00	2	4	26.67	2	3	20.00	2	2	13.33
26.67	3	2	13.33	3	2	13.33	3	2	13.33
13.33	4	2	13.33	4	1	6.67	4	3	20.00
20.00	5	2	13.33	5	2	13.33	M	2	13.33
				M	3	20.00			
Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
0.666	2.273	1.348	0.892	2.5	1.508	0.669	2.154	1.281	0.509

nager	5 Engineering / manu. personnel			6 Design manager			7 Design personnel		
Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
33.33	1	3	20.00	1	6	40.00	1	3	20.00
6.67	2	1	6.67	2	2	13.33	2	4	26.67
13.33	3	3	20.00	3	2	13.33	3	2	13.33
6.67	4	2	13.33	5	1	6.67	4	1	6.67
20.00	5	4	26.67	M	4	26.67	5	2	13.33
20.00	M	2	13.33				M	3	20.00
Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness	Mean	Std. Deviation	Skewness
0.365	3.231	1.589	-0.298	1.909	1.3	1.535	2.583	1.443	0.672

2.4 Individuals / Functions Who Responsibility and authority for Key Activities

a) Identification & Collection of User Needs

1
Chairman / managing director

Value	Frequency	Percentage
1	4	26.67
2	4	26.67
3	3	20.00
4	1	6.67
5	2	13.33
M	1	6.67
Mean	Std. Deviation	Skewness
2.5	1.401	0.686

2
Member of Senior management team

Value	Frequency	Percentage
1	5	33.33
2	6	40.00
4	2	13.33
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.143	1.292	1.191

3
Marketing manager

Value	Frequency	Percentage
1	6	40.00
2	4	26.67
5	2	13.33
M	3	20.00
Mean	St. Deviation	Skewness
2	1.477	1.625

4
Engineering / manufacturing manager

Value	Frequency	Percentage
1	1	6.67
2	1	6.67
3	3	20.00
4	4	26.67
5	3	20.00
M	3	20.00
Mean	St. Deviation	Skewness
3.583	1.24	-0.743

5
Design manager

Value	Frequency	Percentage
1	2	13.33
2	4	26.67
3	1	6.67
4	3	20.00
5	3	20.00
M	2	13.33
Mean	St. Deviation	Skewness
3.167	1.528	-0.15

c) Evaluation of Competiting Products

1
Chairman / managing director

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	5	33.33
4	1	6.67
5	3	20.00
M	1	6.67
Mean	St. Deviation	Skewness
3	1.359	0.215

2
Member of Senior man. team

Value	Frequency	Percentage
1	3	20.00
2	6	40.00
3	2	13.33
4	2	13.33
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.429	1.222	0.782

3
Marketing manager

Value	Frequency	Percentage
1	4	26.67
2	4	26.67
3	3	20.00
5	2	13.33
M	2	13.33
Mean	St. Deviation	Skewness
2.385	1.387	0.947

4
Engineering / manufacturing manager

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	4	26.67
4	1	6.67
5	2	13.33
M	3	20.00
Mean	St. Deviation	Skewness
2.833	1.337	0.36

5
Design manager

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	2	13.33
5	2	13.33
M	2	13.33
Mean	St. Deviation	Skewness
2.25	1.485	1.087

e) Generation of Product Concepts

1
Chairman / managing director

Value	Frequency	Percentage
1	4	26.67
2	4	26.67
3	5	33.33
5	2	13.33
Mean	St. Deviation	Skewness
2.467	1.302	0.756

2
Member of Senior management team

Value	Frequency	Percentage
1	5	33.33
2	6	40.00
3	2	13.33
4	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
2.133	1.187	1.186

3
Marketing manager

Value	Frequency	Percentage
1	5	33.33
2	4	26.67
3	2	13.33
5	2	13.33
M	2	13.33
Mean	St. Deviation	Skewness
2.231	1.423	1.162

4
Engineering / manufacturing manager

Value	Frequency	Percentage
1	4	26.67
2	1	6.67
3	3	20.00
4	1	6.67
5	3	20.00
M	3	20.00
Mean	St. Deviation	Skewness
2.833	1.642	0.17

5
Design manager

Value	Frequency	Percentage
1	5	33.33
2	4	26.67
3	1	6.67
5	2	13.33
M	3	20.00
Mean	St. Deviation	Skewness
2.167	1.467	1.317

b) Establishing Target Markets

1
Chairman / managing director

Value	Frequency	Percentage
1	8	53.33
2	3	20.00
3	2	13.33
4	2	13.33

Mean	St. Deviation	Skewness
1.867	1.125	0.99

2
Member of Senior management team

Value	Frequency	Percentage
1	5	33.33
2	6	40.00
5	2	13.33
M	2	13.33

Mean	St. Deviation	Skewness
2.077	1.382	1.63

3
Marketing manager

Value	Frequency	Percentage
1	5	33.33
2	6	40.00
3	1	6.67
5	1	6.67
M	2	13.33

Mean	St. Deviation	Skewness
1.923	1.115	1.878

4
Engineering / manufacturing manager

Value	Frequency	Percentage
3	2	13.33
4	3	20.00
5	7	46.67
M	3	20.00

Mean	St. Deviation	Skewness
4.417	0.793	-0.988

5
Design manager

Value	Frequency	Percentage
1	1	6.67
2	1	6.67
3	2	13.33
4	2	13.33
5	6	40.00
M	3	20.00

Mean	St. Deviation	Skewness
3.917	1.379	-1.072

d) Generation of Product Design Requirements / Specifications

1
Chairman / managing director

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	3	20.00
4	3	20.00
5	2	13.33
M	1	6.67

Mean	St. Deviation	Skewness
2.786	1.477	0.094

2
Member of Senior management team

Value	Frequency	Percentage
1	6	40.00
2	3	20.00
3	2	13.33
5	2	13.33
M	2	13.33

Mean	St. Deviation	Skewness
2.154	1.463	1.198

3
Marketing manager

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	3	20.00
5	2	13.33
M	2	13.33

Mean	St. Deviation	Skewness
2.308	1.437	0.955

4
Engineering / manufacturing manager

Value	Frequency	Percentage
1	4	26.67
2	1	6.67
3	3	20.00
4	2	13.33
5	2	13.33
M	3	20.00

Mean	St. Deviation	Skewness
2.75	1.545	0.144

5
Design manager

Value	Frequency	Percentage
1	6	40.00
2	2	13.33
4	2	13.33
5	2	13.33
M	3	20.00

Mean	St. Deviation	Skewness
2.333	1.67	0.771

f) Selection of Product Concepts

1
Chairman / managing director

Value	Frequency	Percentage
1	1	6.67
2	2	13.33
3	3	20.00
4	4	26.67
5	3	20.00
M	2	13.33

Mean	St. Deviation	Skewness
3.462	1.266	-0.481

2
Member of Senior management team

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	2	13.33
4	1	6.67
5	2	13.33
M	2	13.33

Mean	St. Deviation	Skewness
2.538	1.391	0.784

3
Marketing manager

Value	Frequency	Percentage
1	3	20.00
2	2	13.33
3	3	20.00
5	4	26.67
M	3	20.00

Mean	St. Deviation	Skewness
3	1.651	0.145

4
Engineering / manufacturing manager

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	2	13.33
4	1	6.67
5	1	6.67
M	2	13.33

Mean	St. Deviation	Skewness
2.231	1.235	1.054

5
Design manager

Value	Frequency	Percentage
1	6	40.00
2	3	20.00
3	2	13.33
5	1	6.67
M	1	6.67

Mean	St. Deviation	Skewness
1.917	1.24	1.558

7 8

3 KEY STAKEHOLDERS

1
a) Identification & Collection of User Needs

Value	Frequency	Percentage
1	10	27.78
2	5	13.89
3	2	5.56
4	6	16.67
5	1	2.78
6	1	2.78
7	10	27.78
8	1	2.78
Mean	St. Deviation	Skewness

2
b) Establishing Target Markets

Value	Frequency	Percentage
1	5	17.86
2	4	14.29
3	3	10.71
4	5	17.86
7	10	35.71
8	1	3.57
Mean	St. Deviation	Skewness

3
c) Evaluation of Competing Products

Value	Frequency	Percentage
1	4	13.79
2	2	6.90
3	3	10.34
4	2	6.90
5	4	13.79
6	2	6.90
7	12	41.38
Mean	St. Deviation	Skewness

4
d) Gen. of Prod. Design Req. / Spec.

Value	Frequency	Percentage
1	5	17.24
2	2	6.90
3	2	6.90
4	4	13.79
5	2	6.90
6	2	6.90
7	12	41.38
Mean	St. Deviation	Skewness

5
e) Gen. & selection of Prod. Design Concepts

Value	Frequency	Percentage
1	2	9.09
2	1	4.55
3	1	4.55
4	2	9.09
6	1	4.55
7	14	63.64
8	1	4.55
Mean	St. Deviation	Skewness

6
f) Testing & Prototyping of New Prod. Ideas

Value	Frequency	Percentage
1	7	21.88
2	1	3.13
3	1	3.13
4	4	12.50
5	3	9.38
6	3	9.38
7	13	40.63
Mean	St. Deviation	Skewness

Key : 1 = end users; 2 = purchasers; 3 = retailers; 4 = distributors; 5 = installers / service engineers;
6 = assemblers / workforce; 7 = management team[s] / functions; 8 = manufacturers / suppliers

3.1 Types of Issues Discussed

a) Identification & Collection of User Needs

1
Aesthetics

Value	Frequency	Percentage
1	9	60.00
2	2	13.33
3	2	13.33
4	1	6.67
5	1	6.67

Mean	St. Deviation	Skewness
1.867	1.302	1.401

2
New Product Improvements

Value	Frequency	Percentage
1	6	40.00
2	4	26.67
3	4	26.67
5	1	6.67

Mean	St. Deviation	Skewness
2.067	1.163	1.111

3
New Product Opportunities

Value	Frequency	Percentage
1	10	66.67
2	2	13.33
3	1	6.67
4	1	6.67
5	1	6.67

Mean	St. Deviation	Skewness
1.733	1.28	1.754

4
Product Usability

Value	Frequency	Percentage
1	10	66.67
2	2	13.33
3	2	13.33
5	1	6.67

Mean	St. Deviation	Skewness
1.667	1.175	1.975

5
Product Performance/ Specification

Value	Frequency	Percentage
1	10	66.67
2	2	13.33
3	2	13.33
5	1	6.67

Mean	St. Deviation	Skewness
1.667	1.175	1.975

c) Evaluation of Competiting Products

1
Aesthetics

Value	Frequency	Percentage
1	6	40.00
2	1	6.67
3	4	26.67
4	2	13.33
5	2	13.33

Mean	St. Deviation	Skewness
2.533	1.506	0.361

2
New Product Improvements

Value	Frequency	Percentage
1	6	40.00
2	6	40.00
3	1	6.67
5	2	13.33

Mean	St. Deviation	Skewness
2.067	1.335	1.526

3
New Product Opportunities

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	3	20.00
4	1	6.67
5	2	13.33

Mean	St. Deviation	Skewness
2.467	1.356	0.776

4
Product Usability

Value	Frequency	Percentage
1	8	53.33
2	5	33.33
3	1	6.67
5	1	6.67

Mean	St. Deviation	Skewness
1.733	1.1	2.096

5
Product Performance/ Specification

Value	Frequency	Percentage
1	10	66.67
2	3	20.00
3	1	6.67
5	1	6.67

Mean	St. Deviation	Skewness
1.6	1.121	2.344

e) Generation & Selection of Product Concepts

1
Aesthetics

Value	Frequency	Percentage
1	3	20.00
2	4	26.67
3	4	26.67
4	3	20.00
5	1	6.67

Mean	St. Deviation	Skewness
2.667	1.234	0.214

2
New Product Improvements

Value	Frequency	Percentage
1	2	13.33
2	6	40.00
3	5	33.33
4	1	6.67
5	1	6.67

Mean	St. Deviation	Skewness
2.533	1.06	0.73

3
New Product Opportunities

Value	Frequency	Percentage
1	4	26.67
2	3	20.00
3	7	46.67
4	1	6.67

Mean	St. Deviation	Skewness
2.333	0.976	-0.256

4
Product Usability

Value	Frequency	Percentage
1	5	33.33
2	4	26.67
3	4	26.67
4	2	13.33

Mean	St. Deviation	Skewness
2.2	1.082	0.328

5
Product Performance/ Specification

Value	Frequency	Percentage
1	7	46.67
2	2	13.33
3	5	33.33
4	1	6.67

Mean	St. Deviation	Skewness
2	1.069	0.405

6
Design for manufacture / assembly

Value	Frequency	Percentage
1	3	20.00
2	3	20.00
3	5	33.33
5	4	26.67
Mean	St. Deviation	Skewness
2.933	1.486	0.281

7
Cost / price

Value	Frequency	Percentage
1	8	53.33
2	4	26.67
3	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
1.8	1.146	1.759

b) Establishing Target Karkets

1
Aesthetics

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	4	26.67
4	1	6.67
5	2	13.33
Mean	St. Deviation	Skewness
2.467	1.407	0.61

2
New Product Improvements

Value	Frequency	Percentage
1	6	40.00
2	5	33.33
3	4	26.67
Mean	St. Deviation	Skewness
1.867	0.834	0.274

3
New Product Opportunities

Value	Frequency	Percentage
1	6	40.00
2	4	26.67
3	4	26.67
M	1	6.67
Mean	St. Deviation	Skewness
1.857	0.864	0.306

4
Product Usabilit

Value
1
2
3
Mean
1.933

6
Design for manufacture / assembly

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	5	33.33
4	2	13.33
5	2	13.33
Mean	St. Deviation	Skewness
2.733	1.387	0.18

7
Cost / price

Value	Frequency	Percentage
1	10	66.67
2	3	20.00
3	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
1.6	1.121	2.344

d) Generation of Product Design Requirements / Specifications

1
Aesthetics

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	4	26.67
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.4	1.298	0.479

2
New Product Improvements

Value	Frequency	Percentage
1	3	20.00
2	7	46.67
3	5	33.33
Mean	St. Deviation	Skewness
2.133	0.743	-0.227

3
New Product Opportunities

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	6	40.00
Mean	St. Deviation	Skewness
2.133	0.834	-0.274

4
Product Usabilit

Value
1
2
3
Mean
2

6
Design for manufacture / assembly

Value	Frequency	Percentage
1	3	20.00
2	4	26.67
3	5	33.33
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.6	1.183	0.322

7
Cost / price

Value	Frequency	Percentage
1	5	33.33
2	6	40.00
3	3	20.00
4	1	6.67
Mean	St. Deviation	Skewness
2	0.926	0.623

f) Testing & Prototyping of New Ideas

1
Aesthetics

Value	Frequency	Percentage
1	4	26.67
2	2	13.33
3	4	26.67
4	3	20.00
5	2	13.33
Mean	St. Deviation	Skewness
2.8	1.424	0.062

2
New Product Improvements

Value	Frequency	Percentage
1	6	40.00
2	4	26.67
3	4	26.67
4	1	6.67
Mean	St. Deviation	Skewness
2	1	0.495

3
New Product Opportunities

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	3	20.00
4	3	20.00
5	1	6.67
Mean	St. Deviation	Skewness
2.6	1.242	0.382

4
Product Usabilit

Value
1
2
3
Mean
1.867

ty		5 Product Performance/ Specification			6 Design for manufacture / assembly			7 Cost / price		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
6	40.00	1	9	60.00	1	3	20.00	1	8	53.33
4	26.67	2	2	13.33	2	2	13.33	2	4	26.67
5	33.33	3	4	26.67	3	6	40.00	3	2	13.33
					4	2	13.33	M	1	6.67
					5	2	13.33			
St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
0.884	0.142	1.667	0.9	0.78	2.867	1.302	0.057	1.571	0.756	0.967

ty		5 Product Performance/ Specification			6 Design for manufacture / assembly			7 Cost / price		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
5	33.33	1	7	46.67	1	2	13.33	1	7	46.67
5	33.33	2	6	40.00	2	6	40.00	2	5	33.33
5	33.33	3	2	13.33	3	4	26.67	3	3	20.00
					4	2	13.33			
					5	1	6.67			
St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
0.845	0	1.667	0.724	0.628	2.6	1.121	0.589	1.733	0.799	0.555

ty		5 Product Performance/ Specification			6 Design for manufacture / assembly			7 Cost / price		
Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage	Value	Frequency	Percentage
7	46.67	1	9	60.00	1	5	33.33	1	7	46.67
3	20.00	2	4	26.67	2	3	20.00	2	4	26.67
5	33.33	3	2	13.33	3	4	26.67	3	3	20.00
					4	1	6.67	5	1	6.67
					5	2	13.33			
St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness	Mean	St. Deviation	Skewness
0.915	0.293	1.533	0.743	1.074	2.467	1.407	0.61	1.933	1.163	1.404

3.2 **Type of Information Sought**

a) Identification & Collection of User Needs

1 Specific data / information

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	4	26.67
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.214	1.122	1.039

2 Generic data / information

Value	Frequency	Percentage
1	3	20.00
2	5	33.33
3	4	26.67
4	1	6.67
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.429	1.158	0.722

3 Other

Value	Frequency	Percentage
1	1	6.67
3	5	33.33
M	9	60.00
Mean	St. Deviation	Skewness
2.667	0.816	-2.449

b) Establishing Target Karkets

1 Specific data / information

Value	Frequency	Percentage
1	7	46.67
2	5	33.33
3	2	13.33
M	1	6.67
Mean	St. Deviation	Skewness
1.643	0.745	0.731

2 Generic data / information

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	5	33.33
M	1	6.67
Mean	St. Deviation	Skewness
2.071	0.829	-0.145

c) Evaluation of Competiting Products

1 Specific data / information

Value	Frequency	Percentage
1	7	46.67
2	3	20.00
3	4	26.67
M	1	6.67
Mean	St. Deviation	Skewness
1.786	0.893	0.479

2 Generic data / information

Value	Frequency	Percentage
1	1	6.67
2	7	46.67
3	5	33.33
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.5	0.941	1.294

3 Other

Value	Frequency	Percentage
2	1	6.67
3	6	40.00
4	1	6.67
M	7	46.67
Mean	St. Deviation	Skewness
3	0.535	0

d) Generation of Product Design Requirements / Specifications

1 Specific data / information

Value	Frequency	Percentage
1	9	60.00
2	2	13.33
3	2	13.33
4	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
1.643	1.008	1.383

2 Generic data / information

Value	Frequency	Percentage
1	5	33.33
2	7	46.67
3	1	6.67
M	2	13.33
Mean	St. Deviation	Skewness
1.692	0.63	0.307

e) Generation & Selection of Product Concepts

1 Specific data / information

Value	Frequency	Percentage
1	8	53.33
2	4	26.67
3	1	6.67
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
1.714	1.139	2.114

2 Generic data / information

Value	Frequency	Percentage
1	5	33.33
2	4	26.67
3	2	13.33
4	1	6.67
5	2	13.33
M	1	6.67
Mean	St. Deviation	Skewness
2.357	1.447	0.865

3 Other

Value	Frequency	Percentage
1	2	13.33
2	1	6.67
3	3	20.00
5	1	6.67
M	8	53.33
Mean	St. Deviation	Skewness
2.571	1.397	0.566

f) Testing & Prototyping of New Ideas

1 Specific data / information

Value	Frequency	Percentage
1	8	53.33
2	4	26.67
3	1	6.67
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
1.714	1.139	2.114

2 Generic data / information

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	1	6.67
4	1	6.67
5	2	13.33
M	2	13.33
Mean	St. Deviation	Skewness
2.385	1.446	0.956

3
Other

Value	Frequency	Percentage
1	2	13.33
2	1	6.67
3	4	26.67
4	1	6.67
M	7	46.67

Mean	St. Deviation	Skewness
2	1.414	-0.295

3
Other

Value	Frequency	Percentage
1	2	13.33
3	4	26.67
M	9	60.00

Mean	St. Deviation	Skewness
2.333	1.033	-0.968

3
Other

Value	Frequency	Percentage
1	2	13.33
3	3	20.00
5	1	6.67
M	9	60.00

Mean	St. Deviation	Skewness
2.667	1.506	0.313

3.3 Quality of Information Captured

1
a) Identification & Collection of User Needs

Value	Frequency	Percentage
1	7	46.67
2	7	46.67
4	1	6.67
Mean	St. Deviation	Skewness
1.667	0.816	1.649

2
b) Establishing Target Markets

Value	Frequency	Percentage
1	2	13.33
2	9	60.00
3	4	26.67
Mean	St. Deviation	Skewness
2.133	0.64	-0.103

3
c) Evaluation of Competing Products

Value	Frequency	Percentage
1	8	53.33
2	3	20.00
3	3	20.00
5	1	6.67
Mean	St. Deviation	Skewness
1.867	1.187	1.474

4
d) Gen. of Prod. Design Req. / Spec.

Value	Frequency	Percentage
1	7	46.67
2	5	33.33
3	2	13.33
4	1	6.67
Mean	St. Deviation	Skewness
1.8	0.941	1.044

5
e) Gen. & selection of Prod. Design Concepts

Value	Frequency	Percentage
1	5	33.33
2	5	33.33
3	4	26.67
4	1	6.67
Mean	St. Deviation	Skewness
2.067	0.961	0.409

6
f) Testing & Prototyping of New Prod. Ideas

Value	Frequency	Percentage
1	7	46.67
2	5	33.33
3	2	13.33
4	1	6.67
Mean	St. Deviation	Skewness
1.8	0.941	1.044

4.1 LEVEL OF UNCERTAINTY EXPERIENCED WHEN UNDERTAKING FOLLOWING ACTIVITIES

a) Identification & Collection of User Needs

Value	Frequency	Percentage
1	2	13.33
2	3	20.00
3	6	40.00
4	2	13.33
5	1	6.67
M	1	6.67
Mean	St. Deviation	Skewness
2.786	1.122	0.105

b) Establishing Target Markets

Value	Frequency	Percentage
1	3	20.00
2	4	26.67
3	3	20.00
4	4	26.67
M	1	6.67
Mean	St. Deviation	Skewness
2.571	1.158	-0.028

c) Evaluation of Competing Products

Value	Frequency	Percentage
1	7	46.67
2	3	20.00
3	1	6.67
4	3	20.00
M	1	6.67
Mean	St. Deviation	Skewness
2	1.24	0.847

d) Gen. of Prod. Design Req. / Spec.

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	3	20.00
4	2	13.33
M	1	6.67
Mean	St. Deviation	Skewness
2.214	1.051	0.436

e) Gen. & selection of Prod. Design Concepts

Value	Frequency	Percentage
1	4	26.67
2	5	33.33
3	5	33.33
M	1	6.67
Mean	St. Deviation	Skewness
2.071	0.829	-0.145

f) Testing & Prototyping of New Prod. Ideas

Value	Frequency	Percentage
1	9	60.00
2	3	20.00
3	2	13.33
M	1	6.67
Mean	St. Deviation	Skewness
1.5	0.76	1.229

4.2 LEVEL OF UNCERTAINTY EXPERIENCED WHEN DISCUSING THE FOLLOWING ISSUES

a) Aesthetics

Value	Frequency	Percentage
1	5	33.33
2	3	20.00
3	4	26.67
4	2	13.33
5	1	6.67
Mean	St. Deviation	Skewness
2.267	1.1	1.25

b) Product Improvements

Value	Frequency	Percentage
1	4	26.67
2	8	53.33
3	3	20.00
Mean	St. Deviation	Skewness
1.933	0.704	0.092

c) New Product Opportunities

Value	Frequency	Percentage
1	2	13.33
2	5	33.33
3	3	20.00
4	5	33.33
Mean	St. Deviation	Skewness
2.733	1.1	-0.134

d) Product Usability

Value	Frequency	Percentage
1	6	40.00
2	5	33.33
3	2	13.33
4	2	13.33
Mean	St. Deviation	Skewness
2	1.069	0.809

e) Product Performance / specification

Value	Frequency	Percentage
1	7	46.67
2	6	40.00
3	2	13.33
Mean	St. Deviation	Skewness
1.667	0.724	0.628

f) Design for manufcature / assembly

Value	Frequency	Percentage
1	3	20.00
2	6	40.00
3	5	33.33
4	1	6.67
Mean	St. Deviation	Skewness
2.267	0.884	0.116

g) Costs

Value	Frequency	Percentage
1	2	13.33
2	10	66.67
3	1	6.67
4	1	6.67
5	1	6.67
Mean	St. Deviation	Skewness
2.267	1.033	1.629

A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	13	86.7	86.7	86.7
	2.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.133 Std dev .352 Skewness 2.405
S E Skew .580

Valid cases 15 Missing cases 0

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A12B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	6	40.0	40.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.400 Std dev 1.056 Skewness .723
S E Skew .580

Valid cases 15 Missing cases 0

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A12C

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	3	20.0	20.0	20.0
	2.00	6	40.0	40.0	60.0
	3.00	4	26.7	26.7	86.7
	4.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev .976 Skewness .276
S E Skew .580

Valid cases 15 Missing cases 0

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A12D

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	6	40.0	40.0	40.0
	2.00	3	20.0	20.0	60.0
	3.00	2	13.3	13.3	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev 1.397 Skewness .577
S E Skew .580

Valid cases 15 Missing cases 0

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A12E

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	5	33.3	33.3	33.3

2.00	5	33.3	33.3	66.7
3.00	3	20.0	20.0	86.7
4.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.133 Std dev 1.060 Skewness .531
S E Skew .580

Valid cases 15 Missing cases 0

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A12F

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	4	26.7	26.7	60.0
	3.00	4	26.7	26.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev 1.345 Skewness .918
S E Skew .580

Valid cases 15 Missing cases 0

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A13A

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	4	26.7	26.7	73.3
	3.00	2	13.3	13.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0

		-------	-------	-------
Total		15	100.0	100.0

Mean 2.000 Std dev 1.254 Skewness 1.255
S E Skew .580

Valid cases 15 Missing cases 0

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A13B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	4	26.7	26.7	53.3
	3.00	4	26.7	26.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.246 Skewness .471
S E Skew .580

Valid cases 15 Missing cases 0

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A13C

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	5	33.3	33.3	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.113 Skewness .412
S E Skew .580

Valid cases 15 Missing cases 0

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A13D

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	3	20.0	20.0	40.0
	3.00	6	40.0	40.0	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.175 Skewness .147
S E Skew .580

Valid cases 15 Missing cases 0

- -

A13E

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	2	13.3	13.3	33.3
	3.00	8	53.3	53.3	86.7
	4.00	1	6.7	6.7	93.3
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.113 Skewness .053
S E Skew .580

Valid cases 15 Missing cases 0

- -

A13F

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	6	40.0	40.0	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.056 Skewness .538
S E Skew .580

Valid cases 15 Missing cases 0

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A14A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	6	40.0	40.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.163 Skewness .659
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	6	40.0	40.0	60.0
	3.00	4	26.7	26.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.400 Std dev 1.121 Skewness .814
S E Skew .580

Valid cases 15 Missing cases 0

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A14A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	35.7	35.7
	2.00	3	20.0	21.4	57.1
	3.00	3	20.0	21.4	78.6
	4.00	3	20.0	21.4	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.286 Std dev 1.204 Skewness .283
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	16.7	16.7
	2.00	2	13.3	16.7	33.3
	3.00	3	20.0	25.0	58.3
	5.00	5	33.3	41.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 3.333 Std dev 1.614 Skewness -.184
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14A5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	3	20.0	23.1	61.5
	3.00	4	26.7	30.8	92.3
	5.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.154 Std dev 1.214 Skewness .979
S E Skew .616

Valid cases 13 Missing cases 2

- -

A14A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	4	26.7	28.6	42.9
	3.00	5	33.3	35.7	78.6
	4.00	2	13.3	14.3	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.714 Std dev 1.139 Skewness .290
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14A7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	1	6.7	7.1	21.4
	3.00	6	40.0	42.9	64.3
	4.00	2	13.3	14.3	78.6
	5.00	3	20.0	21.4	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 3.214 Std dev 1.311 Skewness -.219
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14A8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	5	33.3	33.3	80.0
	3.00	2	13.3	13.3	93.3
	4.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.800 Std dev .941 Skewness 1.044
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	3	20.0	20.0	33.3
	3.00	2	13.3	13.3	46.7
	4.00	5	33.3	33.3	80.0
	5.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.267 Std dev 1.387 Skewness -.365
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	2	13.3	13.3	33.3
	3.00	6	40.0	40.0	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.207 Skewness -.124
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	3	20.0	21.4	35.7
	3.00	5	33.3	35.7	71.4
	4.00	2	13.3	14.3	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.929 Std dev 1.269 Skewness .153
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14B4

Valid Cum

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	3	20.0	25.0	50.0
	3.00	1	6.7	8.3	58.3
	5.00	5	33.3	41.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 3.083 Std dev 1.782 Skewness .082
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14B5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	7	46.7	58.3	83.3
	3.00	1	6.7	8.3	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.083 Std dev 1.084 Skewness 1.866
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14B6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

3.00	6	40.0	46.2	46.2
4.00	2	13.3	15.4	61.5
5.00	5	33.3	38.5	100.0
.	2	13.3	Missing	
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 3.923 Std dev .954 Skewness .173
S E Skew .616

Valid cases 13 Missing cases 2

- -

A14B7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	3.00	4	26.7	26.7	26.7
	4.00	4	26.7	26.7	53.3
	5.00	7	46.7	46.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.200 Std dev .862 Skewness -.433
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14B8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	7	46.7	46.7	80.0
	3.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	

Total	15	100.0	100.0

Mean 2.133 Std dev 1.302 Skewness 1.511
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	2	13.3	13.3	26.7
	3.00	2	13.3	13.3	40.0
	4.00	4	26.7	26.7	66.7
	5.00	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

Mean 3.533 Std dev 1.457 Skewness -.635
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	4	26.7	26.7	40.0
	3.00	5	33.3	33.3	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.146 Skewness .118
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	2	13.3	14.3	28.6
	3.00	5	33.3	35.7	64.3
	4.00	3	20.0	21.4	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.071 Std dev 1.269 Skewness -.153
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	7.7	7.7
	2.00	2	13.3	15.4	23.1
	3.00	5	33.3	38.5	61.5
	5.00	5	33.3	38.5	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.462 Std dev 1.391 Skewness -.126

S E Skew .616

Valid cases 13 Missing cases 2

- -

A14C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	16.7	16.7
	2.00	2	13.3	16.7	33.3
	3.00	5	33.3	41.7	75.0
	4.00	1	6.7	8.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.917 Std dev 1.311 Skewness .181
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14C6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	7.7	7.7
	2.00	2	13.3	15.4	23.1
	3.00	3	20.0	23.1	46.2
	4.00	4	26.7	30.8	76.9
	5.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.462 Std dev 1.266 Skewness -.481

S E Skew .616

Valid cases 13 Missing cases 2

- -

A14C7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	6.7	6.7
	3.00	3	20.0	20.0	26.7
	4.00	4	26.7	26.7	53.3
	5.00	7	46.7	46.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.133 Std dev .990 Skewness -.808
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14C8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	6	40.0	40.0	66.7
	3.00	3	20.0	20.0	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.163 Skewness .973
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	2	13.3	13.3	26.7
	3.00	3	20.0	20.0	46.7
	4.00	3	20.0	20.0	66.7
	5.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.467 Std dev 1.457 Skewness -.483
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	5	33.3	33.3	40.0
	3.00	5	33.3	33.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.163 Skewness .461
S E Skew .580

Valid cases 15 Missing cases 0

- -21

A14D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	7.1	7.1
	2.00	4	26.7	28.6	35.7
	3.00	3	20.0	21.4	57.1
	4.00	3	20.0	21.4	78.6
	5.00	3	20.0	21.4	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.214 Std dev 1.311 Skewness .019
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	4	26.7	33.3	33.3
	3.00	2	13.3	16.7	50.0
	4.00	1	6.7	8.3	58.3
	5.00	5	33.3	41.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.583 Std dev 1.379 Skewness -.083
S E Skew .637

Valid cases 12 Missing cases 3

- -22

A14D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	23.1	23.1
	2.00	3	20.0	23.1	46.2
	3.00	4	26.7	30.8	76.9
	4.00	2	13.3	15.4	92.3
	5.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.615 Std dev 1.261 Skewness .283
S E Skew .616

Valid cases 13 Missing cases 2

- -

A14D6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	2.00	2	13.3	16.7	25.0
	3.00	3	20.0	25.0	50.0
	4.00	4	26.7	33.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.333 Std dev 1.231 Skewness -.416
S E Skew .637

Valid cases 12 Missing cases 3

- -23

A14D7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	2	13.3	13.3	20.0
	3.00	2	13.3	13.3	33.3
	4.00	4	26.7	26.7	60.0
	5.00	6	40.0	40.0	100.0
	Total	15	100.0	100.0	

Mean 3.800 Std dev 1.320 Skewness -.868
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14D8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

Mean 1.467 Std dev .516 Skewness .149
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	2	13.3	13.3	40.0
	3.00	3	20.0	20.0	60.0
	4.00	2	13.3	13.3	73.3
	5.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.604 Skewness .000
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	7	46.7	46.7	46.7
	3.00	4	26.7	26.7	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.867 Std dev .990 Skewness .808
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14E3

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	2.00	3	20.0	21.4	21.4
	3.00	7	46.7	50.0	71.4
	4.00	2	13.3	14.3	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.214 Std dev .975 Skewness .670
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14E4

				Valid	Cum
Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	1	6.7	8.3	8.3
	2.00	2	13.3	16.7	25.0
	3.00	3	20.0	25.0	50.0
	4.00	1	6.7	8.3	58.3
	5.00	5	33.3	41.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.583 Std dev 1.443 Skewness -.417
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14E5

				Valid	Cum
Value Label	Value	Frequency	Percent	Percent	Percent

Value	Frequency	Percent	Valid Percent	Cum Percent
1.00	4	26.7	33.3	33.3
2.00	1	6.7	8.3	41.7
3.00	5	33.3	41.7	83.3
4.00	1	6.7	8.3	91.7
5.00	1	6.7	8.3	100.0
.	3	20.0	Missing	
Total	15	100.0	100.0	

Mean 2.500 Std dev 1.314 Skewness .288
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14E6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	7.7	7.7
	3.00	6	40.0	46.2	53.8
	4.00	3	20.0	23.1	76.9
	5.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 3.615 Std dev .961 Skewness .280
S E Skew .616

Valid cases 13 Missing cases 2

- -

A14E7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

2.00	2	13.3	13.3	13.3
3.00	6	40.0	40.0	53.3
4.00	1	6.7	6.7	60.0
5.00	6	40.0	40.0	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 3.733 Std dev 1.163 Skewness -.030
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14E8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	6	40.0	40.0	86.7
	3.00	1	6.7	6.7	93.3
	4.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.733 Std dev .884 Skewness 1.317
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	3.00	4	26.7	26.7	53.3
	4.00	4	26.7	26.7	80.0
	5.00	3	20.0	20.0	100.0

		-------	-------	-------
Total		15	100.0	100.0

Mean 3.133 Std dev 1.506 Skewness -.404
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	3	20.0	20.0	40.0
	3.00	7	46.7	46.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.121 Skewness .239
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	3	20.0	21.4	21.4
	3.00	6	40.0	42.9	64.3
	4.00	3	20.0	21.4	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.286 Std dev .994 Skewness .425
S E Skew .597

Valid cases 14 Missing cases 1

- -

A14F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	3	20.0	25.0	25.0
	3.00	1	6.7	8.3	33.3
	4.00	2	13.3	16.7	50.0
	5.00	6	40.0	50.0	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 3.917 Std dev 1.311 Skewness -.690
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	16.7	16.7
	2.00	4	26.7	33.3	50.0
	3.00	2	13.3	16.7	66.7
	4.00	1	6.7	8.3	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.917 Std dev 1.505 Skewness .360
S E Skew .637

Valid cases 12 Missing cases 3

- -

A14F6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	2	13.3	15.4	15.4
	3.00	6	40.0	46.2	61.5
	4.00	1	6.7	7.7	69.2
	5.00	4	26.7	30.8	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.538 Std dev 1.127 Skewness .301
S E Skew .616

Valid cases 13 Missing cases 2

- -

A14F7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	1	6.7	6.7	20.0
	3.00	6	40.0	40.0	60.0
	4.00	1	6.7	6.7	66.7
	5.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.400 Std dev 1.404 Skewness -.300
S E Skew .580

Valid cases 15 Missing cases 0

- -

A14F8

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	6	40.0	40.0	73.3
	3.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.067 Std dev 1.100 Skewness 1.339
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	2	13.3	13.3	40.0
	3.00	2	13.3	13.3	53.3
	4.00	4	26.7	26.7	80.0
	5.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.558 Skewness -.131
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	5	33.3	33.3	33.3
	3.00	6	40.0	40.0	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 3.067 Std dev 1.033 Skewness .749
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	6	40.0	40.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.234 Skewness .740
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	4	26.7	26.7	26.7
	3.00	5	33.3	33.3	60.0
	4.00	5	33.3	33.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 3.200 Std dev .941 Skewness .142
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	5	33.3	33.3	40.0
	3.00	5	33.3	33.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.163 Skewness .461
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	5	33.3	33.3	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.113 Skewness .412
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	6	40.0	40.0	46.7
	3.00	5	33.3	33.3	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.733 Std dev 1.033 Skewness .616
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21B4

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	1	6.7	6.7	6.7
	2.00	4	26.7	26.7	33.3
	3.00	4	26.7	26.7	60.0
	4.00	5	33.3	33.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.067 Std dev 1.100 Skewness -.148
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21C1

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	1	6.7	6.7	6.7
	2.00	3	20.0	20.0	26.7
	3.00	7	46.7	46.7	73.3
	4.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.933 Std dev .884 Skewness -.574
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21C2

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	4	26.7	26.7	26.7

2.00	4	26.7	26.7	53.3
3.00	4	26.7	26.7	80.0
4.00	2	13.3	13.3	93.3
5.00	1	6.7	6.7	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.467 Std dev 1.246 Skewness .471
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	3	20.0	20.0	33.3
	3.00	4	26.7	26.7	60.0
	4.00	4	26.7	26.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.067 Std dev 1.280 Skewness -.141
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	4	26.7	26.7	46.7
	3.00	3	20.0	20.0	66.7

4.00	3	20.0	20.0	86.7
5.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.800 Std dev 1.373 Skewness .222
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	5	33.3	33.3	40.0
	3.00	5	33.3	33.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.163 Skewness .461
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	3	20.0	20.0	73.3
	3.00	1	6.7	6.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0

	-------	-------	-------
Total	15	100.0	100.0

Mean 2.000 Std dev 1.363 Skewness 1.172
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	3	20.0	20.0	33.3
	3.00	1	6.7	6.7	40.0
	4.00	7	46.7	46.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.267 Std dev 1.335 Skewness -.563
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	4	26.7	26.7	60.0
	3.00	2	13.3	13.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.457 Skewness .635
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	4	26.7	26.7	46.7
	3.00	2	13.3	13.3	60.0
	4.00	5	33.3	33.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.320 Skewness -.009
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	5	33.3	33.3	60.0
	3.00	2	13.3	13.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.533 Std dev 1.407 Skewness .631

S E Skew .580

Valid cases 15 Missing cases 0

- -

B21E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	3	20.0	20.0	33.3
	3.00	5	33.3	33.3	66.7
	4.00	4	26.7	26.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.163 Skewness -.168
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21E4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	3	20.0	20.0	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.533 Std dev 1.457 Skewness .483
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	2	13.3	13.3	26.7
	3.00	7	46.7	46.7	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.100 Skewness -.224
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	5	33.3	33.3	80.0
	3.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.867 Std dev 1.125 Skewness 1.684
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	3.00	4	26.7	26.7	33.3
	4.00	5	33.3	33.3	66.7
	5.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.867 Std dev 1.125 Skewness -1.091
S E Skew .580

Valid cases 15 Missing cases 0

- -

B21F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	5	33.3	33.3	66.7
	3.00	3	20.0	20.0	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.200 Std dev 1.207 Skewness .967
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	3.00	5	33.3	33.3	40.0
	4.00	5	33.3	33.3	73.3
	5.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.733 Std dev 1.100 Skewness -.878
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	6	40.0	40.0	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.056 Skewness .538
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	6	40.0	40.0	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.163 Skewness .659
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	6	40.0	40.0	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.533 Std dev 1.060 Skewness .730
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22A5

Valid Cum

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	50.0	50.0
	2.00	1	6.7	50.0	100.0
	.	13	86.7	Missing	
	Total	15	100.0	100.0	

Mean 1.500 Std dev .707

Valid cases 2 Missing cases 13

- -

B22A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.00	2	13.3	66.7	66.7
	1.00	1	6.7	33.3	100.0
	.	12	80.0	Missing	
	Total	15	100.0	100.0	

Mean .333 Std dev .577 Skewness 1.732
S E Skew 1.225

Valid cases 3 Missing cases 12

- -47

B22B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	33.3	33.3
	2.00	1	6.7	33.3	66.7
	3.00	1	6.7	33.3	100.0
	.	12	80.0	Missing	

	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.000 Skewness .000
S E Skew 1.225

Valid cases 3 Missing cases 12

- -

B22B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	4	26.7	26.7	46.7
	3.00	3	20.0	20.0	66.7
	4.00	2	13.3	13.3	80.0
	5.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.867 Std dev 1.457 Skewness .264
S E Skew .580

Valid cases 15 Missing cases 0

- -48

B22B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	6	40.0	40.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.121 Skewness .589
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22B4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	5	33.3	35.7	50.0
	3.00	5	33.3	35.7	85.7
	4.00	1	6.7	7.1	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.571 Std dev 1.089 Skewness .620
S E Skew .597

Valid cases 14 Missing cases 1

- -49

B22B5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B22B6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B22C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	50.0	50.0
	3.00	1	6.7	50.0	100.0
	.	13	86.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.414

Valid cases 2 Missing cases 13

- -

B22C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	2	13.3	13.3	20.0
	3.00	5	33.3	33.3	53.3
	4.00	3	20.0	20.0	73.3
	5.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.467 Std dev 1.246 Skewness -.296
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	4	26.7	26.7	33.3
	3.00	6	40.0	40.0	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.134 Skewness .339
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	6	40.0	40.0	40.0

3.00	5	33.3	33.3	73.3
4.00	2	13.3	13.3	86.7
5.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 3.000 Std dev 1.069 Skewness .809
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	15	100.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Valid cases 0 Missing cases 15

- -

B22C6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	15	100.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Valid cases 0 Missing cases 15

- -

B22D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	15	100.0	Missing	
	Total	15	100.0	100.0	

Valid cases 0 Missing cases 15

- -

B22D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	3	20.0	20.0	46.7
	3.00	3	20.0	20.0	66.7
	4.00	3	20.0	20.0	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.733 Std dev 1.438 Skewness .206
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	9	60.0	60.0	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.867 Std dev .990 Skewness 2.335
S E Skew .580

Valid cases 15 Missing cases 0

- -53

B22D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	21.4	21.4
	2.00	5	33.3	35.7	57.1
	3.00	5	33.3	35.7	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.357 Std dev 1.082 Skewness .855
S E Skew .597

Valid cases 14 Missing cases 1

- -

B22D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	50.0	50.0
	3.00	1	6.7	50.0	100.0
	.	13	86.7	Missing	
	Total	15	100.0	100.0	

Mean 2.500 Std dev .707

Valid cases 2 Missing cases 13

- -54

B22D6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	15	100.0	Missing	
	Total	15	100.0	100.0	

Valid cases 0 Missing cases 15

- -

B22E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	3.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
	Total	15	100.0	100.0	

Mean 3.000

Valid cases 1 Missing cases 14

- -

B22E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	1	6.7	6.7	33.3
	3.00	8	53.3	53.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.291 Skewness .264
S E Skew .580

Valid cases 15 Missing cases 0

- -55

B22E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	5	33.3	33.3	60.0
	3.00	5	33.3	33.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.100 Skewness .878
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22E4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.125 Skewness .616
S E Skew .580

Valid cases 15 Missing cases 0

- -56

B22E5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	7	46.7	46.7	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev .986 Skewness .971
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22E6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	4	26.7	26.7	26.7
	3.00	1	6.7	6.7	33.3
	4.00	4	26.7	26.7	60.0
	5.00	6	40.0	40.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.800 Std dev 1.265 Skewness -.547
S E Skew .580

Valid cases 15 Missing cases 0

- -57

B22F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	5	33.3	33.3	60.0
	3.00	4	26.7	26.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev 1.175 Skewness .767
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	6	40.0	40.0	46.7
	3.00	5	33.3	33.3	80.0
	4.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.146 Skewness .775
S E Skew .580

Valid cases 15 Missing cases 0

- -58

B22F3

Value Label	Value	Frequency	Valid Percent	Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	6	40.0	40.0	60.0
	3.00	4	26.7	26.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.400 Std dev 1.121 Skewness .814
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22F4

Value Label	Value	Frequency	Valid Percent	Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.125 Skewness .616
S E Skew .580

Valid cases 15 Missing cases 0

- -59

B22F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	6	40.0	40.0	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.056 Skewness .538
S E Skew .580

Valid cases 15 Missing cases 0

- -

B22F6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	1	6.7	7.1	21.4
	3.00	2	13.3	14.3	35.7
	4.00	3	20.0	21.4	57.1
	5.00	6	40.0	42.9	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.714 Std dev 1.490 Skewness -.894
S E Skew .597

Valid cases 14 Missing cases 1

- -

B23A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	4	26.7	26.7	40.0
	3.00	5	33.3	33.3	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.146 Skewness .118
S E Skew .580

Valid cases 15 Missing cases 0

- -

B23A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	42.9	42.9
	2.00	2	13.3	14.3	57.1
	3.00	4	26.7	28.6	85.7
	4.00	1	6.7	7.1	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.214 Std dev 1.311 Skewness .736
S E Skew .597

Valid cases 14 Missing cases 1

- -61

B23A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	36.4	36.4
	2.00	3	20.0	27.3	63.6
	3.00	3	20.0	27.3	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.182 Std dev 1.250 Skewness 1.088
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	18.2	18.2
	2.00	5	33.3	45.5	63.6
	3.00	3	20.0	27.3	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.364 Std dev 1.120 Skewness 1.199
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23A5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	2	13.3	15.4	15.4
	3.00	3	20.0	23.1	38.5
	4.00	5	33.3	38.5	76.9
	5.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.692 Std dev 1.032 Skewness -.344
S E Skew .616

Valid cases 13 Missing cases 2

- -

B23A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	2.00	1	6.7	8.3	16.7
	3.00	4	26.7	33.3	50.0
	4.00	5	33.3	41.7	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.333 Std dev 1.073 Skewness -.804
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23A7

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	2	13.3	18.2	18.2
	2.00	1	6.7	9.1	27.3
	3.00	4	26.7	36.4	63.6
	4.00	2	13.3	18.2	81.8
	5.00	2	13.3	18.2	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 3.091 Std dev 1.375 Skewness -.196
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	18.2	18.2
	2.00	4	26.7	36.4	54.5
	3.00	2	13.3	18.2	72.7
	4.00	1	6.7	9.1	81.8
	5.00	2	13.3	18.2	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 2.727 Std dev 1.421 Skewness .586
S E Skew .661

Valid cases 11 Missing cases 4

- -64

B23B2

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	9	60.0	64.3	64.3
	2.00	3	20.0	21.4	85.7
	3.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.500 Std dev .760 Skewness 1.229
S E Skew .597

Valid cases 14 Missing cases 1

- -

B23B3

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	6	40.0	54.5	54.5
	2.00	3	20.0	27.3	81.8
	3.00	2	13.3	18.2	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.636 Std dev .809 Skewness .847
S E Skew .661

Valid cases 11 Missing cases 4

- -65

B23B4

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	4	26.7	33.3	33.3
	2.00	2	13.3	16.7	50.0

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	3.00	4	26.7	33.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.500 Std dev 1.446 Skewness .649
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23B5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	3.00	3	20.0	25.0	33.3
	4.00	2	13.3	16.7	50.0
	5.00	6	40.0	50.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.000 Std dev 1.279 Skewness -1.251
S E Skew .637

Valid cases 12 Missing cases 3

- -66

B23B6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	3.00	2	13.3	16.7	25.0
	4.00	3	20.0	25.0	50.0
	5.00	6	40.0	50.0	100.0

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 4.083 Std dev 1.240 Skewness -1.558
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23B7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	20.0	20.0
	2.00	1	6.7	10.0	30.0
	3.00	1	6.7	10.0	40.0
	4.00	3	20.0	30.0	70.0
	5.00	3	20.0	30.0	100.0
	.	5	33.3	Missing	
	Total	15	100.0	100.0	

Mean 3.400 Std dev 1.578 Skewness -.620
S E Skew .687

Valid cases 10 Missing cases 5

- -67

B23C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	9.1	9.1
	2.00	1	6.7	9.1	18.2
	3.00	3	20.0	27.3	45.5
	4.00	2	13.3	18.2	63.6
	5.00	4	26.7	36.4	100.0

	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 3.636 Std dev 1.362 Skewness -.641
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	28.6	28.6
	2.00	2	13.3	14.3	42.9
	3.00	5	33.3	35.7	78.6
	4.00	2	13.3	14.3	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.571 Std dev 1.284 Skewness .197
S E Skew .597

Valid cases 14 Missing cases 1

- -68

B23C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	18.2	18.2
	2.00	3	20.0	27.3	45.5
	3.00	4	26.7	36.4	81.8
	4.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 2.636 Std dev 1.206 Skewness .446
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	4	26.7	33.3	58.3
	3.00	3	20.0	25.0	83.3
	4.00	1	6.7	8.3	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.417 Std dev 1.240 Skewness .743
S E Skew .637

Valid cases 12 Missing cases 3

- -69

B23C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	3	20.0	25.0	58.3
	3.00	3	20.0	25.0	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.417 Std dev 1.443 Skewness .852
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23C6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	2	13.3	16.7	50.0
	3.00	3	20.0	25.0	75.0
	4.00	2	13.3	16.7	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.500 Std dev 1.382 Skewness .372
S E Skew .637

Valid cases 12 Missing cases 3

- -70

B23C7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	45.5	45.5
	2.00	4	26.7	36.4	81.8
	3.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	Total	15	100.0	100.0	

Mean 1.909 Std dev 1.221 Skewness 1.818
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	36.4	36.4
	2.00	5	33.3	45.5	81.8
	3.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.183 Skewness 1.771
S E Skew .661

Valid cases 11 Missing cases 4

- -71

B23D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	50.0	50.0
	2.00	2	13.3	14.3	64.3
	3.00	4	26.7	28.6	92.9
	4.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.929 Std dev 1.072 Skewness .598
S E Skew .597

Valid cases 14 Missing cases 1

- -

B23D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	36.4	36.4
	2.00	2	13.3	18.2	54.5
	3.00	4	26.7	36.4	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 2.273 Std dev 1.272 Skewness .804
S E Skew .661

Valid cases 11 Missing cases 4

- -72

B23D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	2	13.3	16.7	41.7
	3.00	5	33.3	41.7	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.371 Skewness .471
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	2	13.3	16.7	41.7
	3.00	5	33.3	41.7	83.3
	4.00	1	6.7	8.3	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.583 Std dev 1.240 Skewness .287
S E Skew .637

Valid cases 12 Missing cases 3

- -73

B23D6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	3	20.0	25.0	50.0
	3.00	4	26.7	33.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.583 Std dev 1.379 Skewness .666
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	3	20.0	25.0	58.3
	3.00	2	13.3	16.7	75.0
	4.00	1	6.7	8.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.500 Std dev 1.508 Skewness .669
S E Skew .637

Valid cases 12 Missing cases 3

- -74

B23E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	46.2	46.2
	2.00	2	13.3	15.4	61.5
	3.00	2	13.3	15.4	76.9
	4.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.154 Std dev 1.281 Skewness .509
S E Skew .616

Valid cases 13 Missing cases 2

- -

B23E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	36.4	36.4
	2.00	1	6.7	9.1	45.5
	3.00	5	33.3	45.5	90.9
	4.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.273 Std dev 1.104 Skewness -.108
S E Skew .661

Valid cases 11 Missing cases 4

- -75

B23E4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	18.2	18.2
	2.00	3	20.0	27.3	45.5
	3.00	1	6.7	9.1	54.5
	4.00	4	26.7	36.4	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.909 Std dev 1.375 Skewness -.086
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23E5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	3	20.0	25.0	50.0
	3.00	2	13.3	16.7	66.7
	4.00	1	6.7	8.3	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.833 Std dev 1.586 Skewness .325
S E Skew .637

Valid cases 12 Missing cases 3

- -76

B23E6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	15.4	15.4
	2.00	3	20.0	23.1	38.5
	3.00	3	20.0	23.1	61.5
	4.00	3	20.0	23.1	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.354 Skewness .000
S E Skew .616

Valid cases 13 Missing cases 2

- -

B23E7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	36.4	36.4
	2.00	5	33.3	45.5	81.8
	3.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.183 Skewness 1.771
S E Skew .661

Valid cases 11 Missing cases 4

- -77

B23F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	4	26.7	33.3	58.3
	3.00	2	13.3	16.7	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.557 Skewness .668
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	2	13.3	13.3	80.0
	3.00	3	20.0	20.0	100.0
	Total	15	100.0	100.0	

Mean 1.533 Std dev .834 Skewness 1.159
S E Skew .580

Valid cases 15 Missing cases 0

- -78

B23F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	54.5	54.5
	2.00	3	20.0	27.3	81.8
	3.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 1.818 Std dev 1.250 Skewness 1.912
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	3	20.0	25.0	58.3
	3.00	1	6.7	8.3	66.7
	4.00	2	13.3	16.7	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.583 Std dev 1.564 Skewness .499
S E Skew .637

Valid cases 12 Missing cases 3

- -79

B23F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	41.7	41.7
	2.00	1	6.7	8.3	50.0
	3.00	2	13.3	16.7	66.7
	4.00	1	6.7	8.3	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.723 Skewness .365
S E Skew .637

Valid cases 12 Missing cases 3

- -

B23F6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	23.1	23.1
	2.00	1	6.7	7.7	30.8
	3.00	3	20.0	23.1	53.8
	4.00	2	13.3	15.4	69.2
	5.00	4	26.7	30.8	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.231 Std dev 1.589 Skewness -.298
S E Skew .616

Valid cases 13 Missing cases 2

- -80

B23F7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	54.5	54.5
	2.00	2	13.3	18.2	72.7
	3.00	2	13.3	18.2	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.909 Std dev 1.300 Skewness 1.535
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23G1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	4	26.7	33.3	58.3
	3.00	2	13.3	16.7	75.0
	4.00	1	6.7	8.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.583 Std dev 1.443 Skewness .672
S E Skew .637

Valid cases 12 Missing cases 3

- -81

B23G2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	2	13.3	15.4	15.4
	3.00	7	46.7	53.8	69.2
	4.00	3	20.0	23.1	92.3
	5.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.231 Std dev .832 Skewness .528
S E Skew .616

Valid cases 13 Missing cases 2

- -

B23G3

		Valid	Cum
		Valid	Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	3	20.0	27.3	27.3
	2.00	3	20.0	27.3	54.5
	3.00	2	13.3	18.2	72.7
	4.00	2	13.3	18.2	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 2.545 Std dev 1.368 Skewness .456
S E Skew .661

Valid cases 11 Missing cases 4

- -82

B23G4

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	1	6.7	9.1	9.1
	2.00	4	26.7	36.4	45.5
	3.00	4	26.7	36.4	81.8
	4.00	1	6.7	9.1	90.9
	5.00	1	6.7	9.1	100.0
	.	4	26.7	Missing	
	Total	15	100.0	100.0	

Mean 2.727 Std dev 1.104 Skewness .654
S E Skew .661

Valid cases 11 Missing cases 4

- -

B23G5

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	2	13.3	15.4	15.4
	2.00	4	26.7	30.8	46.2
	3.00	2	13.3	15.4	61.5
	4.00	2	13.3	15.4	76.9
	5.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.472 Skewness .185
S E Skew .616

Valid cases 13 Missing cases 2

- -83

B23G6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	30.8	30.8
	2.00	3	20.0	23.1	53.8
	3.00	4	26.7	30.8	84.6
	4.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.308 Std dev 1.109 Skewness .143
S E Skew .616

Valid cases 13 Missing cases 2

- -

B23G7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	40.0	40.0
	2.00	3	20.0	30.0	70.0
	3.00	2	13.3	20.0	90.0
	4.00	1	6.7	10.0	100.0
	.	5	33.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.054 Skewness .712
S E Skew .687

Valid cases 10 Missing cases 5

- -84

B24A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	41.7	41.7
	2.00	4	26.7	33.3	75.0
	3.00	1	6.7	8.3	83.3
	4.00	1	6.7	8.3	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.083 Std dev 1.311 Skewness 1.270
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

1.00	4	26.7	28.6	28.6
2.00	4	26.7	28.6	57.1
3.00	3	20.0	21.4	78.6
4.00	1	6.7	7.1	85.7
5.00	2	13.3	14.3	100.0
.	1	6.7	Missing	
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.500 Std dev 1.401 Skewness .686
S E Skew .597

Valid cases 14 Missing cases 1

- -85

B24A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	35.7	35.7
	2.00	6	40.0	42.9	78.6
	4.00	2	13.3	14.3	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.143 Std dev 1.292 Skewness 1.191
S E Skew .597

Valid cases 14 Missing cases 1

- -

B24A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	50.0	50.0

2.00	4	26.7	33.3	83.3
5.00	2	13.3	16.7	100.0
.	3	20.0	Missing	
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.000 Std dev 1.477 Skewness 1.625
S E Skew .637

Valid cases 12 Missing cases 3

- -86

B24A5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	2.00	1	6.7	8.3	16.7
	3.00	3	20.0	25.0	41.7
	4.00	4	26.7	33.3	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.583 Std dev 1.240 Skewness -.743
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	16.7	16.7
	2.00	3	20.0	25.0	41.7
	3.00	1	6.7	8.3	50.0

4.00	3	20.0	25.0	75.0
5.00	3	20.0	25.0	100.0
.	3	20.0	Missing	
Total	15	100.0	100.0	

Mean 3.167 Std dev 1.528 Skewness -.150
S E Skew .637

Valid cases 12 Missing cases 3

- -87

B24B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B24B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	3	20.0	20.0	73.3
	3.00	2	13.3	13.3	86.7
	4.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 1.867 Std dev 1.125 Skewness .990

S E Skew .580

Valid cases 15 Missing cases 0

- -88

B24B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	6	40.0	46.2	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.077 Std dev 1.382 Skewness 1.630
S E Skew .616

Valid cases 13 Missing cases 2

- -

B24B4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	6	40.0	46.2	84.6
	3.00	1	6.7	7.7	92.3
	5.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 1.923 Std dev 1.115 Skewness 1.878
S E Skew .616

Valid cases 13 Missing cases 2

- -89

B24B5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	3.00	2	13.3	16.7	16.7
	4.00	3	20.0	25.0	41.7
	5.00	7	46.7	58.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.417 Std dev .793 Skewness -.988
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24B6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	8.3	8.3
	2.00	1	6.7	8.3	16.7
	3.00	2	13.3	16.7	33.3
	4.00	2	13.3	16.7	50.0
	5.00	6	40.0	50.0	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.917 Std dev 1.379 Skewness -1.072
S E Skew .637

Valid cases 12 Missing cases 3

- -90

B24C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B24C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	3	20.0	21.4	35.7
	3.00	5	33.3	35.7	71.4
	4.00	1	6.7	7.1	78.6
	5.00	3	20.0	21.4	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.359 Skewness .215
S E Skew .597

Valid cases 14 Missing cases 1

- -91

B24C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	21.4	21.4
	2.00	6	40.0	42.9	64.3
	3.00	2	13.3	14.3	78.6
	4.00	2	13.3	14.3	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.429 Std dev 1.222 Skewness .782
S E Skew .597

Valid cases 14 Missing cases 1

- -

B24C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	30.8	30.8
	2.00	4	26.7	30.8	61.5
	3.00	3	20.0	23.1	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.385 Std dev 1.387 Skewness .947
S E Skew .616

Valid cases 13 Missing cases 2

- -

B24C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	16.7	16.7
	2.00	3	20.0	25.0	41.7
	3.00	4	26.7	33.3	75.0
	4.00	1	6.7	8.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.833 Std dev 1.337 Skewness .360
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24C6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	41.7	41.7
	2.00	3	20.0	25.0	66.7
	3.00	2	13.3	16.7	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.250 Std dev 1.485 Skewness 1.087
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B24D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	28.6	28.6
	2.00	2	13.3	14.3	42.9
	3.00	3	20.0	21.4	64.3
	4.00	3	20.0	21.4	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.786 Std dev 1.477 Skewness .094
S E Skew .597

Valid cases 14 Missing cases 1

- -94

B24D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	46.2	46.2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	3	20.0	23.1	69.2
	3.00	2	13.3	15.4	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.154 Std dev 1.463 Skewness 1.198
S E Skew .616

Valid cases 13 Missing cases 2

- -

B24D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	3	20.0	23.1	61.5
	3.00	3	20.0	23.1	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.308 Std dev 1.437 Skewness .955
S E Skew .616

Valid cases 13 Missing cases 2

- -95

B24D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	1	6.7	8.3	41.7
	3.00	3	20.0	25.0	66.7

4.00	2	13.3	16.7	83.3
5.00	2	13.3	16.7	100.0
.	3	20.0	Missing	
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.750 Std dev 1.545 Skewness .144
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24D6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	50.0	50.0
	2.00	2	13.3	16.7	66.7
	4.00	2	13.3	16.7	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev 1.670 Skewness .771
S E Skew .637

Valid cases 12 Missing cases 3

- -96

B24E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.000

Valid cases 1 Missing cases 14

- -

B24E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	4	26.7	26.7	53.3
	3.00	5	33.3	33.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.302 Skewness .756
S E Skew .580

Valid cases 15 Missing cases 0

- -97

B24E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	6	40.0	40.0	73.3
	3.00	2	13.3	13.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.133 Std dev 1.187 Skewness 1.186
S E Skew .580

Valid cases 15 Missing cases 0

- -

B24E4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	4	26.7	30.8	69.2
	3.00	2	13.3	15.4	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.231 Std dev 1.423 Skewness 1.162
S E Skew .616

Valid cases 13 Missing cases 2

- -98

B24E5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	33.3	33.3
	2.00	1	6.7	8.3	41.7
	3.00	3	20.0	25.0	66.7
	4.00	1	6.7	8.3	75.0
	5.00	3	20.0	25.0	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 2.833 Std dev 1.642 Skewness .170
S E Skew .637

Valid cases 12 Missing cases 3

- -

B24E6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	41.7	41.7
	2.00	4	26.7	33.3	75.0
	3.00	1	6.7	8.3	83.3
	5.00	2	13.3	16.7	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.167 Std dev 1.467 Skewness 1.317
S E Skew .637

Valid cases 12 Missing cases 3

- -99

B24F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	4.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.000

Valid cases 1 Missing cases 14

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B24F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	7.7	7.7
	2.00	2	13.3	15.4	23.1
	3.00	3	20.0	23.1	46.2
	4.00	4	26.7	30.8	76.9
	5.00	3	20.0	23.1	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 3.462 Std dev 1.266 Skewness -.481
S E Skew .616

Valid cases 13 Missing cases 2

B24F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	23.1	23.1
	2.00	5	33.3	38.5	61.5
	3.00	2	13.3	15.4	76.9
	4.00	1	6.7	7.7	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 2.538 Std dev 1.391 Skewness .784
S E Skew .616

Valid cases 13 Missing cases 2

- -

B24F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	25.0	25.0
	2.00	2	13.3	16.7	41.7
	3.00	3	20.0	25.0	66.7
	5.00	4	26.7	33.3	100.0
	.	3	20.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev 1.651 Skewness .145
S E Skew .637

Valid cases 12 Missing cases 3

B24F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	30.8	30.8
	2.00	5	33.3	38.5	69.2
	3.00	2	13.3	15.4	84.6
	4.00	1	6.7	7.7	92.3
	5.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.231 Std dev 1.235 Skewness 1.054
S E Skew .616

Valid cases 13 Missing cases 2

- -

B24F6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	50.0	50.0
	2.00	3	20.0	25.0	75.0
	3.00	2	13.3	16.7	91.7
	5.00	1	6.7	8.3	100.0
	.	3	20.0	Missing	
	Total	15	100.0	100.0	

Mean 1.917 Std dev 1.240 Skewness 1.558
S E Skew .637

Valid cases 12 Missing cases 3

C30A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.	15	100.0	Missing	
	Total	15	100.0	100.0	

Valid cases 0 Missing cases 15

- -

C30A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	1	6.7	6.7	73.3
	3.00	1	6.7	6.7	80.0
	4.00	1	6.7	6.7	86.7
	7.00	2	13.3	13.3	100.0

Total	15	100.0	100.0	

Mean 2.200 Std dev 2.145 Skewness 1.756
S E Skew .580

Valid cases 15 Missing cases 0

C30A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	4	26.7	44.4	44.4
	3.00	1	6.7	11.1	55.6
	4.00	3	20.0	33.3	88.9
	7.00	1	6.7	11.1	100.0
	.	6	40.0	Missing	
	Total	15	100.0	100.0	

Mean 3.333 Std dev 1.658 Skewness 1.433
S E Skew .717

Valid cases 9 Missing cases 6

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C30A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	4.00	2	13.3	28.6	28.6
	5.00	1	6.7	14.3	42.9
	7.00	4	26.7	57.1	100.0
	.	8	53.3	Missing	
	Total	15	100.0	100.0	

Mean 5.857 Std dev 1.464 Skewness -.556

S E Skew .794

Valid cases 7 Missing cases 8

C30A5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	6.00	1	6.7	33.3	33.3
	7.00	2	13.3	66.7	100.0
	.	12	80.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 6.667 Std dev .577 Skewness -1.732
S E Skew 1.225

Valid cases 3 Missing cases 12

- -

C30A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 7.000

Valid cases 1 Missing cases 14

C30B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	8.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 8.000

Valid cases 1 Missing cases 14

- -

C30B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	1	6.7	6.7	40.0
	3.00	3	20.0	20.0	60.0
	4.00	3	20.0	20.0	80.0
	7.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.267 Std dev 2.251 Skewness .701
S E Skew .580

Valid cases 15 Missing cases 0

C30B3

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	2.00	3	20.0	42.9	42.9
	4.00	1	6.7	14.3	57.1
	7.00	3	20.0	42.9	100.0
	.	8	53.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.429 Std dev 2.507 Skewness .118
S E Skew .794

Valid cases 7 Missing cases 8

- -

C30B4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	4.00	1	6.7	25.0	25.0
	7.00	3	20.0	75.0	100.0
	.	11	73.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 6.250 Std dev 1.500 Skewness -2.000
S E Skew 1.014

Valid cases 4 Missing cases 11

C30C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	50.0	50.0
	8.00	1	6.7	50.0	100.0
	.	13	86.7	Missing	

	Total	15	100.0	100.0	

Mean 7.500 Std dev .707

Valid cases 2 Missing cases 13

- -

C30C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	1	6.7	6.7	33.3
	3.00	2	13.3	13.3	46.7
	5.00	1	6.7	6.7	53.3
	7.00	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

Mean 4.400 Std dev 2.720 Skewness -.218
S E Skew .580

Valid cases 15 Missing cases 0

C30C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	16.7	16.7
	3.00	1	6.7	16.7	33.3
	4.00	1	6.7	16.7	50.0
	5.00	2	13.3	33.3	83.3
	7.00	1	6.7	16.7	100.0
	.	9	60.0	Missing	
	Total	15	100.0	100.0	

Mean 4.333 Std dev 1.751 Skewness .248
S E Skew .845

Valid cases 6 Missing cases 9

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C30C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	4.00	1	6.7	25.0	25.0
	5.00	1	6.7	25.0	50.0
	6.00	1	6.7	25.0	75.0
	7.00	1	6.7	25.0	100.0
	.	11	73.3	Missing	
	Total	15	100.0	100.0	

Mean 5.500 Std dev 1.291 Skewness .000
S E Skew 1.014

Valid cases 4 Missing cases 11

C30C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	6.00	1	6.7	33.3	33.3
	7.00	2	13.3	66.7	100.0
	.	12	80.0	Missing	
	Total	15	100.0	100.0	

Mean 6.667 Std dev .577 Skewness -1.732
S E Skew 1.225

Valid cases 3 Missing cases 12

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C30D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
	Total	15	100.0	100.0	

Mean 7.000

Valid cases 1 Missing cases 14

C30D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	1	6.7	6.7	40.0
	3.00	1	6.7	6.7	46.7
	4.00	1	6.7	6.7	53.3
	7.00	7	46.7	46.7	100.0
	Total	15	100.0	100.0	

Mean 4.200 Std dev 2.833 Skewness -.082
S E Skew .580

Valid cases 15 Missing cases 0

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C30D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	14.3	14.3
	3.00	1	6.7	14.3	28.6
	4.00	3	20.0	42.9	71.4
	5.00	1	6.7	14.3	85.7
	6.00	1	6.7	14.3	100.0
	.	8	53.3	Missing	
	Total	15	100.0	100.0	

Mean 4.000 Std dev 1.291 Skewness .000
S E Skew .794

Valid cases 7 Missing cases 8

C30D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	5.00	1	6.7	20.0	20.0
	7.00	4	26.7	80.0	100.0
	.	10	66.7	Missing	
	Total	15	100.0	100.0	

Mean 6.600 Std dev .894 Skewness -2.236
S E Skew .913

Valid cases 5 Missing cases 10

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C30D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	6.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 6.000

Valid cases 1 Missing cases 14

C30E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 7.000

Valid cases 1 Missing cases 14

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C30E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	3.00	1	6.7	6.7	20.0
	4.00	2	13.3	13.3	33.3
	6.00	1	6.7	6.7	40.0
	7.00	9	60.0	60.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 5.467 Std dev 2.264 Skewness -1.186
S E Skew .580

Valid cases 15 Missing cases 0

C30E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	16.7	16.7
	7.00	4	26.7	66.7	83.3
	8.00	1	6.7	16.7	100.0
	.	9	60.0	Missing	
	Total	15	100.0	100.0	

Mean 6.333 Std dev 2.160 Skewness -2.248
S E Skew .845

Valid cases 6 Missing cases 9

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C30F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
	Total	15	100.0	100.0	

Mean 7.000

Valid cases 1 Missing cases 14

C30F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	1	6.7	6.7	53.3
	4.00	1	6.7	6.7	60.0
	6.00	1	6.7	6.7	66.7
	7.00	5	33.3	33.3	100.0
	Total	15	100.0	100.0	

Mean 3.600 Std dev 2.849 Skewness .297
S E Skew .580

Valid cases 15 Missing cases 0

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C30F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	3.00	1	6.7	12.5	12.5
	4.00	2	13.3	25.0	37.5
	5.00	2	13.3	25.0	62.5
	6.00	1	6.7	12.5	75.0
	7.00	2	13.3	25.0	100.0
	.	7	46.7	Missing	
	Total	15	100.0	100.0	

Mean 5.125 Std dev 1.458 Skewness .086
S E Skew .752

Valid cases 8 Missing cases 7

C30F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	4.00	1	6.7	16.7	16.7
	6.00	1	6.7	16.7	33.3
	7.00	4	26.7	66.7	100.0
	.	9	60.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 6.333 Std dev 1.211 Skewness -1.952
S E Skew .845

Valid cases 6 Missing cases 9

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C30F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	5.00	1	6.7	50.0	50.0
	7.00	1	6.7	50.0	100.0
	.	13	86.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 6.000 Std dev 1.414

Valid cases 2 Missing cases 13

C31A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	7.00	1	6.7	100.0	100.0
	.	14	93.3	Missing	
	Total	15	100.0	100.0	

Mean 7.000

Valid cases 1 Missing cases 14

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C31A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	9	60.0	60.0	60.0
	2.00	2	13.3	13.3	73.3
	3.00	2	13.3	13.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.867 Std dev 1.302 Skewness 1.401
S E Skew .580

Valid cases 15 Missing cases 0

C31A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	4	26.7	26.7	66.7

	3.00	4	26.7	26.7	93.3
	5.00	1	6.7	6.7	100.0
			-------	-------	-------
	Total	15	100.0	100.0	

Mean 2.067 Std dev 1.163 Skewness 1.111
S E Skew .580

Valid cases 15 Missing cases 0

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C31A4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	2	13.3	13.3	80.0
	3.00	1	6.7	6.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
			-------	-------	-------
	Total	15	100.0	100.0	

Mean 1.733 Std dev 1.280 Skewness 1.754
S E Skew .580

Valid cases 15 Missing cases 0

C31A5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	2	13.3	13.3	80.0
	3.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
			-------	-------	-------

Total	15	100.0	100.0	

Mean 1.667 Std dev 1.175 Skewness 1.975
S E Skew .580

Valid cases 15 Missing cases 0

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C31A6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	2	13.3	13.3	80.0
	3.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.667 Std dev 1.175 Skewness 1.975
S E Skew .580

Valid cases 15 Missing cases 0

C31A7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	3	20.0	20.0	40.0
	3.00	5	33.3	33.3	73.3
	5.00	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

Mean 2.933 Std dev 1.486 Skewness .281
S E Skew .580

Valid cases 15 Missing cases 0

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C31B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	4	26.7	26.7	80.0
	3.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.800 Std dev 1.146 Skewness 1.759
S E Skew .580

Valid cases 15 Missing cases 0

C31B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.407 Skewness .610
S E Skew .580

Valid cases 15 Missing cases 0

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C31B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	5	33.3	33.3	73.3
	3.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.867 Std dev .834 Skewness .274
S E Skew .580

Valid cases 15 Missing cases 0

C31B4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	42.9	42.9
	2.00	4	26.7	28.6	71.4
	3.00	4	26.7	28.6	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.857 Std dev .864 Skewness .306
S E Skew .597

Valid cases 14 Missing cases 1

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C31B5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	4	26.7	26.7	66.7
	3.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.933 Std dev .884 Skewness .142
S E Skew .580

Valid cases 15 Missing cases 0

C31B6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	9	60.0	60.0	60.0
	2.00	2	13.3	13.3	73.3
	3.00	4	26.7	26.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.667 Std dev .900 Skewness .780
S E Skew .580

Valid cases 15 Missing cases 0

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C31B7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0

2.00	2	13.3	13.3	33.3
3.00	6	40.0	40.0	73.3
4.00	2	13.3	13.3	86.7
5.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.867 Std dev 1.302 Skewness .057
S E Skew .580

Valid cases 15 Missing cases 0

C31C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	57.1	57.1
	2.00	4	26.7	28.6	85.7
	3.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.571 Std dev .756 Skewness .967
S E Skew .597

Valid cases 14 Missing cases 1

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C31C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	1	6.7	6.7	46.7
	3.00	4	26.7	26.7	73.3
	4.00	2	13.3	13.3	86.7

5.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.533 Std dev 1.506 Skewness .361
S E Skew .580

Valid cases 15 Missing cases 0

C31C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	6	40.0	40.0	80.0
	3.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.067 Std dev 1.335 Skewness 1.526
S E Skew .580

Valid cases 15 Missing cases 0

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C31C4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	5	33.3	33.3	60.0
	3.00	3	20.0	20.0	80.0
	4.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.356 Skewness .776
S E Skew .580

Valid cases 15 Missing cases 0

C31C5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	5	33.3	33.3	86.7
	3.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.733 Std dev 1.100 Skewness 2.096
S E Skew .580

Valid cases 15 Missing cases 0

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C31C6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	3	20.0	20.0	86.7
	3.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.600 Std dev 1.121 Skewness 2.344
S E Skew .580

Valid cases 15 Missing cases 0

C31C7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	2	13.3	13.3	40.0
	3.00	5	33.3	33.3	73.3
	4.00	2	13.3	13.3	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.733 Std dev 1.387 Skewness .180
S E Skew .580

Valid cases 15 Missing cases 0

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C31D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	10	66.7	66.7	66.7
	2.00	3	20.0	20.0	86.7
	3.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.600 Std dev 1.121 Skewness 2.344
S E Skew .580

Valid cases 15 Missing cases 0

C31D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.400 Std dev 1.298 Skewness .479
S E Skew .580

Valid cases 15 Missing cases 0

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C31D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	7	46.7	46.7	66.7
	3.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.133 Std dev .743 Skewness -.227
S E Skew .580

Valid cases 15 Missing cases 0

C31D4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	5	33.3	33.3	60.0
	3.00	6	40.0	40.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.133 Std dev .834 Skewness -.274
S E Skew .580

Valid cases 15 Missing cases 0

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C31D5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	5	33.3	33.3	66.7
	3.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev .845 Skewness .000
S E Skew .580

Valid cases 15 Missing cases 0

C31D6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

1.00	7	46.7	46.7	46.7
2.00	6	40.0	40.0	86.7
3.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 1.667 Std dev .724 Skewness .628
S E Skew .580

Valid cases 15 Missing cases 0

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C31D7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	6	40.0	40.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.121 Skewness .589
S E Skew .580

Valid cases 15 Missing cases 0

C31E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	5	33.3	33.3	80.0
	3.00	3	20.0	20.0	100.0

	-------	-------	-------
Total	15	100.0	100.0

Mean 1.733 Std dev .799 Skewness .555
S E Skew .580

Valid cases 15 Missing cases 0

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C31E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	4	26.7	26.7	46.7
	3.00	4	26.7	26.7	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.234 Skewness .214
S E Skew .580

Valid cases 15 Missing cases 0

C31E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	6	40.0	40.0	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.533 Std dev 1.060 Skewness .730
S E Skew .580

Valid cases 15 Missing cases 0

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C31E4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	3	20.0	20.0	46.7
	3.00	7	46.7	46.7	93.3
	4.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev .976 Skewness -.256
S E Skew .580

Valid cases 15 Missing cases 0

C31E5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	4	26.7	26.7	60.0
	3.00	4	26.7	26.7	86.7
	4.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.200 Std dev 1.082 Skewness .328
S E Skew .580

Valid cases 15 Missing cases 0

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C31E6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	2	13.3	13.3	60.0
	3.00	5	33.3	33.3	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.069 Skewness .405
S E Skew .580

Valid cases 15 Missing cases 0

C31E7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	4	26.7	26.7	46.7
	3.00	5	33.3	33.3	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.183 Skewness .322
S E Skew .580

Valid cases 15 Missing cases 0

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C31F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	6	40.0	40.0	73.3
	3.00	3	20.0	20.0	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.000 Std dev .926 Skewness .623
S E Skew .580

Valid cases 15 Missing cases 0

C31F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	2	13.3	13.3	40.0
	3.00	4	26.7	26.7	66.7
	4.00	3	20.0	20.0	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.424 Skewness .062
S E Skew .580

Valid cases 15 Missing cases 0

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C31F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	4	26.7	26.7	66.7
	3.00	4	26.7	26.7	93.3
	4.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.000 Skewness .495
S E Skew .580

Valid cases 15 Missing cases 0

C31F4

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	3	20.0	20.0	73.3
	4.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.600 Std dev 1.242 Skewness .382
S E Skew .580

Valid cases 15 Missing cases 0

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C31F5

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	3	20.0	20.0	66.7
	3.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.867 Std dev .915 Skewness .293
S E Skew .580

Valid cases 15 Missing cases 0

C31F6

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	9	60.0	60.0	60.0
	2.00	4	26.7	26.7	86.7
	3.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.533 Std dev .743 Skewness 1.074
S E Skew .580

Valid cases 15 Missing cases 0

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C31F7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	4	26.7	26.7	80.0

4.00	1	6.7	6.7	86.7
5.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 2.467 Std dev 1.407 Skewness .610
S E Skew .580

Valid cases 15 Missing cases 0

C32A1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	4	26.7	26.7	73.3
	3.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.933 Std dev 1.163 Skewness 1.404
S E Skew .580

Valid cases 15 Missing cases 0

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C32A2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	28.6	28.6
	2.00	5	33.3	35.7	64.3
	3.00	4	26.7	28.6	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	

	Total	15	100.0	100.0	

Mean 2.214 Std dev 1.122 Skewness 1.039
S E Skew .597

Valid cases 14 Missing cases 1

C32A3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	21.4	21.4
	2.00	5	33.3	35.7	57.1
	3.00	4	26.7	28.6	85.7
	4.00	1	6.7	7.1	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.429 Std dev 1.158 Skewness .722
S E Skew .597

Valid cases 14 Missing cases 1

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C32B1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	16.7	16.7
	3.00	5	33.3	83.3	100.0
	.	9	60.0	Missing	
	Total	15	100.0	100.0	

Mean 2.667 Std dev .816 Skewness -2.449

S E Skew .845

Valid cases 6 Missing cases 9

C32B2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	50.0	50.0
	2.00	5	33.3	35.7	85.7
	3.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 1.643 Std dev .745 Skewness .731
S E Skew .597

Valid cases 14 Missing cases 1

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C32B3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	28.6	28.6
	2.00	5	33.3	35.7	64.3
	3.00	5	33.3	35.7	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.071 Std dev .829 Skewness -.145
S E Skew .597

Valid cases 14 Missing cases 1

C32C1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	25.0	25.0
	2.00	1	6.7	12.5	37.5
	3.00	4	26.7	50.0	87.5
	4.00	1	6.7	12.5	100.0
	.	7	46.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.500 Std dev 1.069 Skewness -.468
S E Skew .752

Valid cases 8 Missing cases 7

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C32C2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	50.0	50.0
	2.00	3	20.0	21.4	71.4
	3.00	4	26.7	28.6	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.786 Std dev .893 Skewness .479
S E Skew .597

Valid cases 14 Missing cases 1

C32C3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	7.1	7.1
	2.00	7	46.7	50.0	57.1
	3.00	5	33.3	35.7	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.500 Std dev .941 Skewness 1.294
S E Skew .597

Valid cases 14 Missing cases 1

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C32D1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	1	6.7	12.5	12.5
	3.00	6	40.0	75.0	87.5
	4.00	1	6.7	12.5	100.0
	.	7	46.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 3.000 Std dev .535 Skewness .000
S E Skew .752

Valid cases 8 Missing cases 7

C32D2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	9	60.0	64.3	64.3
	2.00	2	13.3	14.3	78.6
	3.00	2	13.3	14.3	92.9
	4.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 1.643 Std dev 1.008 Skewness 1.383
S E Skew .597

Valid cases 14 Missing cases 1

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C32D3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	38.5	38.5
	2.00	7	46.7	53.8	92.3
	3.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
	Total	15	100.0	100.0	

Mean 1.692 Std dev .630 Skewness .307
S E Skew .616

Valid cases 13 Missing cases 2

C32E1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	33.3	33.3
	3.00	4	26.7	66.7	100.0
	.	9	60.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev 1.033 Skewness -.968
S E Skew .845

Valid cases 6 Missing cases 9

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C32E2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	57.1	57.1
	2.00	4	26.7	28.6	85.7
	3.00	1	6.7	7.1	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.714 Std dev 1.139 Skewness 2.114
S E Skew .597

Valid cases 14 Missing cases 1

C32E3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	35.7	35.7

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	2.00	4	26.7	28.6	64.3
	3.00	2	13.3	14.3	78.6
	4.00	1	6.7	7.1	85.7
	5.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.357 Std dev 1.447 Skewness .865
S E Skew .597

Valid cases 14 Missing cases 1

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C32F1

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	28.6	28.6
	2.00	1	6.7	14.3	42.9
	3.00	3	20.0	42.9	85.7
	5.00	1	6.7	14.3	100.0
	.	8	53.3	Missing	
	Total	15	100.0	100.0	

Mean 2.571 Std dev 1.397 Skewness .566
S E Skew .794

Valid cases 7 Missing cases 8

C32F2

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	57.1	57.1
	2.00	4	26.7	28.6	85.7

3.00	1	6.7	7.1	92.9
5.00	1	6.7	7.1	100.0
.	1	6.7	Missing	
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 1.714 Std dev 1.139 Skewness 2.114
S E Skew .597

Valid cases 14 Missing cases 1

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C32F3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	30.8	30.8
	2.00	5	33.3	38.5	69.2
	3.00	1	6.7	7.7	76.9
	4.00	1	6.7	7.7	84.6
	5.00	2	13.3	15.4	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.385 Std dev 1.446 Skewness .956
S E Skew .616

Valid cases 13 Missing cases 2

C33A

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	33.3	33.3
	3.00	3	20.0	50.0	83.3
	5.00	1	6.7	16.7	100.0

	.	9	60.0	Missing	
	Total	15	100.0	100.0	

Mean 2.667 Std dev 1.506 Skewness .313
S E Skew .845

Valid cases 6 Missing cases 9

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C33B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	7	46.7	46.7	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.667 Std dev .816 Skewness 1.649
S E Skew .580

Valid cases 15 Missing cases 0

C33C

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	9	60.0	60.0	73.3
	3.00	4	26.7	26.7	100.0
	Total	15	100.0	100.0	

Mean 2.133 Std dev .640 Skewness -.103
S E Skew .580

Valid cases 15 Missing cases 0

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C33D

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	8	53.3	53.3	53.3
	2.00	3	20.0	20.0	73.3
	3.00	3	20.0	20.0	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.867 Std dev 1.187 Skewness 1.474
S E Skew .580

Valid cases 15 Missing cases 0

C33E

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	5	33.3	33.3	80.0
	3.00	2	13.3	13.3	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.800 Std dev .941 Skewness 1.044
S E Skew .580

Valid cases 15 Missing cases 0

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C33F

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	5	33.3	33.3	66.7
	3.00	4	26.7	26.7	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.067 Std dev .961 Skewness .409
S E Skew .580

Valid cases 15 Missing cases 0

D41A

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	46.7	46.7
	2.00	5	33.3	33.3	80.0
	3.00	2	13.3	13.3	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 1.800 Std dev .941 Skewness 1.044
S E Skew .580

Valid cases 15 Missing cases 0

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D41B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	14.3	14.3
	2.00	3	20.0	21.4	35.7
	3.00	6	40.0	42.9	78.6
	4.00	2	13.3	14.3	92.9
	5.00	1	6.7	7.1	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.786 Std dev 1.122 Skewness .105
S E Skew .597

Valid cases 14 Missing cases 1

D41C

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	21.4	21.4
	2.00	4	26.7	28.6	50.0
	3.00	3	20.0	21.4	71.4
	4.00	4	26.7	28.6	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.571 Std dev 1.158 Skewness -.028
S E Skew .597

Valid cases 14 Missing cases 1

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D41D

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	7	46.7	50.0	50.0
	2.00	3	20.0	21.4	71.4
	3.00	1	6.7	7.1	78.6
	4.00	3	20.0	21.4	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.240 Skewness .847
S E Skew .597

Valid cases 14 Missing cases 1

D41E

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	28.6	28.6
	2.00	5	33.3	35.7	64.3
	3.00	3	20.0	21.4	85.7
	4.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
	Total	15	100.0	100.0	

Mean 2.214 Std dev 1.051 Skewness .436
S E Skew .597

Valid cases 14 Missing cases 1

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D41F

Valid Cum

Value Label	Value	Frequency	Percent	Percent	Percent
	1.00	4	26.7	28.6	28.6
	2.00	5	33.3	35.7	64.3
	3.00	5	33.3	35.7	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.071 Std dev .829 Skewness -.145
S E Skew .597

Valid cases 14 Missing cases 1

D42A

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	9	60.0	64.3	64.3
	2.00	3	20.0	21.4	85.7
	3.00	2	13.3	14.3	100.0
	.	1	6.7	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.500 Std dev .760 Skewness 1.229
S E Skew .597

Valid cases 14 Missing cases 1

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D42AF

Value Label	Value	Frequency	Valid Percent	Cum Percent	Percent
	1.00	7	46.7	46.7	46.7
	2.00	6	40.0	40.0	86.7

3.00	2	13.3	13.3	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 1.667 Std dev .724 Skewness .628
S E Skew .580

Valid cases 15 Missing cases 0

D42AH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	10	66.7	66.7	80.0
	3.00	1	6.7	6.7	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.033 Skewness 1.629
S E Skew .580

Valid cases 15 Missing cases 0

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D42B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	5	33.3	33.3	33.3
	2.00	3	20.0	20.0	53.3
	3.00	4	26.7	26.7	80.0
	4.00	2	13.3	13.3	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	

Total	15	100.0	100.0	

Mean 2.400 Std dev 1.298 Skewness .479
S E Skew .580

Valid cases 15 Missing cases 0

D42C

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	4	26.7	26.7	26.7
	2.00	8	53.3	53.3	80.0
	3.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.933 Std dev .704 Skewness .092
S E Skew .580

Valid cases 15 Missing cases 0

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D42D

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	5	33.3	33.3	46.7
	3.00	3	20.0	20.0	66.7
	4.00	5	33.3	33.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.733 Std dev 1.100 Skewness -.134
S E Skew .580

Valid cases 15 Missing cases 0

D42E

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	5	33.3	33.3	73.3
	3.00	2	13.3	13.3	86.7
	4.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.069 Skewness .809
S E Skew .580

Valid cases 15 Missing cases 0

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D42G

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	6	40.0	40.0	60.0
	3.00	5	33.3	33.3	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.267 Std dev .884 Skewness .116
S E Skew .580

Valid cases 15 Missing cases 0

D43A

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	33.3	33.3
	2.00	1	6.7	33.3	66.7
	3.00	1	6.7	33.3	100.0
	.	12	80.0	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.000 Std dev 1.000 Skewness .000
S E Skew 1.225

Valid cases 3 Missing cases 12

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D43B

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	8	53.3	53.3	73.3
	3.00	2	13.3	13.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.267 Std dev 1.100 Skewness 1.250
S E Skew .580

Valid cases 15 Missing cases 0

D43C

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	4	26.7	26.7	80.0
	4.00	3	20.0	20.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.467 Std dev 1.060 Skewness .100
S E Skew .580

Valid cases 15 Missing cases 0

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D43D

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	4	26.7	26.7	66.7
	3.00	3	20.0	20.0	86.7
	4.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.067 Std dev 1.100 Skewness .595
S E Skew .580

Valid cases 15 Missing cases 0

D43E

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	2	13.3	13.3	13.3
	2.00	8	53.3	53.3	66.7
	3.00	4	26.7	26.7	93.3
	4.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.267 Std dev .799 Skewness .415
S E Skew .580

Valid cases 15 Missing cases 0

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D43F

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	6	40.0	40.0	46.7
	3.00	5	33.3	33.3	80.0
	4.00	1	6.7	6.7	86.7
	5.00	2	13.3	13.3	100.0
	Total	15	100.0	100.0	

Mean 2.800 Std dev 1.146 Skewness .775
S E Skew .580

Valid cases 15 Missing cases 0

D43G

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent

Value	Frequency	Percent	Valid Percent	Cum Percent
1.00	4	26.7	26.7	26.7
2.00	5	33.3	33.3	60.0
3.00	3	20.0	20.0	80.0
4.00	3	20.0	20.0	100.0
Total	15	100.0	100.0	

Mean 2.333 Std dev 1.113 Skewness .306
S E Skew .580

Valid cases 15 Missing cases 0

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D43H

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	7	46.7	46.7	53.3
	3.00	5	33.3	33.3	86.7
	4.00	1	6.7	6.7	93.3
	5.00	1	6.7	6.7	100.0
	Total	15	100.0	100.0	

Mean 2.600 Std dev .986 Skewness .971
S E Skew .580

Valid cases 15 Missing cases 0

D43I

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	5	33.3	33.3	73.3
	3.00	3	20.0	20.0	93.3

4.00	1	6.7	6.7	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 1.933 Std dev .961 Skewness .705
S E Skew .580

Valid cases 15 Missing cases 0

- -

D43J

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	6	40.0	40.0	40.0
	2.00	7	46.7	46.7	86.7
	3.00	2	13.3	13.3	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 1.733 Std dev .704 Skewness .433
S E Skew .580

Valid cases 15 Missing cases 0

EMPLOYEE

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	18.00	1	6.7	6.7	6.7
	20.00	1	6.7	6.7	13.3
	28.00	1	6.7	6.7	20.0
	45.00	1	6.7	6.7	26.7
	51.00	1	6.7	6.7	33.3
	65.00	1	6.7	6.7	40.0
	70.00	1	6.7	6.7	46.7
	80.00	1	6.7	6.7	53.3

120.00	1	6.7	6.7	60.0
150.00	1	6.7	6.7	66.7
170.00	1	6.7	6.7	73.3
180.00	1	6.7	6.7	80.0
318.00	1	6.7	6.7	86.7
550.00	1	6.7	6.7	93.3
1200.00	1	6.7	6.7	100.0
	-------	-------	-------	
Total	15	100.0	100.0	

Mean 204.333 Std dev 309.054 Skewness 2.781
S E Skew .580

Valid cases 15 Missing cases 0

GROWTH

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	-50.00	1	6.7	7.7	7.7
	2.50	1	6.7	7.7	15.4
	5.00	2	13.3	15.4	30.8
	6.00	2	13.3	15.4	46.2
	8.00	2	13.3	15.4	61.5
	11.00	1	6.7	7.7	69.2
	12.00	1	6.7	7.7	76.9
	13.00	1	6.7	7.7	84.6
	15.00	1	6.7	7.7	92.3
	17.00	1	6.7	7.7	100.0
	.	2	13.3	Missing	
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 4.500 Std dev 16.934 Skewness -3.192
S E Skew .616

Valid cases 13 Missing cases 2

NUMBER

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	1	6.7	6.7	6.7
	2.00	1	6.7	6.7	13.3
	3.00	1	6.7	6.7	20.0
	4.00	1	6.7	6.7	26.7
	5.00	1	6.7	6.7	33.3
	6.00	1	6.7	6.7	40.0
	7.00	1	6.7	6.7	46.7
	8.00	1	6.7	6.7	53.3
	9.00	1	6.7	6.7	60.0
	10.00	1	6.7	6.7	66.7
	11.00	1	6.7	6.7	73.3
	12.00	1	6.7	6.7	80.0
	13.00	1	6.7	6.7	86.7
	14.00	1	6.7	6.7	93.3
	15.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 8.000 Std dev 4.472 Skewness .000
S E Skew .580

Valid cases 15 Missing cases 0

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SECTOR 3

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	G	5	33.3	33.3	33.3
	M	4	26.7	26.7	60.0
	SP	6	40.0	40.0	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Valid cases 15 Missing cases 0

TURNOVER

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	.80	1	6.7	6.7	6.7
	1.80	1	6.7	6.7	13.3
	2.50	1	6.7	6.7	20.0
	3.00	1	6.7	6.7	26.7
	3.50	2	13.3	13.3	40.0
	6.00	1	6.7	6.7	46.7
	9.50	2	13.3	13.3	60.0
	12.00	1	6.7	6.7	66.7
	16.00	1	6.7	6.7	73.3
	20.00	1	6.7	6.7	80.0
	32.00	1	6.7	6.7	86.7
	60.00	1	6.7	6.7	93.3
	200.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 25.340 Std dev 50.746 Skewness 3.330
S E Skew .580

Valid cases 15 Missing cases 0

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VAR00002

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	1.00	3	20.0	20.0	20.0
	2.00	5	33.3	33.3	53.3
	3.00	6	40.0	40.0	93.3
	4.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

Mean 2.333 Std dev .900 Skewness -.101
S E Skew .580

Valid cases 15 Missing cases 0

YEAR

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	10.00	1	6.7	6.7	6.7
	15.00	1	6.7	6.7	13.3
	20.00	1	6.7	6.7	20.0
	22.00	1	6.7	6.7	26.7
	25.00	1	6.7	6.7	33.3
	30.00	1	6.7	6.7	40.0
	31.00	1	6.7	6.7	46.7
	32.00	1	6.7	6.7	53.3
	33.00	1	6.7	6.7	60.0
	35.00	1	6.7	6.7	66.7
	50.00	1	6.7	6.7	73.3
	79.00	1	6.7	6.7	80.0
	101.00	1	6.7	6.7	86.7
	109.00	1	6.7	6.7	93.3
	110.00	1	6.7	6.7	100.0
		-------	-------	-------	
	Total	15	100.0	100.0	

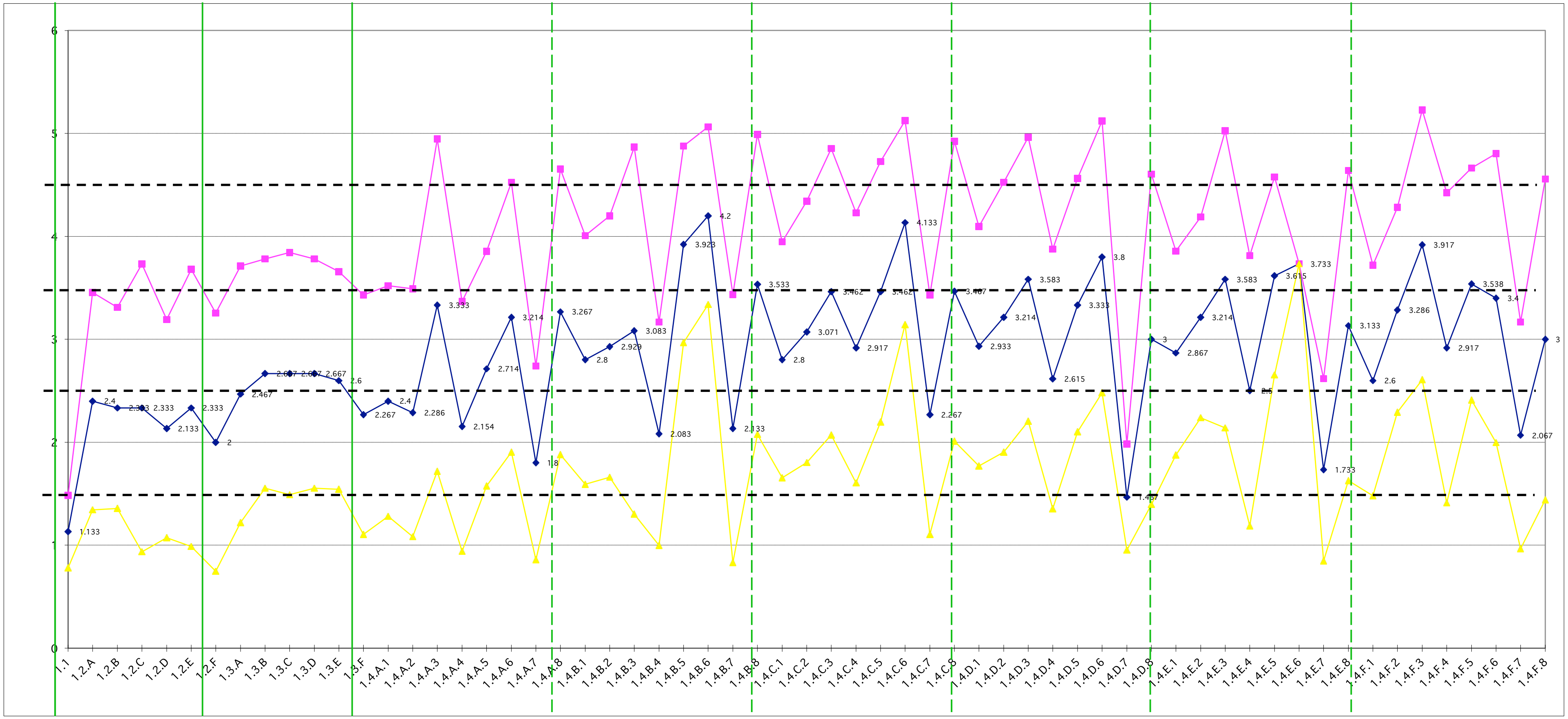
Mean 46.800 Std dev 34.951 Skewness 1.048
S E Skew .580

Valid cases 15 Missing cases 0

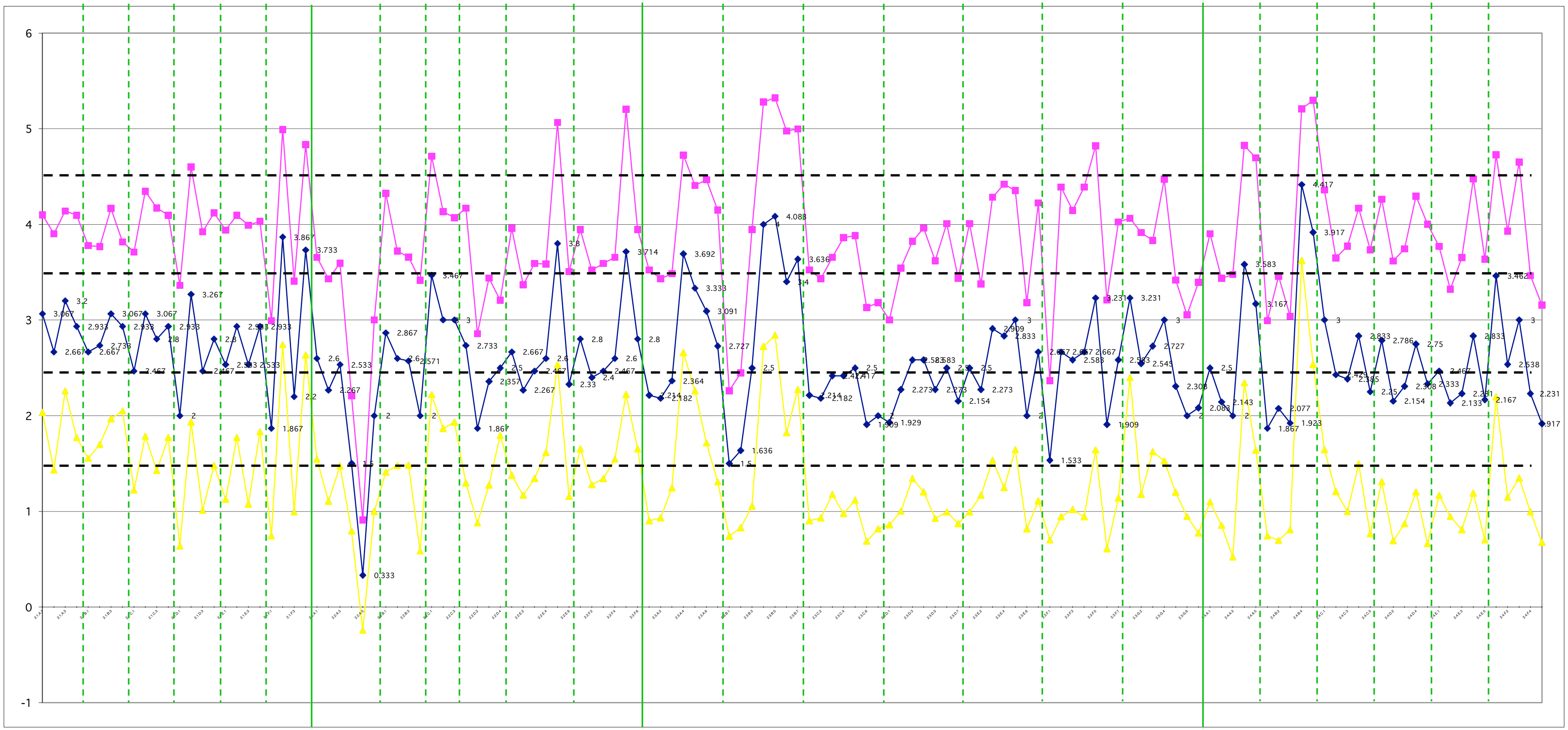
Appendix 4

Mean and Standard Deviation Modeling

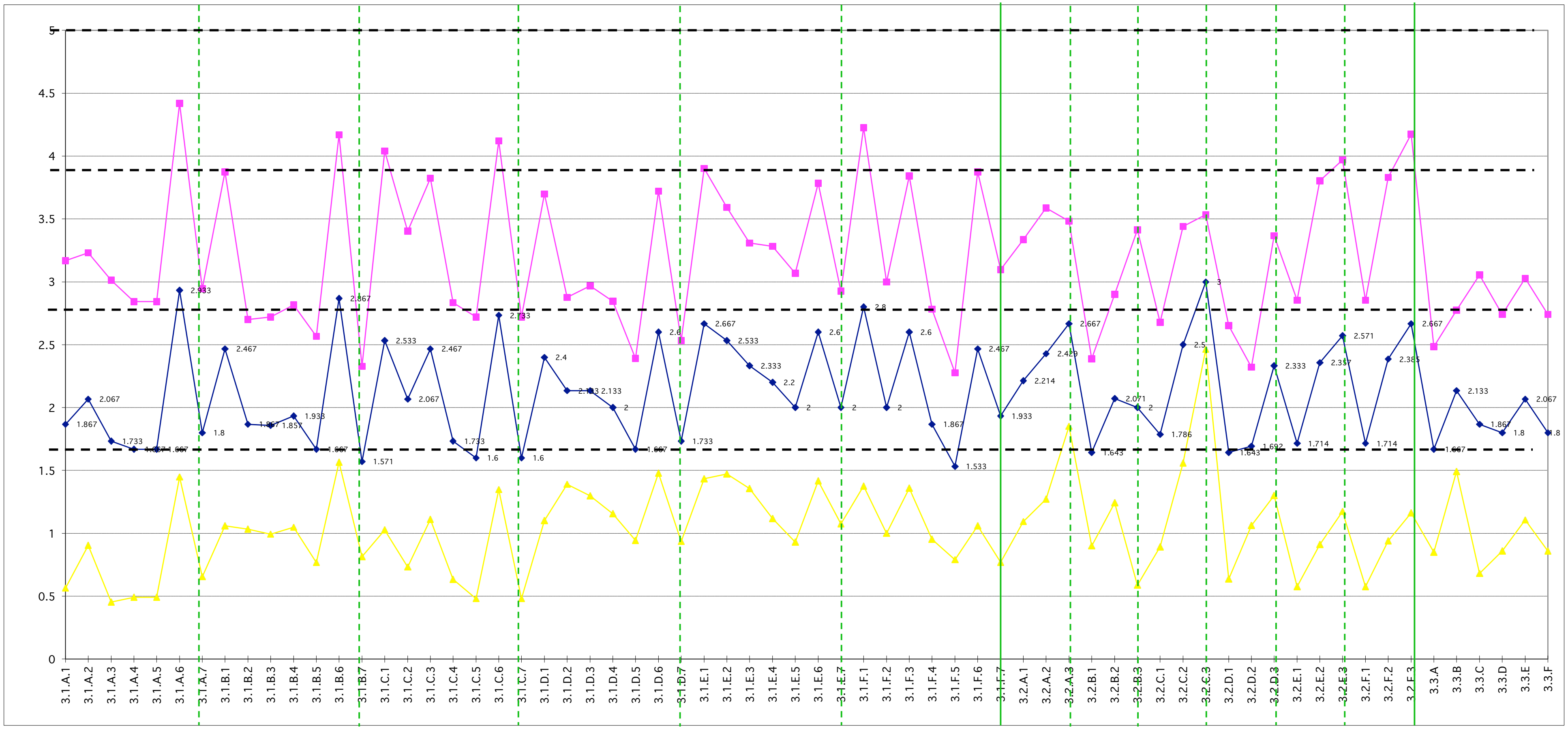
CUSTOMER INVOLVEMENT



ACTIVITIES UNDERTAKEN



ISSUES ADDRESSED



AREAS OF UNCERTAINTY

	MEAN	PLUS STD.DEV	MINUS STD. DEV	STD. DEV
1.1	1.133	1.485	0.781	0.352
1.2.A	2.4	3.456	1.344	1.056
1.2.B	2.333	3.309	1.357	0.976
1.2.C	2.333	3.73	0.936	1.397
1.2.D	2.133	3.193	1.073	1.06
1.2.E	2.333	3.678	0.988	1.345
1.2.F	2	3.254	0.746	1.254
1.3.A	2.467	3.713	1.221	1.246
1.3.B	2.667	3.78	1.554	1.113
1.3.C	2.667	3.842	1.492	1.175
1.3.D	2.667	3.78	1.554	1.113
1.3.E	2.6	3.656	1.544	1.056
1.3.F	2.267	3.43	1.104	1.163
1.4.A.1	2.4	3.521	1.279	1.121
1.4.A.2	2.286	3.49	1.082	1.204
1.4.A.3	3.333	4.947	1.719	1.614
1.4.A.4	2.154	3.368	0.94	1.214
1.4.A.5	2.714	3.853	1.575	1.139
1.4.A.6	3.214	4.525	1.903	1.311
1.4.A.7	1.8	2.741	0.859	0.941
1.4.A.8	3.267	4.654	1.88	1.387
1.4.B.1	2.8	4.007	1.593	1.207
1.4.B.2	2.929	4.198	1.66	1.269
1.4.B.3	3.083	4.865	1.301	1.782
1.4.B.4	2.083	3.167	0.999	1.084
1.4.B.5	3.923	4.877	2.969	0.954
1.4.B.6	4.2	5.062	3.338	0.862
1.4.B.7	2.133	3.435	0.831	1.302
1.4.B.8	3.533	4.99	2.076	1.457
1.4.C.1	2.8	3.946	1.654	1.146
1.4.C.2	3.071	4.34	1.802	1.269
1.4.C.3	3.462	4.853	2.071	1.391
1.4.C.4	2.917	4.228	1.606	1.311
1.4.C.5	3.462	4.728	2.196	1.266
1.4.C.6	4.133	5.123	3.143	0.99
1.4.C.7	2.267	3.43	1.104	1.163
1.4.C.8	3.467	4.924	2.01	1.457
1.4.D.1	2.933	4.096	1.77	1.163
1.4.D.2	3.214	4.525	1.903	1.311
1.4.D.3	3.583	4.962	2.204	1.379
1.4.D.4	2.615	3.876	1.354	1.261
1.4.D.5	3.333	4.564	2.102	1.231
1.4.D.6	3.8	5.12	2.48	1.32
1.4.D.7	1.467	1.983	0.951	0.516
1.4.D.8	3	4.604	1.396	1.604
1.4.E.1	2.867	3.857	1.877	0.99
1.4.E.2	3.214	4.189	2.239	0.975
1.4.E.3	3.583	5.026	2.14	1.443
1.4.E.4	2.5	3.814	1.186	1.314
1.4.E.5	3.615	4.576	2.654	0.961
1.4.E.6	3.733	3.733	3.733	1.163

1.4.E.7	1.733	2.617	0.849	0.884
1.4.E.8	3.133	4.639	1.627	1.506
1.4.F.1	2.6	3.721	1.479	1.121
1.4.F.2	3.286	4.28	2.292	0.994
1.4.F.3	3.917	5.228	2.606	1.311
1.4.F.4	2.917	4.422	1.412	1.505
1.4.F.5	3.538	4.665	2.411	1.127
1.4.F.6	3.4	4.804	1.996	1.404
1.4.F.7	2.067	3.167	0.967	1.1
1.4.F.8	3	4.558	1.442	1.558
2.1.A.1	3.067	4.1	2.034	1.033
2.1.A.2	2.667	3.901	1.433	1.234
2.1.A.3	3.2	4.141	2.259	0.941
2.1.A.4	2.933	4.096	1.77	1.163
2.1.B.1	2.667	3.78	1.554	1.113
2.1.B.2	2.733	3.766	1.7	1.033
2.1.B.3	3.067	4.167	1.967	1.1
2.1.B.4	2.933	3.817	2.049	0.884
2.1.C.1	2.467	3.713	1.221	1.246
2.1.C.2	3.067	4.347	1.787	1.28
2.1.C.3	2.8	4.173	1.427	1.373
2.1.C.4	2.933	4.096	1.77	1.163
2.1.D.1	2	3.363	0.637	1.363
2.1.D.2	3.267	4.602	1.932	1.335
2.1.D.3	2.467	3.924	1.01	1.457
2.1.D.4	2.8	4.12	1.48	1.32
2.1.E.1	2.533	3.94	1.126	1.407
2.1.E.2	2.933	4.096	1.77	1.163
2.1.E.3	2.533	3.99	1.076	1.457
2.1.E.4	2.933	4.033	1.833	1.1
2.1.F.1	1.867	2.992	0.742	1.125
2.1.F.2	3.867	4.992	2.742	1.125
2.1.F.3	2.2	3.407	0.993	1.207
2.1.F.4	3.733	4.833	2.633	1.1
2.2.A.1	2.6	3.656	1.544	1.056
2.2.A.2	2.267	3.43	1.104	1.163
2.2.A.3	2.533	3.593	1.473	1.06
2.2.A.4	1.5	2.207	0.793	0.707
2.2.A.5	0.333	0.91	-0.244	0.577
2.2.A.6	2	3	1	1
2.2.B.1	2.867	4.324	1.41	1.457
2.2.B.2	2.6	3.721	1.479	1.121
2.2.B.3	2.571	3.66	1.482	1.089
2.2.B.6	2	3.414	0.586	1.414
2.2.C.1	3.467	4.713	2.221	1.246
2.2.C.2	3	4.134	1.866	1.134
2.2.C.3	3	4.069	1.931	1.069
2.2.D.1	2.733	4.171	1.295	1.438
2.2.D.2	1.867	2.857	0.877	0.99
2.2.D.3	2.357	3.439	1.275	1.082
2.2.D.4	2.5	3.207	1.793	0.707
2.2.E.1	2.667	3.958	1.376	1.291
2.2.E.2	2.267	3.367	1.167	1.1

2.2.E.3	2.467	3.592	1.342	1.125
2.2.E.4	2.6	3.586	1.614	0.986
2.2.E.5	3.8	5.065	2.535	1.265
2.2.E.6	2.33	3.505	1.155	1.175
2.2.F.1	2.8	3.946	1.654	1.146
2.2.F.2	2.4	3.521	1.279	1.121
2.2.F.3	2.467	3.592	1.342	1.125
2.2.F.4	2.6	3.656	1.544	1.056
2.2.F.5	3.714	5.204	2.224	1.49
2.2.F.6	2.8	3.946	1.654	1.146
2.3.A.1	2.214	3.525	0.903	1.311
2.3.A.2	2.182	3.432	0.932	1.25
2.3.A.3	2.364	3.484	1.244	1.12
2.3.A.4	3.692	4.724	2.66	1.032
2.3.A.5	3.333	4.406	2.26	1.073
2.3.A.6	3.091	4.466	1.716	1.375
2.3.A.7	2.727	4.148	1.306	1.421
2.3.B.1	1.5	2.26	0.74	0.76
2.3.B.2	1.636	2.445	0.827	0.809
2.3.B.3	2.5	3.946	1.054	1.446
2.3.B.4	4	5.279	2.721	1.279
2.3.B.5	4.083	5.323	2.843	1.24
2.3.B.6	3.4	4.978	1.822	1.578
2.3.B.7	3.636	4.998	2.274	1.362
2.3.C.1	2.214	3.525	0.903	1.311
2.3.C.2	2.182	3.432	0.932	1.25
2.3.C.3	2.417	3.657	1.177	1.24
2.3.C.4	2.417	3.86	0.974	1.443
2.3.C.5	2.5	3.882	1.118	1.382
2.3.C.6	1.909	3.13	0.688	1.221
2.3.C.7	2	3.183	0.817	1.183
2.3.D.1	1.929	3.001	0.857	1.072
2.3.D.2	2.273	3.545	1.001	1.272
2.3.D.3	2.583	3.823	1.343	1.24
2.3.D.4	2.583	3.962	1.204	1.379
2.3.D.5	2.273	3.621	0.925	1.348
2.3.D.6	2.5	4.008	0.992	1.508
2.3.D.7	2.154	3.435	0.873	1.281
2.3.E.1	2.5	4.008	0.992	1.508
2.3.E.2	2.273	3.377	1.169	1.104
2.3.E.3	2.909	4.284	1.534	1.375
2.3.E.4	2.833	4.419	1.247	1.586
2.3.E.5	3	4.354	1.646	1.354
2.3.E.6	2	3.183	0.817	1.183
2.3.E.7	2.667	4.224	1.11	1.557
2.3.F.1	1.533	2.367	0.699	0.834
2.3.F.2	2.667	4.39	0.944	1.723
2.3.F.3	2.583	4.147	1.019	1.564
2.3.F.4	2.667	4.39	0.944	1.723
2.3.F.5	3.231	4.82	1.642	1.589
2.3.F.6	1.909	3.209	0.609	1.3
2.3.F.7	2.583	4.026	1.14	1.443
2.3.G.1	3.231	4.063	2.399	0.832

2.3.G.2	2.545	3.913	1.177	1.368
2.3.G.3	2.727	3.831	1.623	1.104
2.3.G.4	3	4.472	1.528	1.472
2.3.G.5	2.308	3.417	1.199	1.109
2.3.G.6	2	3.054	0.946	1.054
2.3.G.7	2.083	3.394	0.772	1.311
2.4.A.1	2.5	3.901	1.099	1.401
2.4.A.2	2.143	3.435	0.851	1.292
2.4.A.3	2	3.477	0.523	1.477
2.4.A.4	3.583	4.823	2.343	1.24
2.4.A.5	3.167	4.695	1.639	1.528
2.4.B.1	1.867	2.992	0.742	1.125
2.4.B.2	2.077	3.459	0.695	1.382
2.4.B.3	1.923	3.038	0.808	1.115
2.4.B.4	4.417	5.21	3.624	0.793
2.4.B.5	3.917	5.296	2.538	1.379
2.4.C.1	3	4.359	1.641	1.359
2.4.C.2	2.429	3.651	1.207	1.222
2.4.C.3	2.385	3.772	0.998	1.387
2.4.C.4	2.833	4.17	1.496	1.337
2.4.C.5	2.25	3.735	0.765	1.485
2.4.D.1	2.786	4.263	1.309	1.477
2.4.D.2	2.154	3.617	0.691	1.463
2.4.D.3	2.308	3.745	0.871	1.437
2.4.D.4	2.75	4.295	1.205	1.545
2.4.D.5	2.333	4.003	0.663	1.67
2.4.E.1	2.467	3.769	1.165	1.302
2.4.E.2	2.133	3.32	0.946	1.187
2.4.E.3	2.231	3.654	0.808	1.423
2.4.E.4	2.833	4.475	1.191	1.642
2.4.E.5	2.167	3.634	0.7	1.467
2.4.F.1	3.462	4.728	2.196	1.266
2.4.F.2	2.538	3.929	1.147	1.391
2.4.F.3	3	4.651	1.349	1.651
2.4.F.4	2.231	3.466	0.996	1.235
2.4.F.5	1.917	3.157	0.677	1.24
3.1.A.1	1.867	3.169	0.565	1.302
3.1.A.2	2.067	3.23	0.904	1.163
3.1.A.3	1.733	3.013	0.453	1.28
3.1.A.4	1.667	2.842	0.492	1.175
3.1.A.5	1.667	2.842	0.492	1.175
3.1.A.6	2.933	4.419	1.447	1.486
3.1.A.7	1.8	2.946	0.654	1.146
3.1.B.1	2.467	3.874	1.06	1.407
3.1.B.2	1.867	2.701	1.033	0.834
3.1.B.3	1.857	2.721	0.993	0.864
3.1.B.4	1.933	2.817	1.049	0.884
3.1.B.5	1.667	2.567	0.767	0.9
3.1.B.6	2.867	4.169	1.565	1.302
3.1.B.7	1.571	2.327	0.815	0.756
3.1.C.1	2.533	4.039	1.027	1.506
3.1.C.2	2.067	3.402	0.732	1.335
3.1.C.3	2.467	3.823	1.111	1.356

3.1.C.4	1.733	2.833	0.633	1.1
3.1.C.5	1.6	2.721	0.479	1.121
3.1.C.6	2.733	4.12	1.346	1.387
3.1.C.7	1.6	2.721	0.479	1.121
3.1.D.1	2.4	3.698	1.102	1.298
3.1.D.2	2.133	2.876	1.39	0.743
3.1.D.3	2.133	2.967	1.299	0.834
3.1.D.4	2	2.845	1.155	0.845
3.1.D.5	1.667	2.391	0.943	0.724
3.1.D.6	2.6	3.721	1.479	1.121
3.1.D.7	1.733	2.532	0.934	0.799
3.1.E.1	2.667	3.901	1.433	1.234
3.1.E.2	2.533	3.593	1.473	1.06
3.1.E.3	2.333	3.309	1.357	0.976
3.1.E.4	2.2	3.282	1.118	1.082
3.1.E.5	2	3.069	0.931	1.069
3.1.E.6	2.6	3.783	1.417	1.183
3.1.E.7	2	2.926	1.074	0.926
3.1.F.1	2.8	4.224	1.376	1.424
3.1.F.2	2	3	1	1
3.1.F.3	2.6	3.842	1.358	1.242
3.1.F.4	1.867	2.782	0.952	0.915
3.1.F.5	1.533	2.276	0.79	0.743
3.1.F.6	2.467	3.874	1.06	1.407
3.1.F.7	1.933	3.096	0.77	1.163
3.2.A.1	2.214	3.336	1.092	1.122
3.2.A.2	2.429	3.587	1.271	1.158
3.2.A.3	2.667	3.483	1.851	0.816
3.2.B.1	1.643	2.388	0.898	0.745
3.2.B.2	2.071	2.9	1.242	0.829
3.2.B.3	2	3.414	0.586	1.414
3.2.C.1	1.786	2.679	0.893	0.893
3.2.C.2	2.5	3.441	1.559	0.941
3.2.C.3	3	3.535	2.465	0.535
3.2.D.1	1.643	2.651	0.635	1.008
3.2.D.2	1.692	2.322	1.062	0.63
3.2.D.3	2.333	3.366	1.3	1.033
3.2.E.1	1.714	2.853	0.575	1.139
3.2.E.2	2.357	3.804	0.91	1.447
3.2.E.3	2.571	3.968	1.174	1.397
3.2.F.1	1.714	2.853	0.575	1.139
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3.3.B	2.133	2.773	1.493	0.64
3.3.C	1.867	3.054	0.68	1.187
3.3.D	1.8	2.741	0.859	0.941
3.3.E	2.067	3.028	1.106	0.961
3.3.F	1.8	2.741	0.859	0.941
4.1.A	2.786	3.908	1.664	1.122
4.1.B	2.571	3.729	1.413	1.158
4.1.C	2	3.24	0.76	1.24
4.1.D	2.214	3.265	1.163	1.051

4.1.E	2.071	2.9	1.242	0.829
4.1.F	1.5	2.26	0.74	0.76
4.2.A	2.267	3.367	1.167	1.1
4.2.B	1.933	2.637	1.229	0.704
4.2.C	2.733	3.833	1.633	1.1
4.2.D	2	3.069	0.931	1.069
4.2.E	1.667	2.391	0.943	0.724
4.2.F	2.267	3.151	1.383	0.884
4.2.G	2.267	3.3	1.234	1.033
4.3.A	2.267	3.367	1.167	1.1
4.3.B	2.467	3.527	1.407	1.06
4.3.C	2.067	3.167	0.967	1.1
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4.3.F	2.333	3.446	1.22	1.113
4.3.G	2.6	3.586	1.614	0.986
4.3.H	1.933	2.894	0.972	0.961
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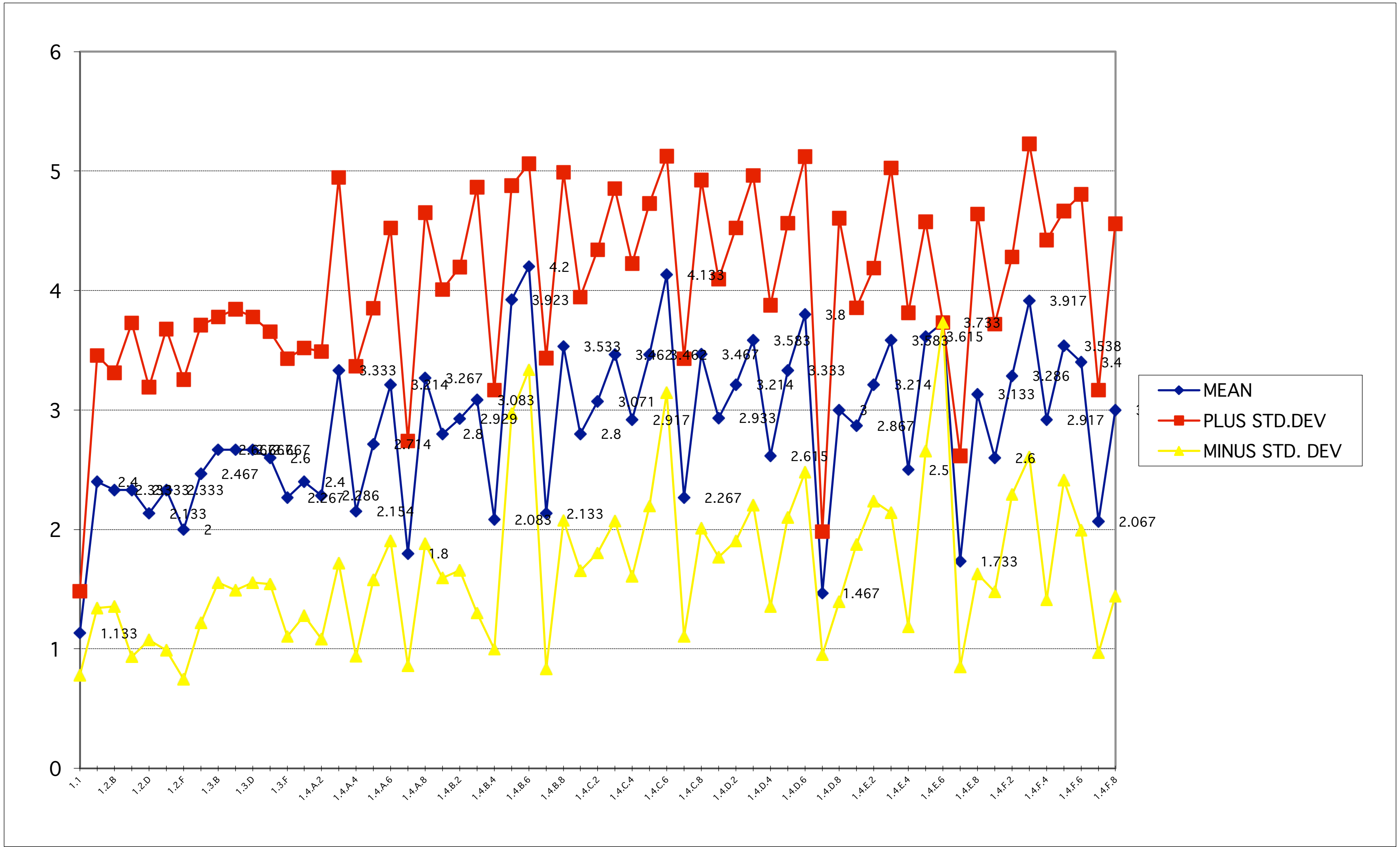
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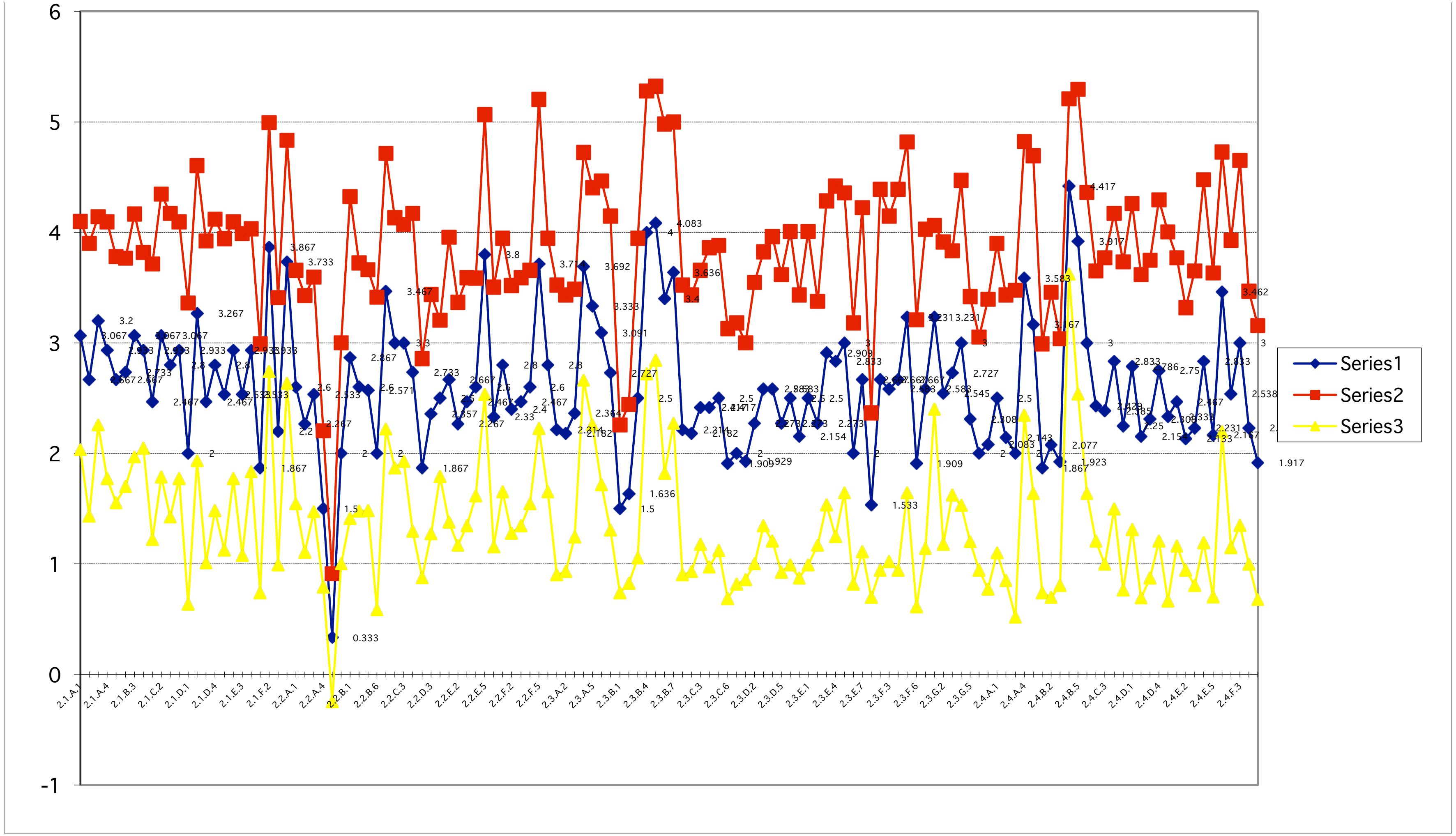

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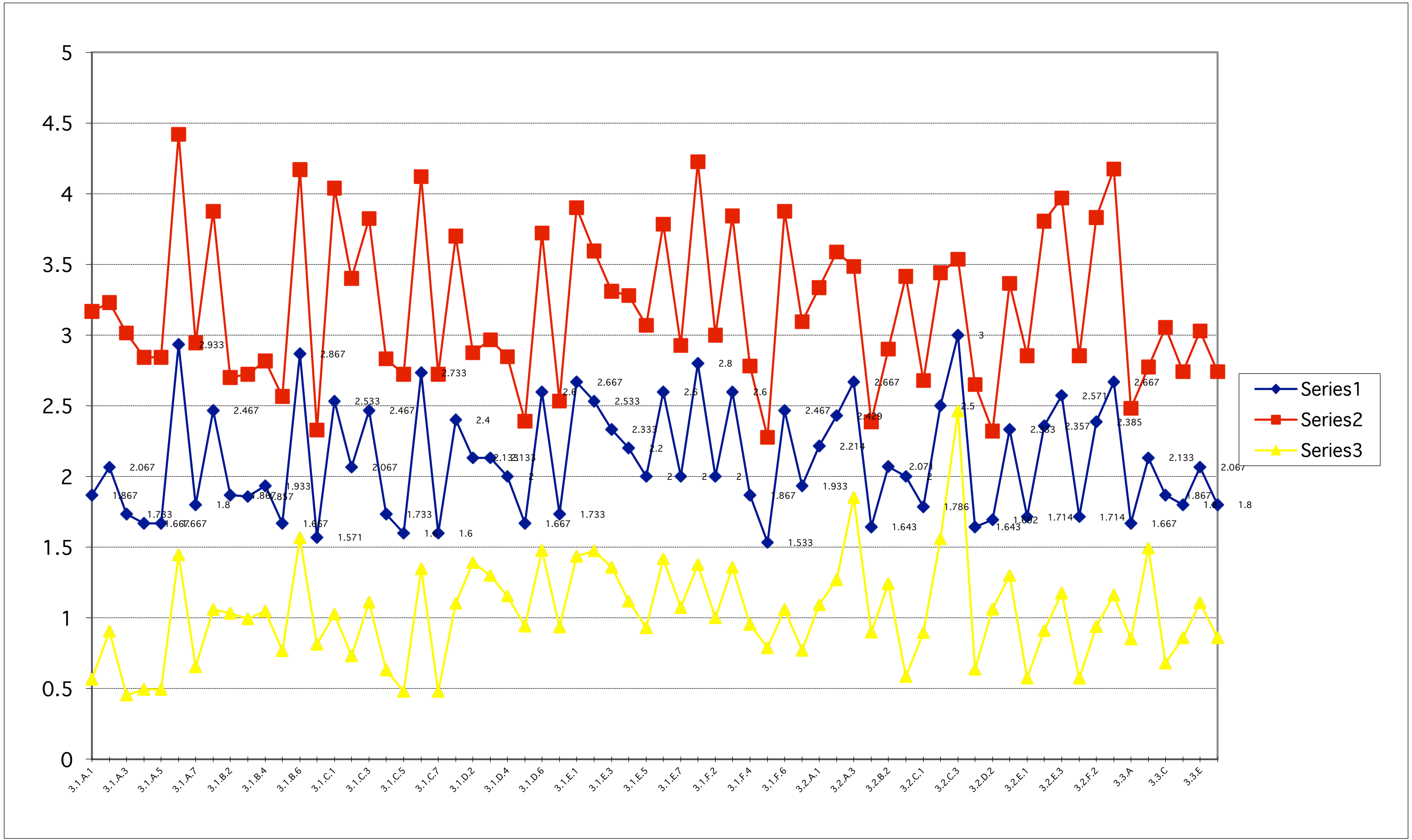

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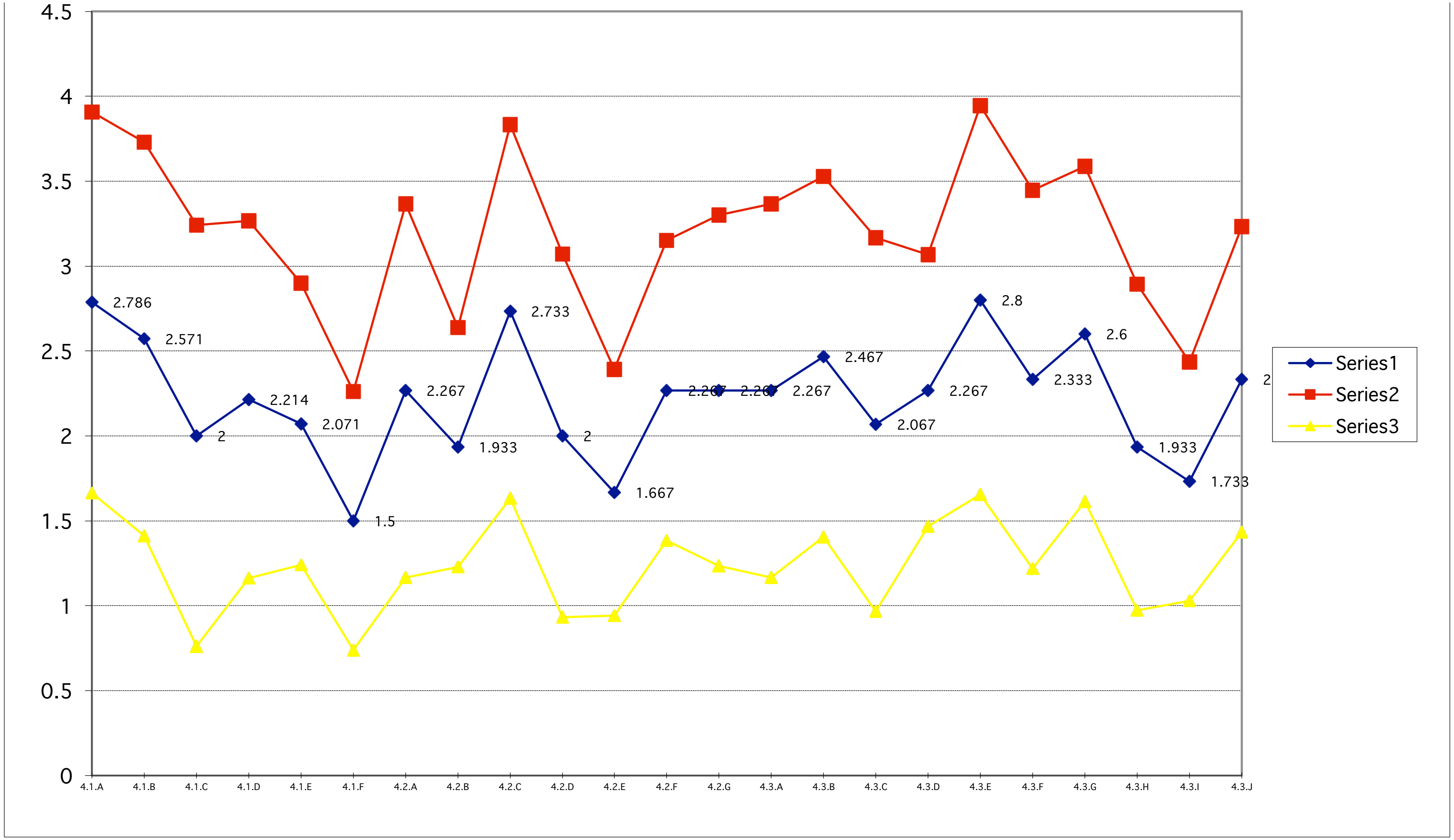
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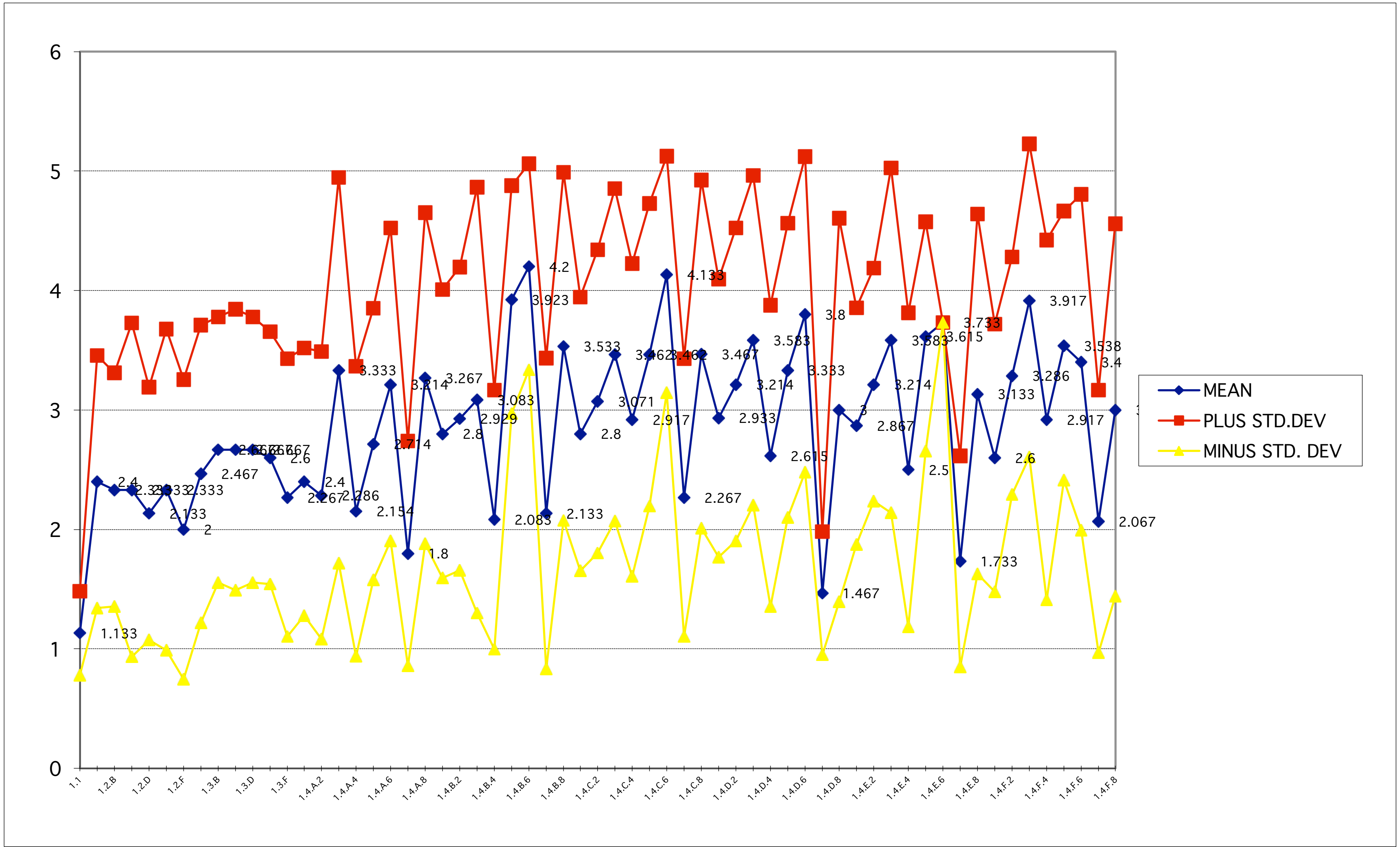
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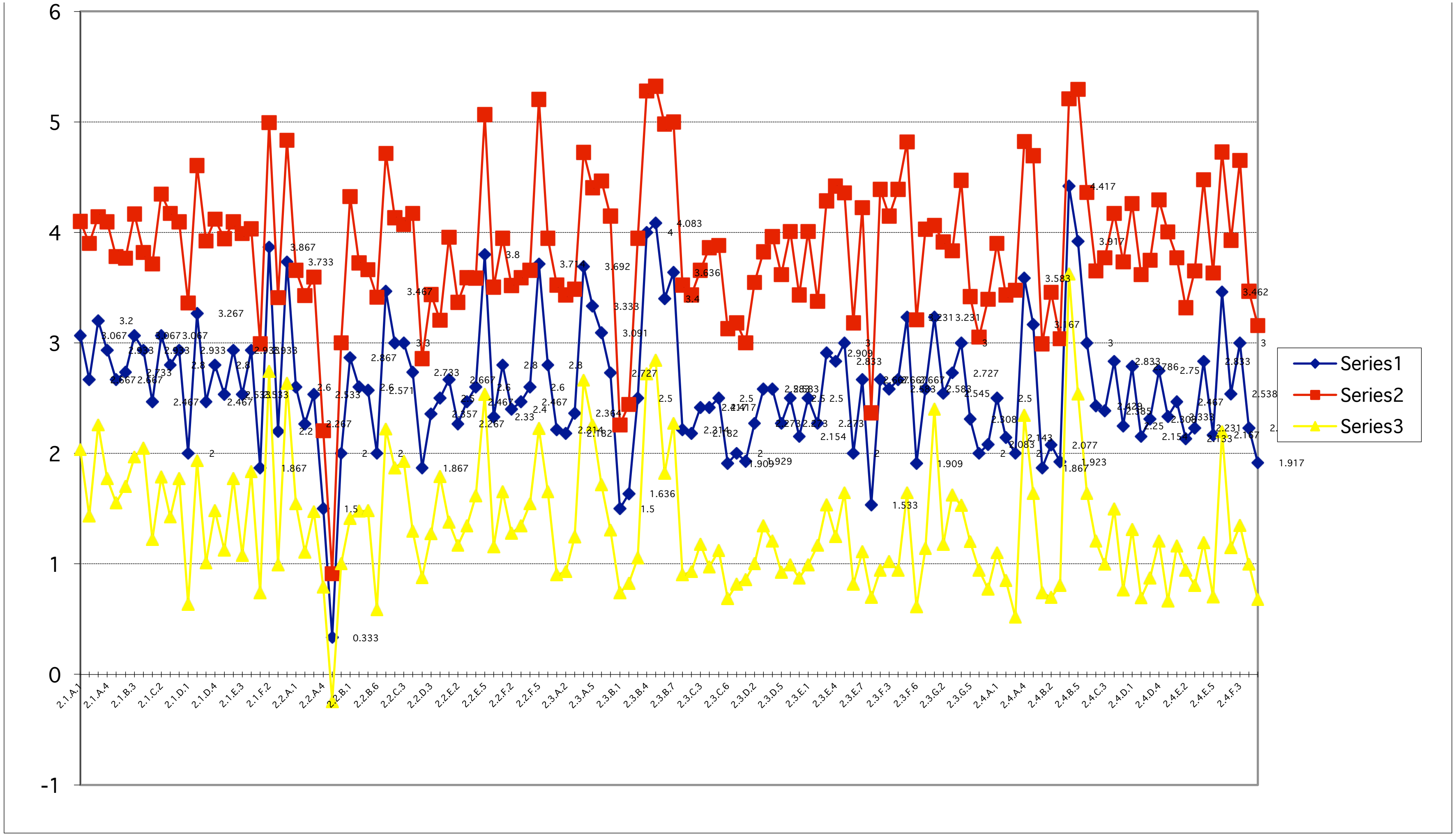
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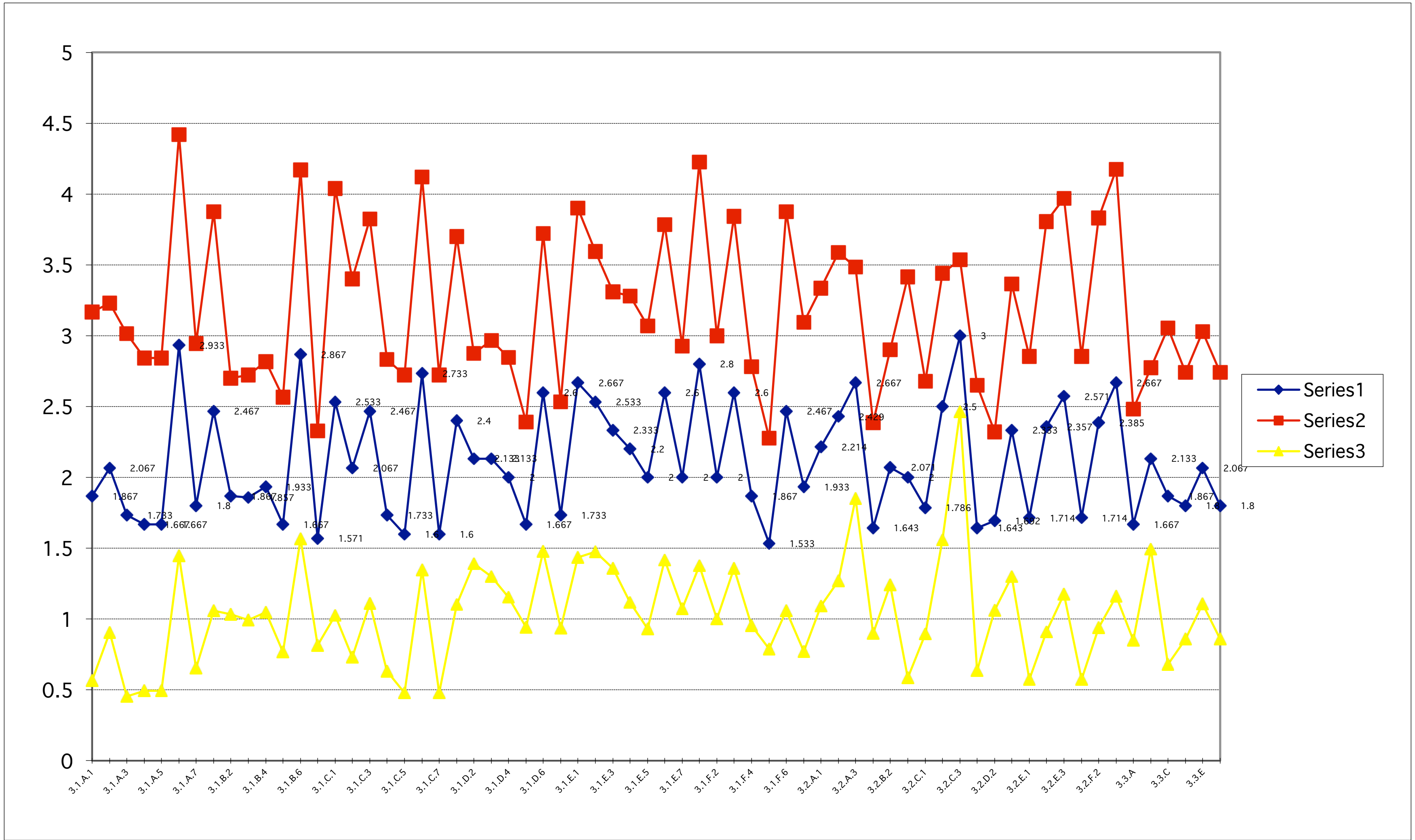
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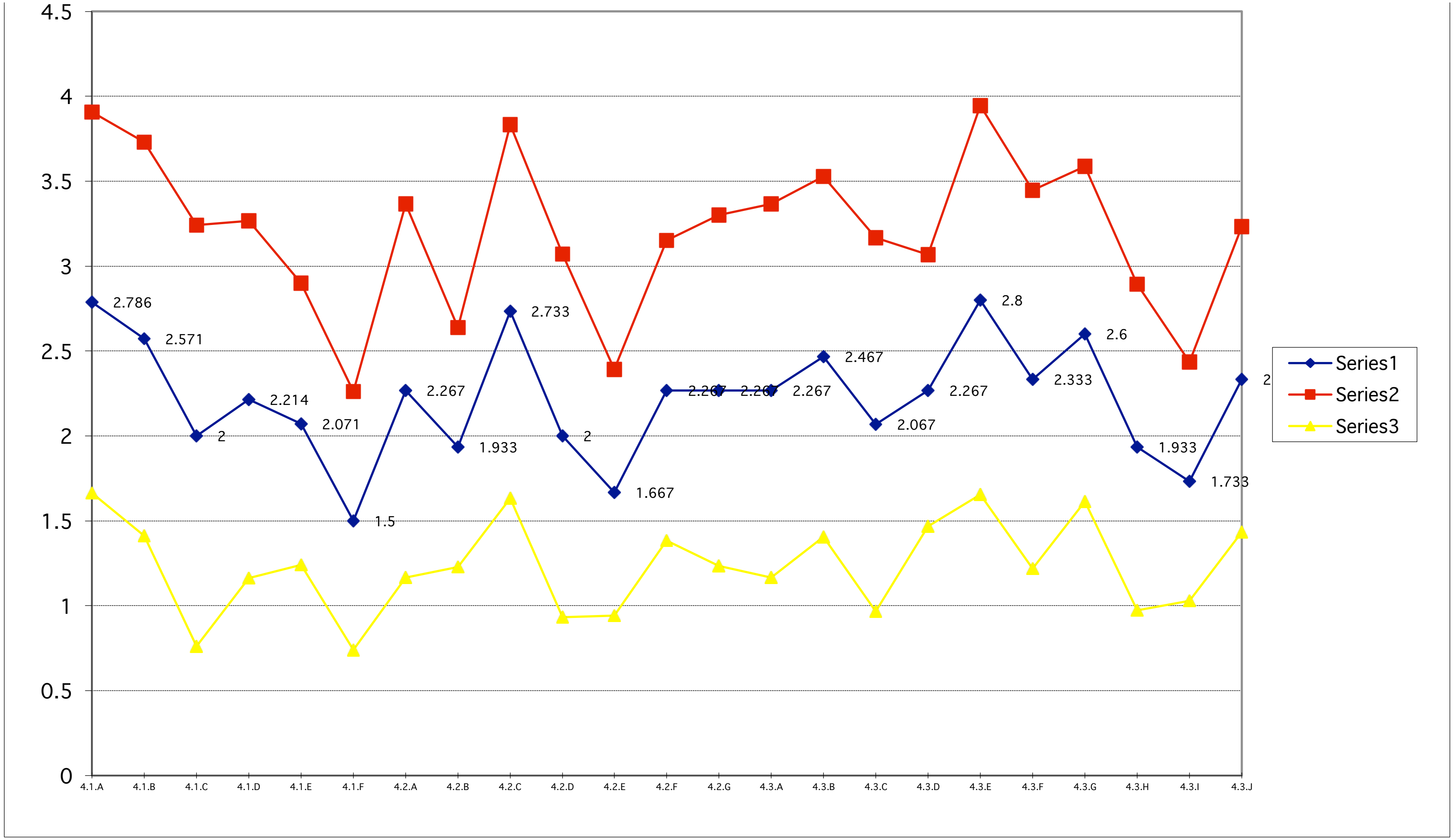
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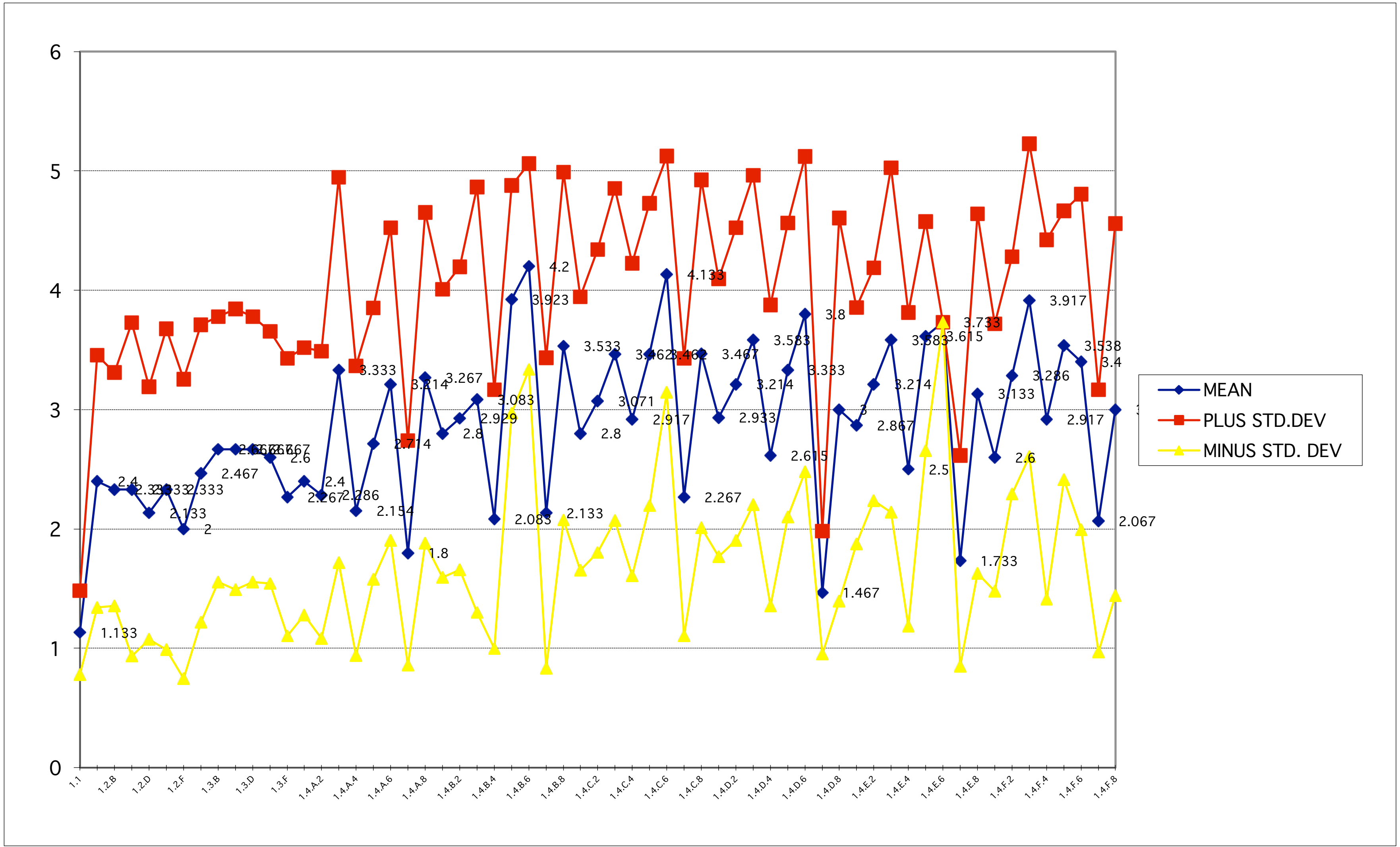

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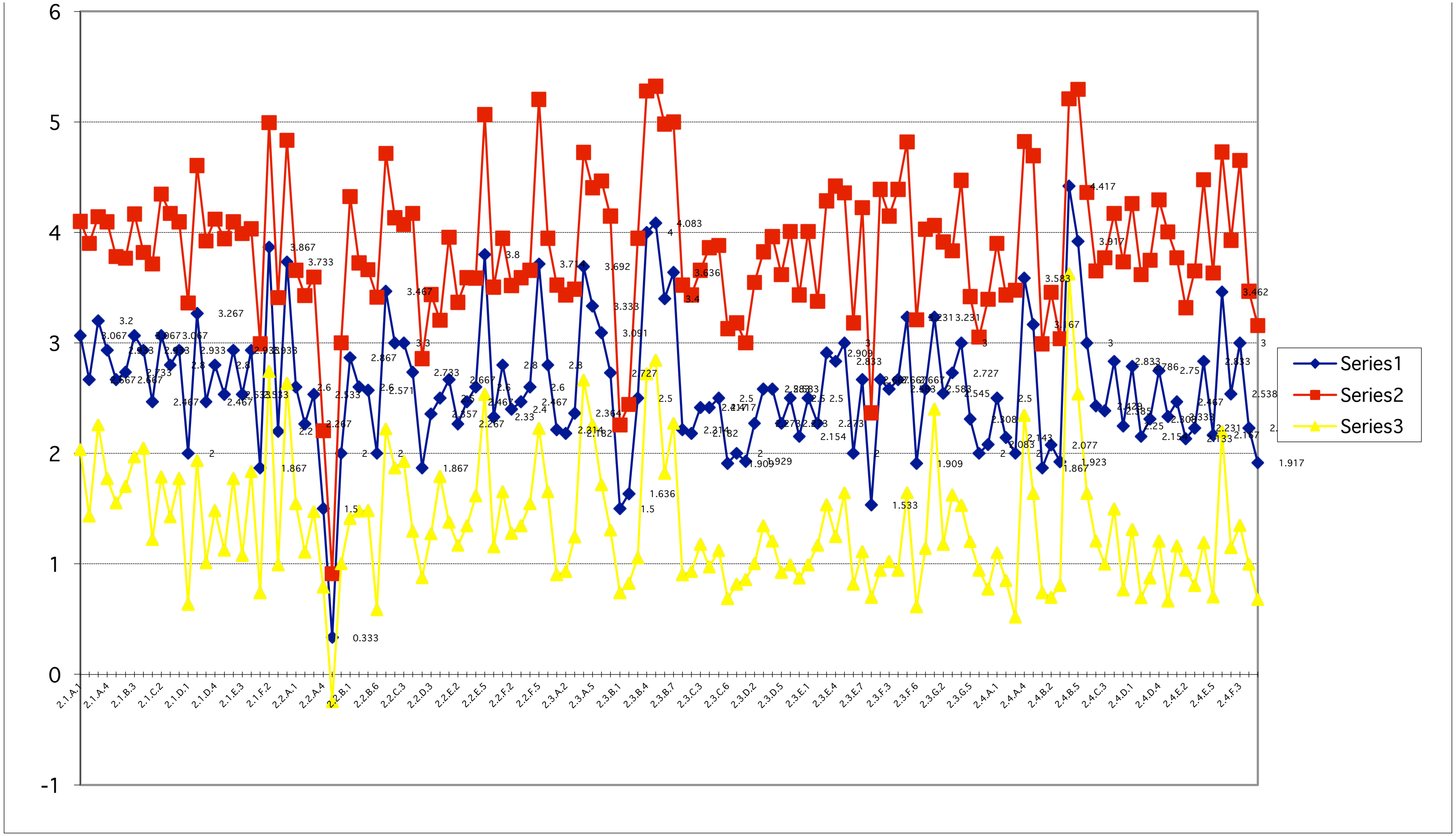
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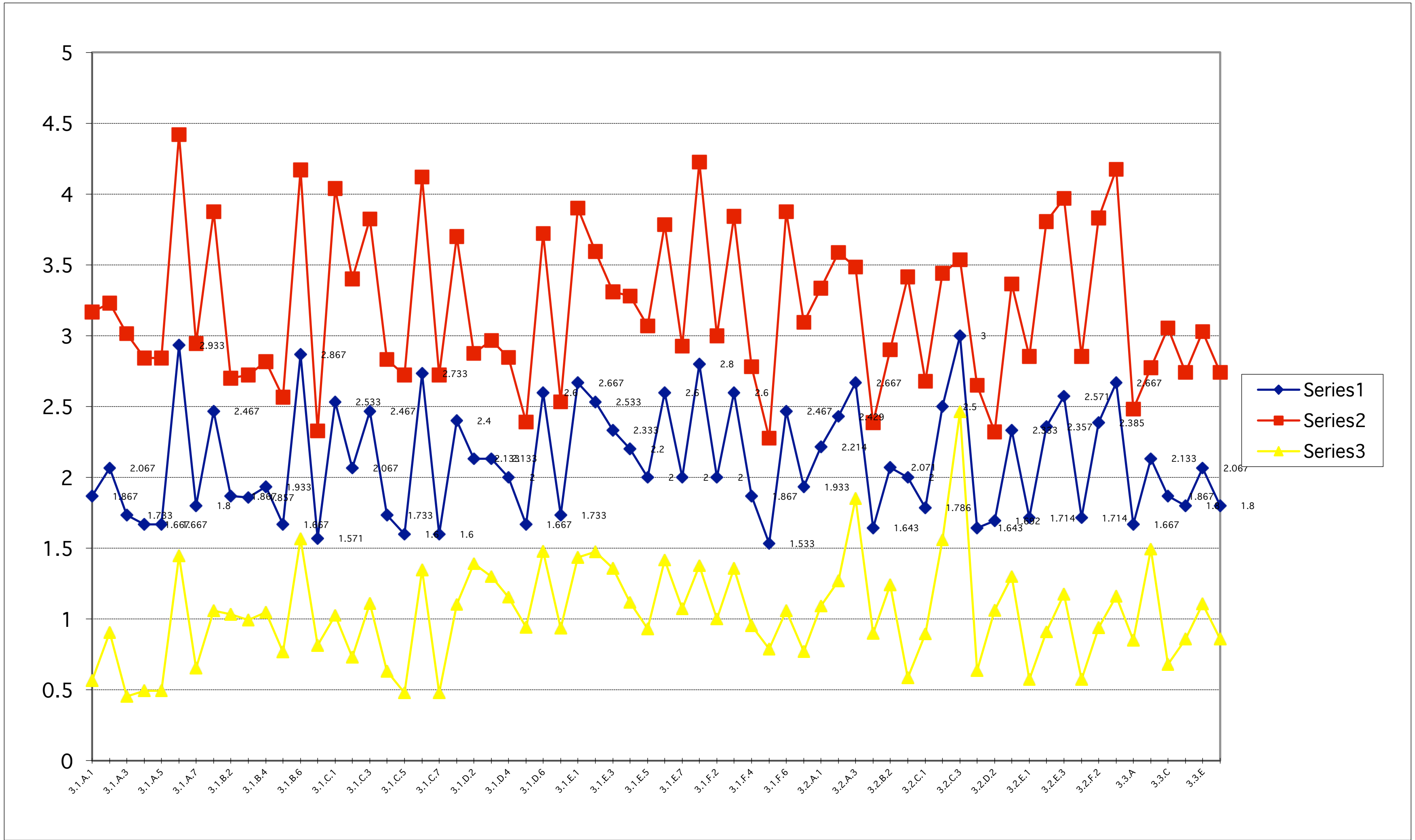
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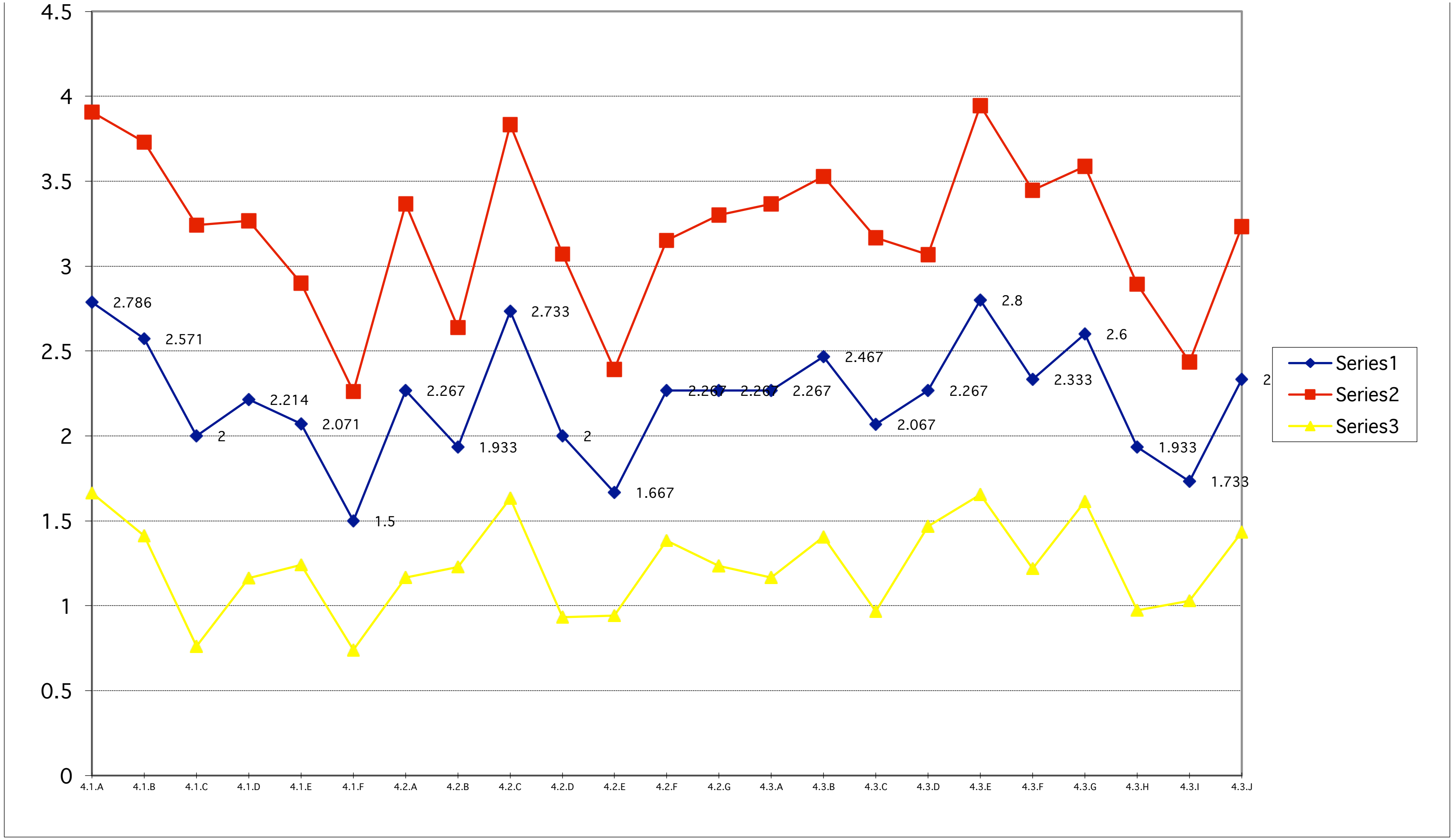
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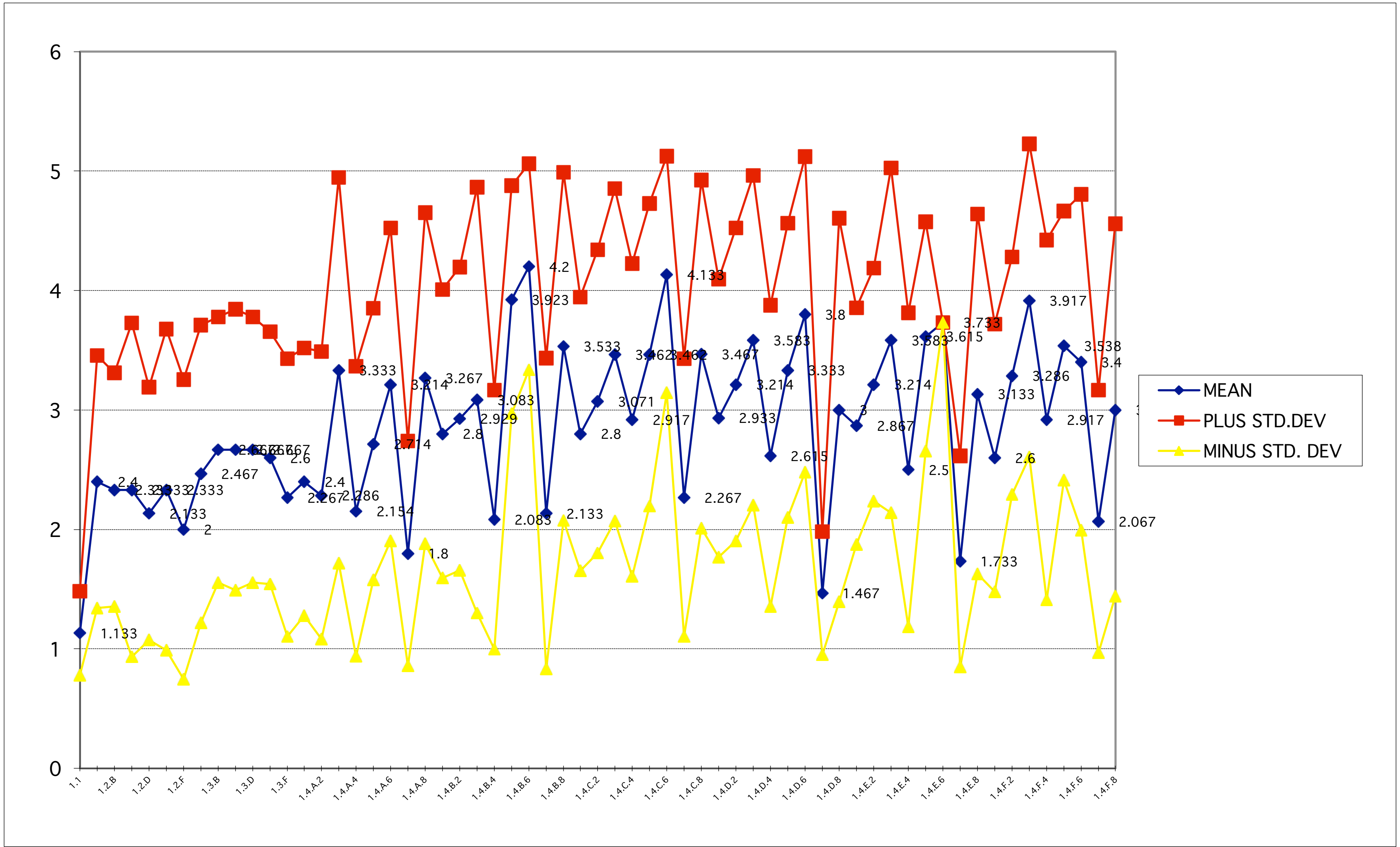

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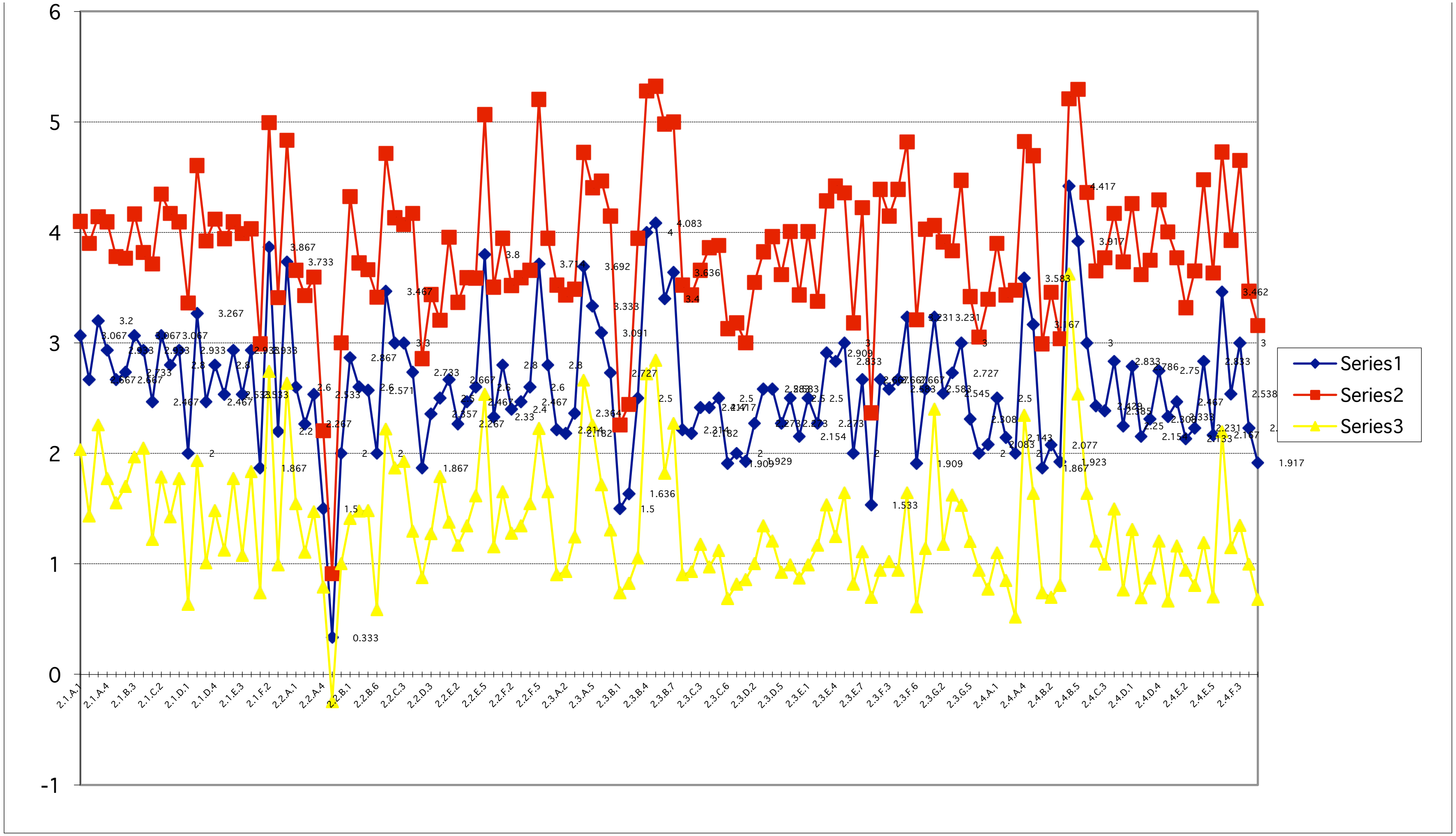

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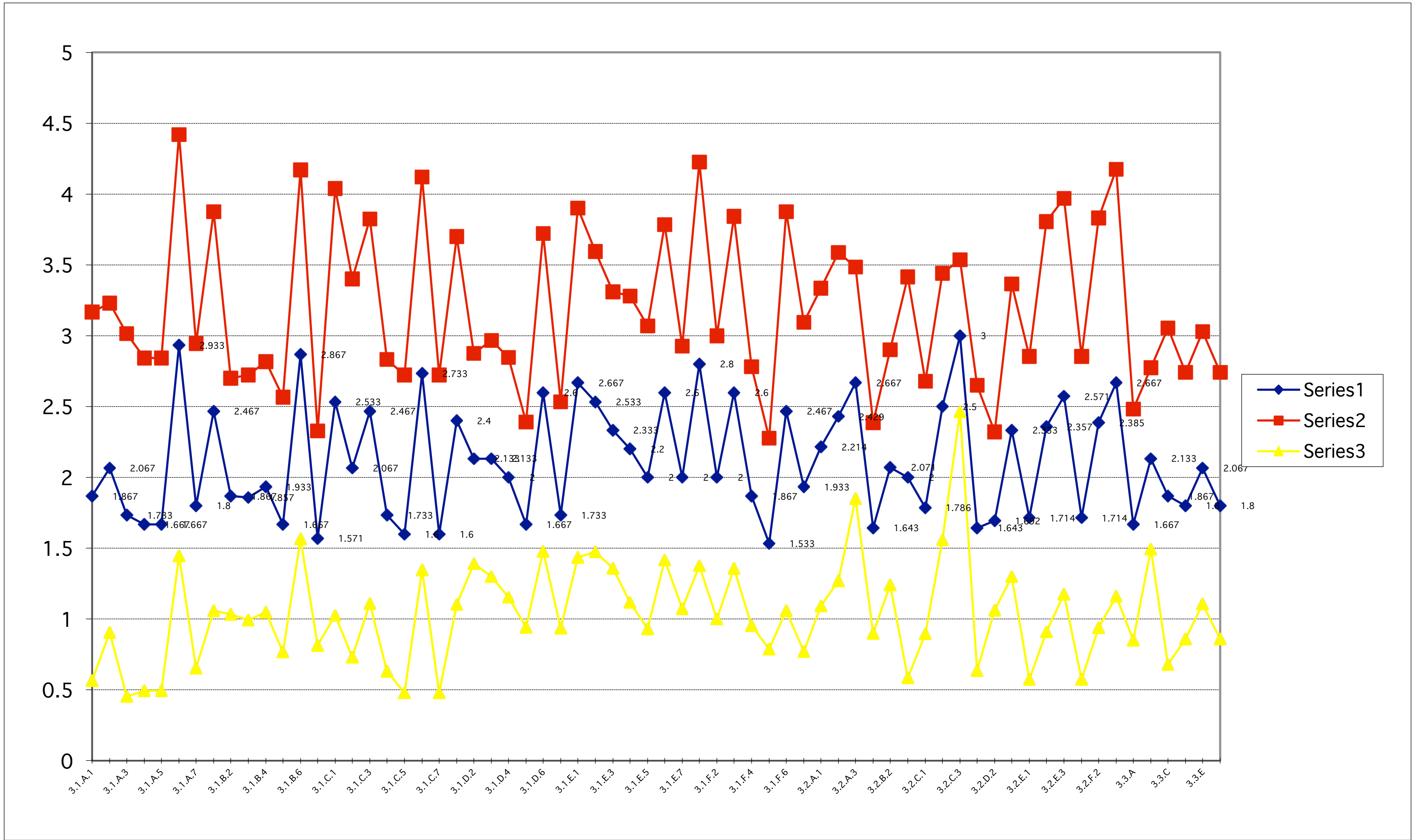
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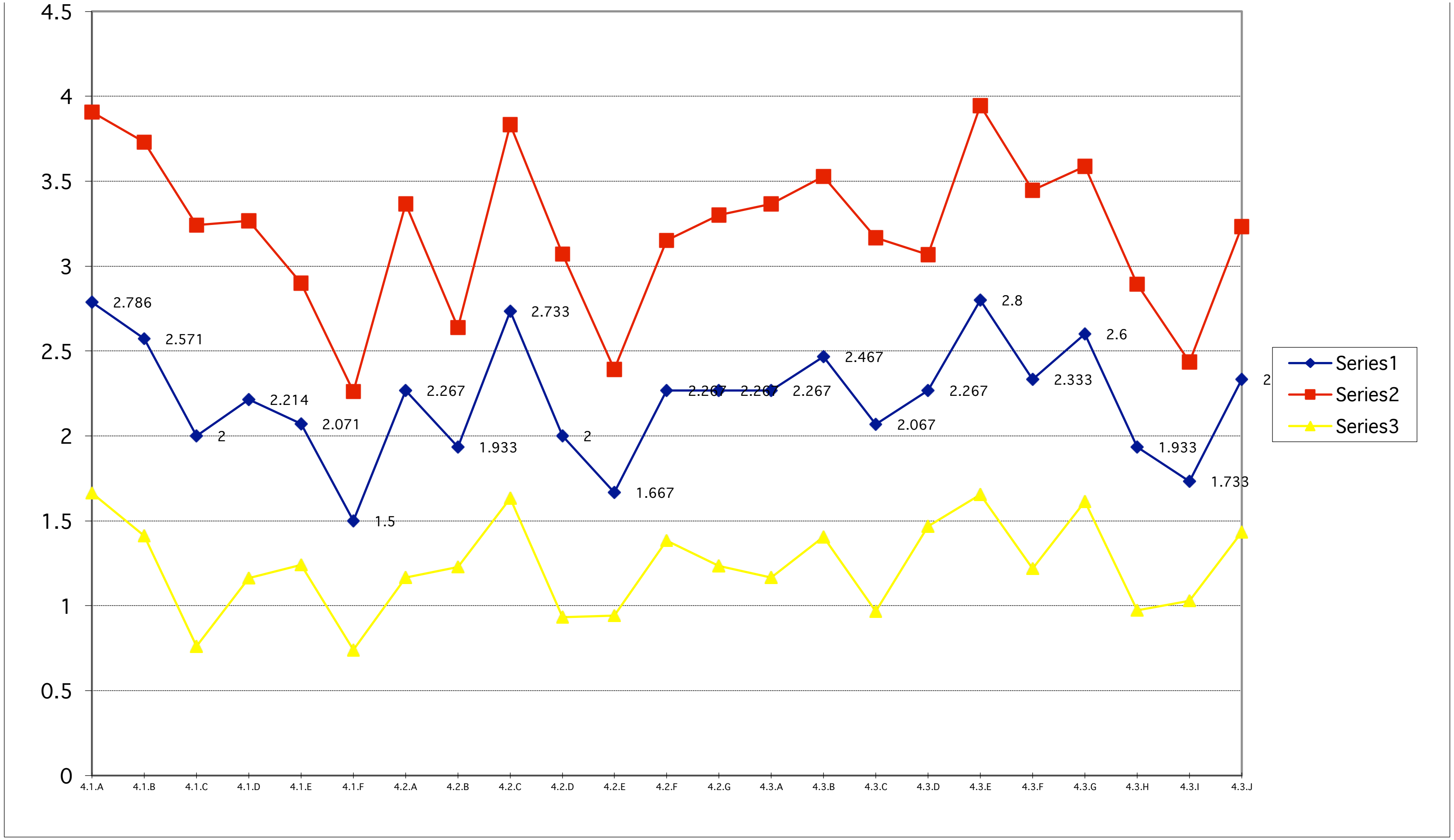

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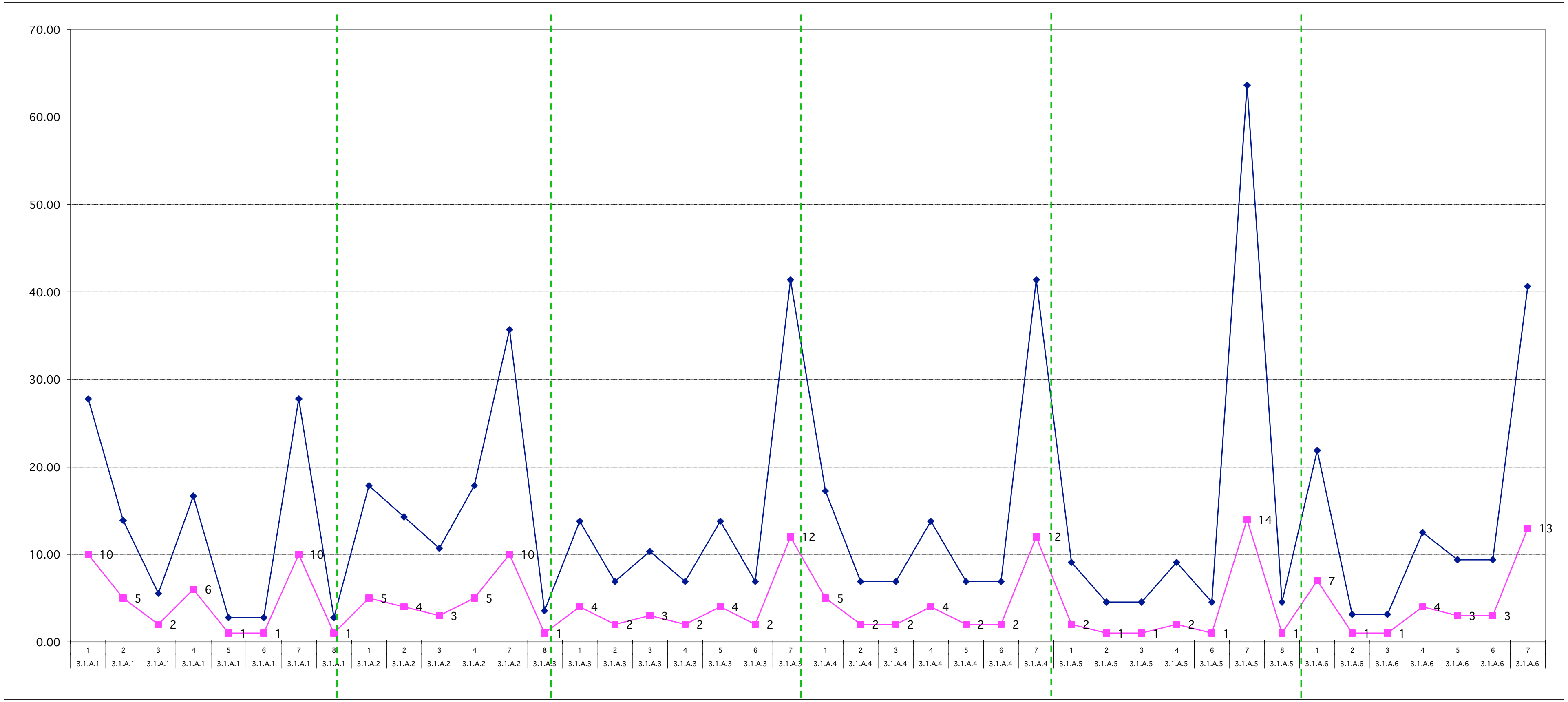
3.1.A.6	2	3.13	1
3.1.A.6	3	3.13	1
3.1.A.6	4	12.50	4
3.1.A.6	5	9.38	3
3.1.A.6	6	9.38	3
3.1.A.6	7	40.63	13

KEY STAKEHOLDERS



Appendix 5

Qualitative Data Analysis

FINDINGS

SECTION 3:TYPE & NATURE OF ISSUES ADDRESSED

3. Please indicate who are tge most frequently used stakeholders in your req. capture process:

[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

Issues

FINDINGS

SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

3.1. Please indicate the types of issues discussed with stakeholders within the following

[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

Issues

FINDINGS

SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

3.2. Please indicate the type of information sought within the following activities:

[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

Issues

FINDINGS
SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

3.2 Type of Information Sought

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Problem areas, wish lists	*who is in market, at what time [market segments well known to us]*	*problem areas, good / bad features, running costs*	*new features, new methods, technological change, market needs*	*size, shape, weight, appearance, colour. style*	*Is it feasible, quality of results, comparison with existing methodologies*
Methods of use, functionality	Market size, pricing, competitors	Price, market share	Look, feel and function	Look, feel and function	Look, feel and function
Functionality	Size, risk, competition	Functionality	Functionality	Technology and user needs	Usability, functionality, installation problems
Search for continuos product improvement. Focus will change depending on new accessories that are available and competitor activity as well as new creative	*Detailed specification and price point*	*Need to know why the product is successful*	*Need to prepare a detailed design bill and design drawings*	*Will start off in the general and narrow down to the specific*	*What testing is done depends on what is being introduced. The more radical the change the more testing is needed.*
Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc	*National /European market figures, what trends are likely*	*Performance criteria, quality standards, ease of manufacture, competitor costs*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*
Usability, supply issues and cost	Specific market sectors	Specifications , cost and viability	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]. Profit , Accounting, manufacturing base	Performance
Technical specification - time reduction	*Products hitting market in key sectors*	*Technical specification*	*Market / Technical specifications*	*Technical data*	*Technical data*
design, performance, ease of use, frequency of use	products used, health care culture, population, clinical indicators	Performance, claims, price, design, composition	internal and external requirements	Cost versus sales benefits, cost of manufacture, capacity	In-vitro and in-vivo testing, volunteer trials
[1] What is it that they are not getting?, [2] Where is there business heading in the future?. [3] what influences are there and opportunities?	*Road spending: value, demand and trends*	*Demand, technical performance, cost, design for manufacture, perception of product quality*	*Demand, technical performance, cost, design for manufacture, perception of product quality*	*Does it fit original brief. Cost parameter and cost advantages*	*Does it fit original brief. Cost parameter and cost advantages*
Technically and competitor driven	Hearsay	Direct communication with rival manufacturers / exhibitions	Minimum requirements taken as base and exceeded	Not done	Only physical testing of engineering principles

CONCLUSIONS
SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

3.2 Type of Information Sought

Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Functionality Performance Price / cost Features Quality	Features Style Function Performance Cost Volume	User needs Appearance Technical specification Cost versus volume / demand

Issues
Understand what they need to know but lack expertise, resources or time

Functionality Technical Feasibility Performance Appeal / style

FINDINGS

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.1 Nature of Processes & Methods Used

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
User group meetings, quality system, market survey / audit	*products are in relevant market. have large database of very useful information*	*Assessed by R&D + QA in Head Office. Information sent in by other subsidiaries / Organisation*	*Business Unit Meetings and R&D input*	*Agreed at Business Unit Meetings and R&D input*	*Undertaken by R&D then Quality Assurance*
Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conf., Boatshow visits	Salesmen, dealer, distributor feedback, Distributor conferences	Engineering driven in relation to [a]	Favourite Customer Installations, Design process procedures
User group panels, dealer panels, market research, supplier input, visits to shows and rallies	*Dealer panels, supplier input, visits to shows*	*Dealer panels, supplier input and in-depth product reviews where necessary*	*Broad specification agreed, designs approved, design bill and drawings prepared for building of prototype*	*Must allow creativity*	*New products are tested in a formal way*
Contact with key users, University Study Groups, Formal design Bodies	*Gather Government statistics, Health and Safety, Formal Representative Institutions*	*In-house Testing, Field Trials, Testing by approved institutions*	*Formal design review meeting to establish performance / style criteria*	*Mock up samples*	*In-house destructive tests. Field trials include: wearer trials for comfort, durability, etc*
Questionnaire	*Based on sales or potential*	*Test to European standards*	*NR*	*NR*	*NR*
Assessment of Health & Safety Regulations and requirements [legislation]. Informal discussions	Gaps in market [technical specification]	Quality assessment [ISO9000], Cost - competitor prices [materials + volumes], market penetration	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil. Customer input sometimes.	Proven technically above - marketing input. Review designs in teams. Multi - functional teams [range of stakeholders]	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil
Literature reviews / Personal Contacts - Buyers	*Specific advertising / targeting specific markets*	*Literature searches - Competitor analysis*	*Technical specifications and space packages*	*Analytical tools [technical], targeted brainstorming, individual expertise*	*specific test equipment and assessment of results*
Focus groups, user visits, clinical trials, market research, internal brainstorming, sales reports	Market research, sales feedback, journals, links with opinion formers, information databases	In-vitro and in-vivo testing, subjective assessments, comparitor trials	Product performance tests, benchmarking, identifying needs of product	Feasibility projects	[1] idea generation: [2] get feedback, [3] make samples, [4] test, [5] get feedback
Discussion based, observation. Easy access to ask end users. Standards committees	*Quantitative market analysis [internal markets]. Export markets: consultancy, opportunity and distributor analysis*	*Lab tests, manufacturing costs, product sector*	*Formal list of market size / value, logistics, return on investment, essential and desirable characteristics, sustainable advantage*	*Change opportunities, external input [design concultancy , university input]*	*Test labs, technical evaluation, customer and on site testing*

CONCLUSIONS
SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.1 Nature of Processes & Methods Used

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts
Creativity methods User groups Market surveys Sales reports and feedback Distributors feedback Standards and regulations	Sales feedback Distributor feedback Exhibitions Formal Bodies / Standards Committees	Product reviews In-house product testing Field trials	Design Cost Product Design Specification • technical specification • customer specification • product innovations • product image / style Design Specification / Criteria Design reviews Benchmarking	Technical / specification driven Design input Market driven

Issues
Rear end driven: specification and test driven processes
Works but is it the right product?

f) Testing & Prototyping of New Prod. Ideas

user testing
[favourite customers]

standards and regulatory testing

FINDINGS

SECTION 3: TYPE & NATURE OF ISSUES ADDRESSED

3.3. Please indicate the quality of the information captured within each of the following activities:

[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

Issues

FINDINGS

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.1 Please indicate the nature of the processes and methods used to collect information within the following activities:					
[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

(1) unstructured process, (2) informal techniques	(1) structured process, (2) informal techniques * *informal processes are almost equal to structured processes*	(1) structured process, (2) formal techniques	(1) structured process, (2) formal techniques	(1) structured process, (2) formal techniques	(1) structured process, (2) formal techniques

Issues

High frequency: (1) Generation of product design requiremnts / specifications, [2] Testing & prototyping of new product ideas

FINDINGS

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.2 Please indicate the type of formats currently used to com. & rep. the following issues to either customers or internal					
[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

(1) report, (2) memo's	(1) memo's, (2) report	(1) memo's / report	(1) report, (2) memo's	(1) reports, (2) appearence models	(1) report, (2) memo's

Issues

High frequency: (1) reports [all sectors], (2) memos [A,B,C,D,F], (3) appearence models [E] Low frequency: (1) formal presentations, (2) 3D CAD models

FINDINGS

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.3 Please indicate who undertakes the following tasks within your company:						
[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation of product design concepts	[F] Selection of product design concepts	[G] Testing & prototyping of new product ideas

Findings

main input	**main input**	**main input**	**main input**	**main input**	**main input**	**main input**
(1) marketing manager, (2) senior management team	(1) senior management team, (2) marketing manager	(1) design manager, (2) design personel	(1) senior management team, (2) design personel	(1) design manager, (2) marketing manager	(1) senior management team, (2) design managers	(1) design manager, (2) design personel

least input	**least input**	**least input**	**least input**	**least input**	**least input**	**least input**
(1) eng./ manufacturing manager	(1) eng./ manufacturing manager, (2) eng. /manufacturing personel	(1) eng. /manufacturing personel	(1) marketing personel, (2) eng. / manufacturing manager	(1) eng. / manufacturing personel, (2) marketing personel	(1) eng. / manufacturing personel	(1) senior management team, (2) eng. / manufacturing personel

Issues

High frequency: (1) senior managers [A,B,C,D,E], (2) marketing managers [A,B,E], (3) design managers [C,E,F,G] Least frequent: (1) eng. / manufacturing managers [A,B,D], (2) eng. / manufacturing personel [B,C,E,F,G],

FINDINGS

SECTION 2: KEY ACTIVITIES UNDERTAKEN

2.4 Please indicate who has the responsibility and authority within the company for the following activities:					
[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requiremnts / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Findings

main respon.	**main respon.**	**main respon.**	**main respon.**	**main respon.**	**main respon.**
(1) marketing manager	(1) managing director, (2) marketing manager	(1) design manager	(1) marketing manager, (2) design manager	(1) managing director, (2) design manager	(1) design manager

least respon	**least respon**	**least respon**	**least respon**	**least respon**	**least respon**
(1) eng./ manufacturing manager	(1) eng./ manufacturing manager	(1) managing director, (2) eng. /manufacturing manager	(1) managing director, (2) eng. /manufacturing manager	(1) eng. / manufacturing manager	(1) managing director

Issues

FINDINGS

SECTION 1: CUSTOMER INVOLVEMENT

1.1 Please indicate how important is fulfilling customer needs to your business success?	**1.2 Please indicate the current nature of customer involvement within the following activities: A, B, C, D, E, F**	**1.3 Please indicate the frequency of customer involvement within the following activities: A, B, C, D, E, F**

Findings

	Key formal inputs	**Key areas of C.I.**
90 % of all companies indicated it was very important to business success	(1) testing & prototyping new product ideas, (2) Generation and selection of product design concepts	(1) Identifying & collecting customer needs, (2) testing & prototyping new product ideas

	least formal inputs	**least area of C.I**
	(1) Identifying new target markets	(1) Identifying new target markets

Issues

Why did the other 10% not say it was very important?	HIGH INPUT: (1) testing & prototyping new product ideas, (2) Generation and selection of product design concepts Mediun Input : all others LOW INPUT: (1) Identifying & collecting customer needs	High frequency: (1) user testing, (2) testing & prototyping new product ideas Mediun Frequency : all others LOW FREQUENCY:

FINDINGS

SECTION 1: CUSTOMER INVOLVEMENT

1.4 Please indicate which stakeholders are typically involved within the following activities					
[A] Identification & Collection of customer needs	[B] Establishing target markets	[C] Evaluation of competing products	[D] Generation of product design requirements / specifications	[E] Generation & selection of product design concepts	[F] Testing & prototyping of new product ideas

Key inputs	**Key inputs**	**Key inputs**	**Key inputs**	**Key inputs**	**Key inputs**
(1) management team, (2) distributors	(1) management team, (2) distributors	(1) management team, (2) end users	(1) management team, (2) distributors	(1) management team, (2) distributors	(1) management team, (2) end users, (3) distributors

least input	**least input**	**least input**	**least input**	**least input**	**least input**
(1) workforce, (2) manufacturers/suppliers	(1) workforce, (2) installers / service eng.	(1) workforce, (2) manufacturers/suppliers	(1) workforce	(1) workforce	

Issues

High Involvement: (1) management teams [all sectors], (2) distributors [A, B, D,E,F]   Low Involvement: (1) workforce [all sectors], (2) manufacturers / suppliers

FINDINGS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.3 Reasons for Success / Failure

a) Identifying customer / user needs	b) establishing target markets	c) evaluating competing products	d) determining and Intro. Prod. Improvements	e) Introducing new products	f) establishing prod. design req. / spec.	g) selecting product design concepts	h) developing aesthetically pleasing products	i) functional acceptable products	j) determining product price points
Good reputation, company stability, excellent people in organisation	Niche markets easy to define	We put a lot of effort into finding all about our competitors	Subsidiary of World wide organisation. Destiny is not always in our hands!!	Very focused organisation and know our markets	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Understand what the competition do and what market will stand
Close contact with users	NR	Models on the market are always changing	Detailed understanding of market	Detailed understanding of market	Experience	Experience	Excellent contacts and expertise	Time in business. Good user relationships	Market knowledge
Lack of resource	Lack of resource	Close knit industry	Too slow	Not good at collecting all the information	NR	NR	NR	Continuous changes	Very market led
We consult a great deal	We only attack when we feel reasonably confident	We take our competition seriously	We have a through TQM system	We consult a great deal	We consult a great deal	We have good feel for what our customers like	We employ talented people who understand the market	We use our own products and consult other users	We are getting much better at linking cost to price, i.e. achieving the right product at the right price and the right cost equals the right profit
NR	NR	NR	NR	Often late to market, limited manpower resources	NR	NR	Often difficult to source suitable quality materials to meet target cost of product. Limited scope on capital expenditure	NR	NR
Not enough end user involvement	Living on existing activities and markets	Good technical specification and requirements	Good production planning	Poor marketing strategy and time to manufacture requirements	Good technical specification and requirements	Do not establish actual needs and do not develop enough new ideas	Defined process	Good technical specification and identification of business sectors	Marketing and Internal costings
Expertise in specific sectors [s]	Lack of appreciation of market requirements [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]	Lack of expertise and resources	Expertise in specific sectors [s]	Expertise in specific sectors [s]	By accident not by design [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]
Large sales and marketing world-wide [s]	Not enough demographic data [f]	Resource available and committed[f]	Dedicated design group [s]	Good turnover, but rarely on-time with full stock	Don't go far enough down each track. Too vague with specifications	Not enough options considered [f]	Majority of products are top ones within their category. Long history of products [s]	New products well liked and copied by competition [s]	manufacturing costs are too high [f]
Just do not do it enough [f]	Just do not do it enough [f]	Expertise and testing [s]	Responsiveness to stake holders	Just do not do it enough [f]	Not enough external data [f]	Well define requirements and specifications [s]	External involvement [s]	Testing and Prototyping [s]	Just do not do it enough and not aggressive enough [f]
No input	Do not know where to start little input	Little input	On the hoof	Lack of planning / suitable people to do work	Engineering expertise [s]	Lack of experience and expertise	Lack of experience and expertise	No user testing	NR

CONCLUSIONS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.3 Reasons for Success / Failure

a) Identifying customer / user needs	b) establishing target markets	c) evaluating competing products	d) determining and Intro. Prod. Improvements	e) Introducing new products	f) establishing prod. design req. / spec.	g) selecting product design concepts	h) developing aesthetically pleasing products	i) functional acceptable products	j) determining product price points
Success									
Staff expertise	Easily definable markets / sectors	Expertise in product testing	Familiarity with market and user needs	Detailed understanding of key market sectors	Well defined technical specification and requirement	Understanding customer base	Staff expertise	Testing and prototyping	Market knowledge
Good communication		Committed resources	TQM procedures / process	Focused organisation / processes	Identifiable expertise within organisation	Well defined markets	Strong corporate image	Technical sustainability	Ability to bring product to market at right cost
Knowledge and understanding of key market sectors		Commitment to process[es]	Specific expertise and resources	Good communication		Well defined technical specification and requirement	Ability to identify the need for external involvement		
Generating usable data		Understanding / knowledge of specific market sectors							
Close contact with users / customers		Easily definable sectors							
Failure									
Lack of resources	Low risk/ incremental strategies	Market / sectors continually changing	Slow response time	Late to market	Engineering driven [not understanding user needs]	Real needs not identified and explored	Achieving success by accident not by design		Do not undertake process enough
Not enough end user contact	Lack of resource / expertise			Limited manpower and resources	Insufficient data and thoroughness in addressing key issues	Not enough option and time spent on developing ideas	Lack of expertise		Manufacturing costs too high
Do not undertake process enough	Lack of appropriate market data			Incomplete data		lack of expertise			Defining internal costs
	Being too familiar with own markets								
	Do not undertake process enough								

Issues
Lack of appropriate human resources and expertise
Commitment to incremental product improvement rather than new product development
Too much time and money spent on getting the product right in production

FINDINGS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.2 Reasons for Levels of Uncertainty

a) Aesthetic	b) Product Improvements	c) New Product Opportunities	d) Product Usability	e) Product performance / spec	f) Design for manufacture	g) costs	h) Other
Differing tastes	Differing needs	Market size and penetration	Different Practices	Differing needs	NR	NR	NR
World-wide products , Fashion	NR	Risk	NR	NR	NR	NR	NR
Always know when you've got it right. Do not always know when you've got it wrong	*Usually see a need for them*	*Can never be sure of success*	*Usually an area of success*	*Depends how radical the change. Testing is essential*	*Provided consultation has been good, high chance of success*	*Always hidden costs crawling out of woodwork*	*NR*
NR	*Unproven claims e.g. without factual evidence*	*Established marketing structure may not realise full implication of new market*	*NR*	*NR*	*NR*	*Hidden test costs e.g. outside test costs etc.*	*NR*
Established products	Established products	Low risk strategy. Lack of new ideas.	Established products with good technical back up	Good technical ability	Do not allow enough time [concept to market]	Materials and manufacturing costs. Understanding over heads and need for better definition	NR
Lack of expertise	*Expertise*	*Lack of resource / time and lack of knowledge*	*Nature of product governs*	*Nature of product governs*	*Nature of product governs*	*Nature of product governs*	*Customer input. Lack of understanding of new manufacturing technology*
Well established data [s]	Do we know all that is technically possible [u]	Lack of market research data	Don't approach enough users to try the product	Matching invitro performance to in-vivo performance	Can do, will do, but is it quick enough? Do we do enough of it?	Waste levels, operator experience	NR
Identified lack of internal expertise. When external consultants used, not a key issue in core product areas	*incremental [s]*	*Just doing enough of it*	*Distributor involvement [s]*	*Distributor involvement [s]*	*Spending enough time doing front end*	*NR*	*NR*
Lack of expertise and knowledge	Piecemeal approach to improvements	Lack of expertise and knowledge	No research done / no user testing	Engineering skills high [s]	Piecemeal approach/ quick fix / growth	Captive market / competition much the same [s]	NR

CONCLUSIONS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.2 Reasons for Levels of Uncertainty

a) Aesthetic	b) Product Improvements	c) New Product Opportunities	d) Product Usability	e) Product performance / spec	f) Design for manufacture	g) costs	h) Other
Lack of internal expertise	Low risk/ incremental strategies	Determining market size	Lack of user testing	Technology driven	Not enough time spent at front end	Not hitting deadlines	
Differing markets / taste	Lack of resource / expertise	Lack of appropriate market research	Incremental product improvement [already know answer syndrome]		Having to spend time getting the product right during production	Actual costs not properly define	
		Not developing enough new ideas				Stages not defined properly	

Issues
Lack of appropriate expertise and resources.
Not Enough time spent on front end activities
Low risk / short term / incremental strategies

FINDINGS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.1 Reasons for Uncertainty

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Different global needs	competitive strength	Bias	Differing tastes	Differing tastes	NR
Many user require different things	Not close enough to new market	NR	Cannot please all of the people. Who is right?	Cannot please all of the people. Who is right?	Cannot cover all environments
How you interpret the information you have is very important	*Launching new products is always risky*	*Dealing in facts and therefore more secure*	*Always a matter of opinion*	*Always a matter of opinion*	*Testing for particular in manufacture and use - provided tests are relevant you can feel reasonably secure*
Reliability of information is uncertain e.g. personal preference etc	*Case history has proved we frequently fail in this area*	*NR*	*NR*	*NR*	*New test regimes*
Do not do enough	Do not do enough	Poorly define customer requirements	Not enough new ideas coming through / customer needs	Do not have enough new ideas	NR
Users do not know needs / have not defined needs	*Resource for data collection*	*Difficulty of getting samples / access to competing products*	*Customer expectations*	*Experience and expertise*	*Users do not know needs / have not defined needs*
Not enough customers provided [number and type of]	Not enough customers provided [number and type of], Understanding country specifics e.g. health funding in the future	Do in-vitro tests reflect in-vivo situation	Don't go detailed enough	Are all options covered? Are assessment tools correct?	Not enough clinical feedback before finalising design
Do not do enough of it	*Expertise within market place*	*Expertise within market place [testing]*	*Trying to identify what customers actually want*	*NR*	*NR*
Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Every confidence that idea will pay off	Every confidence that idea will pay off - Not based on research	Every confidence that idea will pay off

CONCLUSIONS
SECTION 4: ESTABLISHING KEY AREAS OF UNCERTAINTY

4.1 Reasons for Uncertainty

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Reliability of data	Lack of knowledge of new markets	Inability to access competitor data / products	Subjective process	Subjective process	
Wide range of users	Low risk strategies	Lack of expertise / resources	Lack in-depth detailed data	Lack of new ideas	
Lack of knowledge and expertise of process[es]	Insufficient resources committed	Validity of data captured or given	Lack of new ideas	Do not do process enough	
Lack of resources					
Issues Lack of commitment and resources to front end activities					

Qualitative Responses

2.1 Nature of Processes & Methods Used

No.	a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
2	User group meetings, quality system, market survey / audit	products are in relevant market. have large database of very useful information	Assessed by R&D + QA in Head Office. Information sent in by other subsidiaries / Organisation	Business Unit Meetings and R&D input	Agreed at Business Unit Meetings and R&D input	Undertaken by R&D then Quality Assurance
3	NR	NR	NR	NR	NR	NR
5	Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conf., Boatshow visits	Salesmen, dealer, distributor feedback, Distributor conferences	Engineering driven in relation to [a]	Favourite Customer Installations, Design process procedures
6	User group panels, dealer panels, market research, supplier input, visits to shows and rallies	Dealer panels, supplier input, visits to shows	Dealer panels, supplier input and in-depth product reviews where necessary	Broad specification agreed, designs approved, design bill and drawings prepared for building of prototype	Must allow creativity	New products are tested in a formal way
8	Contact with key users, University Study Groups, Formal design Bodies	Gather Government statistics, Health and Safety, Formal Representative Institutions	In-house Testing, Field Trials, Testing by approved institutions	Formal design review meeting to establish performance / style criteria	Mock up samples	In-house destructive tests. Field trials include: wearer trials for comfort, durability, etc.
10	Questionnaire	Based on sales or potential	Test to European standards	NR	NR	NR
11	Assessment of Health & Safety Regulations and requirements [legislation]. Informal discussions	Gaps in market [technical specification]	Quality assessment [ISO9000], Cost - competitor prices [materials + volumes], market penetration	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil. Customer input sometimes.	Proven technically above - marketing input. Review designs in teams. Multi - functional teams [range of stakeholders]	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil
12	Literature reviews / Personal Contacts - Buyers	Specific advertising / targeting specific markets	Literature searches - Competitor analysis	Technical specifications and space packages	Analytical tools [technical], targeted brainstorming, individual expertise	specific test equipment and assessment of results
13	Focus groups, user visits, clinical trials, market research, internal brainstorming, sales reports	Market research, sales feedback, journals, links with opinion formers, information databases	In-vitro and in-vivo testing, subjective assessments, comparitor trials	Product performance tests, benchmarking, identifying needs of product	Feasibility projects	[1] idea generation: [2] get feedback, [3] make samples, [4] test, [5] get feedback
14	Discussion based, observation. Easy access to ask end users. Standards committees	Quantitative market analysis [internal markets]. Export markets: consultancy, opportunity and distributor analysis	Lab tests, manufacturing costs, product sector	Formal list of market size / value, logistics, return on investment, essential and desirable characteristics, sustainable advantage	Change opportunities, external input [design concultancy , university input]	Test labs, technical evaluation, customer and on site testing
15	NR	NR	NR	NR	NR	NR

3.2 Type of Information Sought

No.	a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
2	Problem areas, wish lists	who is in market, at what time [market segments well known to us]	problem areas, good / bad features, running costs	new features, new methods, technological change, market needs	size, shape, weight, appearance, colour. style	Is it feasible, quality of results, comparison with existing methodologies
3	Methods of use, functionality	Market size, pricing, competitors	Price, market share	Look, feel and function	Look, feel and function	Look, feel and function
5	Functionality	Size, risk, competition	Functionality	Functionality	Technology and user needs	Usability, functionality, installation problems
6	Search for continuos product improvement. Focus will change depending on new accessories that are available and competitor activity as well as new creative designs	Detailed specification and price point	Need to know why the product is successful	Need to prepare a detailed design bill and design drawings	Will start off in the general and narrow down to the specific	What testing is done depends on what is being introduced. The more radical the change the more testing is needed.
8	Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc.	National /European market figures, what trends are likely	Performance criteria, quality standards, ease of manufacture, competitor costs	Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc.	Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc.	Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc.
10	NR	NR	NR	NR	NR	NR
11	Usability, supply issues and cost	Specific market sectors	Specifications , cost and viability	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]. Profit , Accounting, manufacturing base	Performance
12	Technical specification - time reduction	Products hitting market in key sectors	Technical specification	Market / Technical specifications	Technical data	Technical data
13	design, performance, ease of use, frequency of use	products used, health care culture, population, clinical indicators	Performance, claims, price, design, composition	internal and external requirements	Cost versus sales benefits, cost of manufacture, capacity	In-vitro and in-vivo testing, volunteer trials
14	[1] What is it that they are not getting?, [2] Where is there business heading in the future?. [3] what influences are there and opportunities?	Road spending: value, demand and trends	Demand, technical performance, cost, design for manufacture, perception of product quality	Demand, technical performance, cost, design for manufacture, perception of product quality	Does it fit original brief. Cost parameter and cost advantages	Does it fit original brief. Cost parameter and cost advantages
15	Technically and competitor driven	Hearsay	Direct communication with rival manufacturers / exhibitions	Minimum requirements taken as base and exceeded	Not done	Only physical testing of engineering principles

4.1 Reasons for Uncertainty

No.	a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
2	NR	NR	NR	NR	NR	NR
3	Different global needs	competitive strength	Bias	Differing tastes	Differing tastes	NR
5	Many user require different things	Not close enough to new market	NR	Cannot please all of the people. Who is right?	Cannot please all of the people. Who is right?	Cannot cover all environments
6	How you interpret the information you have is very important	Launching new products is always risky	Dealing in facts and therefore more secure	Always a matter of opinion	Always a matter of opinion	Testing for particular in manufacture and use - provided tests are relevant you can feel reasonably secure
8	Reliability of information is uncertain e.g. personal preference etc.	Case history has proved we frequently fail in this area	NR	NR	NR	New test regimes
10	NR	NR	NR	NR	NR	NR
11	Do not do enough	Do not do enough	Poorly define customer requirements	Not enough new ideas coming through / customer needs	Do not have enough new ideas	NR
12	Users do not know needs / have not defined needs	Resource for data collection	Difficulty of getting samples / access to competing products	Customer expectations	Experience and expertise	Users do not know needs / have not defined needs
13	Not enough customers provided [number and type of]	Not enough customers provided [number and type of], Understanding country specifics e.g. health funding in the future	Do in-vitro tests reflect in-vivo situation	Don't go detailed enough	Are all options covered? Are assessment tools correct?	Not enough clinical feedback before finalising design
14	Do not do enough of it	Expertise within market place	Expertise within market place [testing]	Trying to identify what customers actually want	NR	NR
15	Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Every confidence that idea will pay off	Every confidence that idea will pay off - Not based on research	Every confidence that idea will pay off

4.2 Reasons for Levels of Uncertainty

No.	a) Aesthetic	b) Product Improvements	c) New Product Opportunities	d) Product Usability	e) Product performance / spec	f) Design for manufacture	g) costs	h) Other
2	NR	NR	NR	NR	NR	NR	NR	NR
3	Differing tastes	Differing needs	Market size and penetration	Different Practices	Differing needs	NR	NR	NR
5	World-wide products , Fashion	NR	Risk	NR	NR	NR	NR	NR
6	Always know when you've got it right. Do not always know when you've got it wrong	Usually see a need for them	Can never be sure of success	Usually an area of success	Depends how radical the change. Testing is essential	Provided consultation has been good, high chance of success	Always hidden costs crawling out of woodwork	NR
8	NR	Unproven claims e.g. without factual evidence	Established marketing structure may not realise full implication of new market	NR	NR	NR	Hidden test costs e.g. outside test costs etc.	NR
10	NR	NR	NR	NR	NR	NR	NR	NR
11	Established products	Established products	Low risk strategy. Lack of new ideas.	Established products with good technical back up	Good technical ability	Do not allow enough time [concept to market]	Materials and manufacturing costs. Understanding over heads and need for better definition	NR
12	Lack of expertise	Expertise	Lack of resource / time and lack of knowledge	Nature of product governs	Nature of product governs	Nature of product governs	Nature of product governs	Customer input. Lack of understanding of new manufacturing technology
13	Well established data [s]	Do we know all that is technically possible [u]	Lack of market research data	Don't approach enough users to try the product	Matching invitro performance to in-vivo performance	Can do, will do, but is it quick enough? Do we do enough of it?	Waste levels, operator experience	NR
14	Identified lack of internal expertise. When external consultants used, not a key issue in core product areas	incremental [s]	Just doing enough of it	Distributor involvement [s]	Distributor involvement [s]	Spending enough time doing front end	NR	NR
15	Lack of expertise and knowledge	Piecemeal approach to improvements	Lack of expertise and knowledge	No research done / no user testing	Engineering skills high [s]	Piecemeal approach/ quick fix / growth	Captive market / competition much the same [s]	NR

4.3 Reasons for Success / Failure

No.	a) Identifying customer / user needs	b) establishing target markets	c) evaluating competing products	d) determining and Intro. Prod. Improvements	e) Introducing new products	f) establishing prod. design req. / spec.	g) selecting product design concepts	h) developing aesthetically pleasing products	i) functional acceptable products	j) determining product price points
2	Good reputation, company stability, excellent people in organisation	Niche markets easy to define	We put a lot of effort into finding all about our competitors	Subsidiary of World wide organisation. Destiny is not always in our hands!!	Very focused organisation and know our markets	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Understand what the competition do and what market will stand
3	Close contact with users	NR	Models on the market are always changing	Detailed understanding of market	Detailed understanding of market	Experience	Experience	Excellent contacts and expertise	Time in business. Good user relationships	Market knowledge
5	Lack of resource	Lack of resource	Close knit industry	Too slow	Not good at collecting all the information	NR	NR	NR	Continuous changes	Very market led
6	We consult a great deal	We only attack when we feel reasonably confident	We take our competition seriously	We have a through TQM system	We consult a great deal	We consult a great deal	We have good feel for what our customers like	We employ talented people who understand the market	We use our own products and consult other users	We are getting much better at linking cost to price, i.e. achieving the right product at the right price and the right cost equals the right profit
8	NR	NR	NR	NR	Often late to market, limited manpower resources	NR	NR	Often difficult to source suitable quality materials to meet target cost of product. Limited scope on capital expenditure	NR	NR
10	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
11	Not enough end user involvement	Living on existing activities and markets	Good technical specification and requirements	Good production planning	Poor marketing strategy and time to manufacture requirements	Good technical specification and requirements	Do not establish actual needs and do not develop enough new ideas	Defined process	Good technical specification and identification of business sectors	Marketing and Internal costings
12	Expertise in specific sectors [s]	Lack of appreciation of market requirements [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]	Lack of expertise and resources	Expertise in specific sectors [s]	Expertise in specific sectors [s]	By accident not by design [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]
13	Large sales and marketing world-wide [s]	Not enough demographic data [f]	Resource available and committed[f]	Dedicated design group [s]	Good turnover, but rarely on-time with full stock	Don't go far enough down each track. Too vague with specifications	Not enough options considered [f]	Majority of products are top ones within their category. Long history of products [s]	New products well liked and copied by competition [s]	manufacturing costs are too high [f]
14	Just do not do it enough [f]	Just do not do it enough [f]	Expertise and testing [s]	Responsiveness to stake holders	Just do not do it enough [f]	Not enough external data [f]	Well define requirements and specifications [s]	External involvement [s]	Testing and Prototyping [s]	Just do not do it enough and not aggressive enough [f]
15	No input	Do not know where to start little input	Little input	On the hoof	Lack of planning / suitable people to do work	Engineering expertise [s]	Lack of experience and expertise	Lack of experience and expertise	No user testing	NR

Conclusions from Qualitative Responses

2.1 Nature of Processes & Methods Used

a)	b)	c)	d)	e)	f)
Creativity methods User groups Market surveys Sales reports and feedback Distributors feedback Standards and regulations	Sales feedback Distributor feedback Exhibitions Formal Bodies / Standards Committees	Product reviews In-house product testing Field trials	Design Cost Product Design Specification • technical specification • customer specification • product innovations • product image / style Design Specification / Criteria Design reviews Benchmarking	Technical / specification driven Design input Market driven	user testing [favourite customers] standards and regulatory testing

Issues
Rear end driven: specification and test driven processes
Works but is it the right product?

3.2 Type of Information Sought

a)	b)	c)	d)	e)	f)
Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Functionality Performance Price / cost Features Quality	Features Style Function Performance Cost Volume	User needs Appearance Technical specification Cost versus volume / demand	Functionality Technical Feasibility Performance Appeal / style

Issues
Understand what they need to know but lack expertise, resources or time

4.1 Reasons for Uncertainty

a)	b)	c)	d)	e)	f)
Reliability of data Wide range of users Lack of knowledge and expertise of process[es] Lack of resources	Lack of knowledge of new markets Low risk strategies Insufficient resources committed	Inability to access competitor data / products Lack of expertise / resources Validity of data captured or given	Subjective process Lack in-depth detailed data Lack of new ideas	Subjective process Lack of new ideas Do not do process enough	

Issues
Lack of commitment and resources to front end activities

4.2 Reasons for Levels of Uncertainty

a)	b)	c)	d)	e)	f)	g)	h)
Lack of internal expertise Differing markets / taste	Low risk/ incremental strategies Lack of resource / expertise	Determining market size Lack of appropriate market research Not developing enough new ideas	Lack of user testing Incremental product improvement [already know answer syndrome]	Technology driven	Not enough time spent at front end Having to spend time getting the product right during production	Not hitting deadlines Actual costs not properly define Stages not defined properly	

Issues
Lack of appropriate expertise and resources.
Not Enough time spent on front end activities
Low risk / short term / incremental strategies

4.3 Reasons for Success / Failure

	a)	b)	c)	d)	e)	f)	g)	h)	i)	j)
Success	Staff expertise Good communication Knowledge and understanding of key market sectors Generating usable data Close contact with users / customers	Easily definable markets / sectors	Expertise in product testing Committed resources Commitment to process[es] Understanding / knowledge of specific market sectors Easily definable sectors	Familiarity with market and user needs TQM procedures / process Specific expertise and resources	Detailed understanding of key market sectors Focused organisation / processes Good communication	Well defined technical specification and requirement Identifiable expertise within organisation	Understanding customer base Well defined markets Well defined technical specification and requirement	Staff expertise Strong corporate image Ability to identify the need for external involvement	Testing and prototyping Technical sustainability	Market knowledge Ability to bring product to market at right cost
Failure	Lack of resources Not enough end user contact Do not undertake process enough	Low risk/ incremental strategies Lack of resource / expertise Lack of appropriate market data Being too familiar with own markets Do not undertake process enough	Market / sectors continually changing	Slow response time	Late to market Limited manpower and resources Incomplete data	Engineering driven [not understanding user needs] Insufficient data and thoroughness in addressing key issues	Real needs not identified and explored Not enough option and time spent on developing ideas lack of expertise	Achieving success by accident not by design Lack of expertise		Do not undertake process enough Manufacturing costs too high Defining internal costs

Issues
Lack of appropriate human resources and expertise
Commitment to incremental product improvement rather than new product development
Too much time and money spent on getting the product right in production

Conclusions from Qualitative Responses

Nature of Processes & Methods Used

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Creativity methods User groups Market surveys Sales reports and feedback Distributors feedback Standards and regulations	Sales feedback Distributor feedback Exhibitions Formal Bodies / Standards Committees	Product reviews In-house product testing Field trials	Design Cost Product Design Specification • technical specification • customer specification • product innovations • product image / style Design Specification / Criteria Design reviews Benchmarking	Technical / specification driven Design input Market driven	user testing [favourite customers] standards and regulatory testing

Issues
Rear end driven: specification and test driven processes
Works but is it the right product?

Type of Information Sought

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Key players Market size Market sectors Value / demand Trends	Functionality Performance Price / cost Features Quality	Features Style Function Performance Cost Volume	User needs Appearance Technical specification Cost versus volume / demand	Functionality Technical Feasibility Performance Appeal / style

Issues
Understand what they need to know but lack expertise, resources or time

Reasons for Uncertainty

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Reliability of data Wide range of users Lack of knowledge and expertise of process[es] Lack of resources	Lack of knowledge of new markets Low risk strategies Insufficient resources committed	Inability to access competitor data / products Lack of expertise / resources Validity of data captured or given	Subjective process Lack in-depth detailed data Lack of new ideas	Subjective process Lack of new ideas Do not do process enough	

Issues
Lack of commitment and resources to front end activities

Areas of Uncertainty

a) Aesthetic	b) Product Improvements	c) New Product Opportunities	d) Product Usability	e) Product performance / spec	f) Design for manufacture	g) costs	h) Other
Lack of internal expertise Differing markets / taste	Low risk/ incremental strategies Lack of resource / expertise	Determining market size Lack of appropriate market research Not developing enough new ideas	Lack of user testing Incremental product improvement [already know answer syndrome]	Technology driven	Not enough time spent at front end Having to spend time getting the product right during production	Not hitting deadlines Actual costs not properly define Stages not defined properly	

Issues
Lack of appropriate expertise and resources.
Not Enough time spent on front end activities
Low risk / short term / incremental strategies

Reasons for Success / Failure

	a) Identifying customer / user needs	b) establishing target markets	c) evaluating competing products	d) determining and Intro. Prod. Improvements	e) Introducing new products	f) establishing prod. design req. / spec.	g) selecting product design concepts	h) developing aesthetically pleasing products	i) functional acceptable products	j) determining product price points
Success	Staff expertise Good communication Knowledge and understanding of key market sectors Generating usable data Close contact with users / customers	Easily definable markets / sectors	Expertise in product testing Committed resources Commitment to process[es] Understanding / knowledge of specific market sectors Easily definable sectors	Familiarity with market and user needs TQM procedures / process Specific expertise and resources	Detailed understanding of key market sectors Focused organisation / processes Good communication	Well defined technical specification and requirement Identifiable expertise within organisation	Understanding customer base Well defined markets Well defined technical specification and requirement	Staff expertise Strong corporate image Ability to identify the need for external involvement	Testing and prototyping Technical sustainability	Market knowledge Ability to bring product to market at right cost
Failure	Lack of resources Not enough end user contact Do not undertake process enough	Low risk/ incremental strategies Lack of resource / expertise Lack of appropriate market data Being too familiar with own markets Do not undertake process enough	Market / sectors continually changing	Slow response time	Late to market Limited manpower and resources Incomplete data	Engineering driven [not understanding user needs] Insufficient data and thoroughness in addressing key issues	Real needs not identified and explored Not enough option and time spent on developing ideas lack of expertise	Achieving success by accident not by design Lack of expertise		Do not undertake process enough Manufacturing costs too high Defining internal costs

Issues
Lack of appropriate human resources and expertise
Commitment to incremental product improvement rather than new product development
Too much time and money spent on getting the product right in production

4.3 Reasons for Success / Failure

a) Identifying customer / user needs	b) establishing target markets	c) evaluating competing products	d) determining and Intro. Prod. Improvements	e) Introducing new products	f) establishing prod. design req. / spec.	g) selecting product design concepts	h) developing aesthetically pleasing products	i) functional acceptable products	j) determining product price points
Good reputation, company stability, excellent people in organisation	Niche markets easy to define	We put a lot of effort into finding all about our competitors	Subsidiary of World wide organisation. Destiny is not always in our hands!!	Very focused organisation and know our markets	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Subsidiary of World wide Organisation. Destiny is not always in our hands!!	Understand what the competition do and what market will stand
Close contact with users	NR	Models on the market are always changing	Detailed understanding of market	Detailed understanding of market	Experience	Experience	Excellent contacts and expertise	Time in business. Good user relationships	Market knowledge
Lack of resource	Lack of resource	Close knit industry	Too slow	Not good at collecting all the information	NR	NR	NR	Continuous changes	Very market led
We consult a great deal	We only attack when we feel reasonably confident	We take our competition seriously	We have a through TQM system	We consult a great deal	We consult a great deal	We have good feel for what our customers like	We employ talented people who understand the market	We use our own products and consult other users	We are getting much better at linking cost to price, i.e. achieving the right product at the right price and the right cost equals the right profit
NR	NR	NR	NR	Often late to market, limited manpower resources	NR	NR	Often difficult to source suitable quality materials to meet target cost of product. Limited scope on capital expenditure	NR	NR
Not enough end user involvement	Living on existing activities and markets	Good technical specification and requirements	Good production planning	Poor marketing strategy and time to manufacture requirements	Good technical specification and requirements	Do not establish actual needs and do not develop enough new ideas	Defined process	Good technical specification and identification of business sectors	Marketing and Internal costings
Expertise in specific sectors [s]	Lack of appreciation of market requirements [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]	Lack of expertise and resources	Expertise in specific sectors [s]	Expertise in specific sectors [s]	By accident not by design [f]	Expertise in specific sectors [s]	Expertise in specific sectors [s]
Large sales and marketing world-wide [s]	Not enough demographic data [f]	Resource available and committed[f]	Dedicated design group [s]	Good turnover, but rarely on-time with full stock	Don't go far enough down each track. Too vague with specifications	Not enough options considered [f]	Majority of products are top ones within their category. Long history of products [s]	New products well liked and copied by competition [s]	manufacturing costs are too high [f]
Just do not do it enough [f]	Just do not do it enough [f]	Expertise and testing [s]	Responsiveness to stake holders	Just do not do it enough [f]	Not enough external data [f]	Well define requirements and specifications [s]	External involvement [s]	Testing and Prototyping [s]	Just do not do it enough and not aggressive enough [f]
No input	Do not know where to start little input	Little input	On the hoof	Lack of planning / suitable people to do work	Engineering expertise [s]	Lack of experience and expertise	Lack of experience and expertise	No user testing	NR

Conclusions from Qualitative Responses

4.3 Reasons for Success / Failure

Success									
Staff expertise	Easily definable markets / sectors	Expertise in product testing	Familiarity with market and user needs	Detailed understanding of key market sectors	Well defined technical specification and requirement	Understanding customer base	Staff expertise	Testing and prototyping	Market knowledge
Good communication		Committed resources	TQM procedures / process	Focused organisation / processes	Identifiable expertise within organisation	Well defined markets	Strong corporate image	Technical sustainability	Ability to bring product to market at right cost
Knowledge and understanding of key market sectors		Commitment to process[es]	Specific expertise and resources	Good communication		Well defined technical specification and requirement	Ability to identify the need for external involvement		
Generating usable data		Understanding / knowledge of specific market sectors							
Close contact with users / customers		Easily definable sectors							
Failure									
Lack of resources	Low risk/ incremental strategies	Market / sectors continually changing	Slow response time	Late to market	Engineering driven [not understanding user needs]	Real needs not identified and explored	Achieving success by accident not by design		Do not undertake process enough
Not enough end user contact	Lack of resource / expertise			Limited manpower and resources	Insufficient data and thoroughness in addressing key issues	Not enough option and time spent on developing ideas	Lack of expertise		Manufacturing costs too high
Do not undertake process enough	Lack of appropriate market data			Incomplete data		lack of expertise			Defining internal costs
	Being too familiar with own markets								
	Do not undertake process enough								

Issues
Lack of appropriate human resources and expertise
Commitment to incremental product improvement rather than new product development
Too much time and money spent on getting the product right in production

4.2 Reasons for Levels of Uncertainty

a) Aesthetic	b) Product Improvements	c) New Product Opportunities	d) Product Usability	e) Product performance / spec	f) Design for manufacture	g) costs	h) Other
Differing tastes	Differing needs	Market size and penetration	Different Practices	Differing needs	NR	NR	NR
World-wide products , Fashion	NR	Risk	NR	NR	NR	NR	NR
Always know when you've got it right. Do not always know when you've got it wrong	*Usually see a need for them*	*Can never be sure of success*	*Usually an area of success*	*Depends how radical the change. Testing is essential*	*Provided consultation has been good, high chance of success*	*Always hidden costs crawling out of woodwork*	*NR*
NR	*Unproven claims e.g. without factual evidence*	*Established marketing structure may not realise full implication of new market*	*NR*	*NR*	*NR*	*Hidden test costs e.g. outside test costs etc.*	*NR*
Established products	Established products	Low risk strategy. Lack of new ideas.	Established products with good technical back up	Good technical ability	Do not allow enough time [concept to market]	Materials and manufacturing costs. Understanding over heads and need for better definition	NR
Lack of expertise	*Expertise*	*Lack of resource / time and lack of knowledge*	*Nature of product governs*	*Nature of product governs*	*Nature of product governs*	*Nature of product governs*	*Customer input. Lack of understanding of new manufacturing technology*
Well established data [s]	Do we know all that is technically possible [u]	Lack of market research data	Don't approach enough users to try the product	Matching invitro performance to in-vivo performance	Can do, will do, but is it quick enough? Do we do enough of it?	Waste levels, operator experience	NR
Identified lack of internal expertise. When external consultants used, not a key issue in core product areas	*incremental [s]*	*Just doing enough of it*	*Distributor involvement [s]*	*Distributor involvement [s]*	*Spending enough time doing front end*	*NR*	*NR*
Lack of expertise and knowledge	Piecemeal approach to improvements	Lack of expertise and knowledge	No research done / no user testing	Engineering skills high [s]	Piecemeal approach/ quick fix / growth	Captive market / competition much the same [s]	NR

Conclusions from Qualitative Responses

4.2 Reasons for Levels of Uncertainty

Lack of internal expertise Differing markets / taste	Low risk/ incremental strategies Lack of resource / expertise	Determining market size Lack of appropriate market research Not developing enough new ideas	Lack of user testing Incremental product improvement [already know answer syndrome]	Technology driven	Not enough time spent at front end Having to spend time getting the product right during production	Not hitting deadlines Actual costs not properly define Stages not defined properly	
Issues Lack of appropriate expertise and resources. Not Enough time spent on front end activities Low risk / short term / incremental strategies							

4.1 Reasons for Uncertainty

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Different global needs	competitive strength	Bias	Differing tastes	Differing tastes	NR
Many user require different things	Not close enough to new market	NR	Cannot please all of the people. Who is right?	Cannot please all of the people. Who is right?	Cannot cover all environments
How you interpret the information you have is very important	*Launching new products is always risky*	*Dealing in facts and therefore more secure*	*Always a matter of opinion*	*Always a matter of opinion*	*Testing for particular in manufacture and use - provided tests are relevant you can feel reasonably secure*
Reliability of information is uncertain e.g. personal preference etc	*Case history has proved we frequently fail in this area*	*NR*	*NR*	*NR*	*New test regimes*
Do not do enough	Do not do enough	Poorly define customer requirements	Not enough new ideas coming through / customer needs	Do not have enough new ideas	NR
Users do not know needs / have not defined needs	*Resource for data collection*	*Difficulty of getting samples / access to competing products*	*Customer expectations*	*Experience and expertise*	*Users do not know needs / have not defined needs*
Not enough customers provided [number and type of]	Not enough customers provided [number and type of], Understanding country specifics e.g. health funding in the future	Do in-vitro tests reflect in-vivo situation	Don't go detailed enough	Are all options covered? Are assessment tools correct?	Not enough clinical feedback before finalising design
Do not do enough of it	*Expertise within market place*	*Expertise within market place [testing]*	*Trying to identify what customers actually want*	*NR*	*NR*
Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Lack of expertise and procedure / processes	Every confidence that idea will pay off	Every confidence that idea will pay off - Not based on research	Every confidence that idea will pay off

Conclusions from Qualitative Responses

4.1 Reasons for Uncertainty

Reliability of data Wide range of users Lack of knowledge and expertise of process[es] Lack of resources	Lack of knowledge of new markets Low risk strategies Insufficient resources committed	Inability to access competitor data / products Lack of expertise / resources Validity of data captured or given	Subjective process Lack in-depth detailed data Lack of new ideas	Subjective process Lack of new ideas Do not do process enough	
Issues Lack of commitment and resources to front end activities					

Conclusions from Qualitative Responses

3.2 Type of Information Sought

Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Usability Functionality Problem areas / wish lists Performance criteria Frequency of use	Functionality Performance Price / cost Features Quality	Features Style Function Performance Cost Volume	User needs Appearance Technical specification Cost versus volume / demand	Functionality Technical Feasibility Performance Appeal / style
Issues Understand what they need to know but lack expertise, resources or time					

2.1 Nature of Processes & Methods Used

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
User group meetings, quality system, market survey / audit	*products are in relevant market. have large database of very useful information*	*Assessed by R&D + QA in Head Office. Information sent in by other subsidiaries / Organisation*	*Business Unit Meetings and R&D input*	*Agreed at Business Unit Meetings and R&D input*	*Undertaken by R&D then Quality Assurance*
Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conferences	Salesmen, dealer, distributor feedback, Distributor conf., Boatshow visits	Salesmen, dealer, distributor feedback, Distributor conferences	Engineering driven in relation to [a]	Favourite Customer Installations, Design process procedures
User group panels, dealer panels, market research, supplier input, visits to shows and rallies	*Dealer panels, supplier input, visits to shows*	*Dealer panels, supplier input and in-depth product reviews where necessary*	*Broad specification agreed, designs approved, design bill and drawings prepared for building of prototype*	*Must allow creativity*	*New products are tested in a formal way*
Contact with key users, University Study Groups, Formal design Bodies	*Gather Government statistics, Health and Safety, Formal Representative Institutions*	*In-house Testing, Field Trials, Testing by approved institutions*	*Formal design review meeting to establish performance / style criteria*	*Mock up samples*	*In-house destructive tests. Field trials include: wearer trials for comfort, durability, etc*
Questionnaire	*Based on sales or potential*	*Test to European standards*	*NR*	*NR*	*NR*
Assessment of Health & Safety Regulations and requirements [legislation]. Informal discussions	Gaps in market [technical specification]	Quality assessment [ISO9000], Cost - competitor prices [materials + volumes], market penetration	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil. Customer input sometimes.	Proven technically above - marketing input. Review designs in teams. Multi - functional teams [range of stakeholders]	Technically controlled process [quality, R&D and Marketing] set requirements ideas must fulfil
Literature reviews / Personal Contacts - Buyers	*Specific advertising / targeting specific markets*	*Literature searches - Competitor analysis*	*Technical specifications and space packages*	*Analytical tools [technical], targeted brainstorming, individual expertise*	*specific test equipment and assessment of results*
Focus groups, user visits, clinical trials, market research, internal brainstorming, sales reports	Market research, sales feedback, journals, links with opinion formers, information databases	In-vitro and in-vivo testing, subjective assessments, comparitor trials	Product performance tests, benchmarking, identifying needs of product	Feasibility projects	[1] idea generation: [2] get feedback, [3] make samples, [4] test, [5] get feedback
Discussion based, observation. Easy access to ask end users. Standards committees	*Quantitative market analysis [internal markets]. Export markets: consultancy, opportunity and distributor analysis*	*Lab tests, manufacturing costs, product sector*	*Formal list of market size / value, logistics, return on investment, essential and desirable characteristics, sustainable advantage*	*Change opportunities, external input [design concultancy , university input]*	*Test labs, technical evaluation, customer and on site testing*

Conclusions from Qualitative Responses

2.1 Nature of Processes & Methods Used

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Creativity methods User groups Market surveys Sales reports and feedback Distributors feedback Standards and regulations	Sales feedback Distributor feedback Exhibitions Formal Bodies / Standards Committees	Product reviews In-house product testing Field trials	Design Cost Product Design Specification • technical specification • customer specification • product innovations • product image / style Design Specification / Criteria Design reviews Benchmarking	Technical / specification driven Design input Market driven	user testing [favourite customers] standards and regulatory testing

Issues
Rear end driven: specification and test driven processes
Works but is it the right product?

3.2 Type of Information Sought

a) Identification & Collection of User Needs	b) Establishing Target Markets	c) Evaluation of Competing Products	d) Gen. of Prod. Design Req. / Spec.	e) Gen. & selection of Prod. Design Concepts	f) Testing & Prototyping of New Prod. Ideas
Problem areas, wish lists	*who is in market, at what time [market segments well known to us]*	*problem areas, good / bad features, running costs*	*new features, new methods, technological change, market needs*	*size, shape, weight, appearance, colour. style*	*Is it feasible, quality of results, comparison with existing methodologies*
Methods of use, functionality	Market size, pricing, competitors	Price, market share	Look, feel and function	Look, feel and function	Look, feel and function
Functionality	Size, risk, competition	Functionality	Functionality	Technology and user needs	Usability, functionality, installation problems
Search for continuos product improvement. Focus will change depending on new accessories that are available and competitor activity as well as new creative designs	*Detailed specification and price point*	*Need to know why the product is successful*	*Need to prepare a detailed design bill and design drawings*	*Will start off in the general and narrow down to the specific*	*What testing is done depends on what is being introduced. The more radical the change the more testing is needed.*
Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc	*National /European market figures, what trends are likely*	*Performance criteria, quality standards, ease of manufacture, competitor costs*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*	*Performance standard criteria e.g.. national / CE standards for products. Styling / aesthetic demands fro end users / retailers etc*
Usability, supply issues and cost	Specific market sectors	Specifications , cost and viability	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]	Technical Spec. [feasibility and quality] and Marketing Spec. [volume and demand]. Profit , Accounting, manufacturing base	Performance
Technical specification - time reduction	*Products hitting market in key sectors*	*Technical specification*	*Market / Technical specifications*	*Technical data*	*Technical data*
design, performance, ease of use, frequency of use	products used, health care culture, population, clinical indicators	Performance, claims, price, design, composition	internal and external requirements	Cost versus sales benefits, cost of manufacture, capacity	In-vitro and in-vivo testing, volunteer trials
[1] What is it that they are not getting?, [2] Where is there business heading in the future?. [3] what influences are there and opportunities?	*Road spending: value, demand and trends*	*Demand, technical performance, cost, design for manufacture, perception of product quality*	*Demand, technical performance, cost, design for manufacture, perception of product quality*	*Does it fit original brief. Cost parameter and cost advantages*	*Does it fit original brief. Cost parameter and cost advantages*
Technically and competitor driven	Hearsay	Direct communication with rival manufacturers / exhibitions	Minimum requirements taken as base and exceeded	Not done	Only physical testing of engineering principles

Appendix 6

Workshop Sessions with Participants 14 and 15

Focus Group
Perceptions and Attitudes
Company 15

PERCEIVED COMPANY WEAKNESSES

ISSUES

TIME MANAGEMENT		**TEAMS / JOBS**		**COMMUNICATION**		**PLANNING**		**FACILITIES**		**WORKFORCE**		**ROLES / PROCEDURES**		**SALES / MARKETING**	
No. of Responses	14	No. of Responses	12	No. of Responses	11	No. of Responses	7	No. of Responses	4	No. of Responses	9	No. of Responses	9	No. of Responses	8
managing products	4	control	1	*lack of communication*	3	no strategic direction	2	no prototyping	1	resource management	1	time taken to address problems	1	poor sales feedback	1
project planning	2	team work	1	*listening to workforce*	4	*lack of planning and co-ordination*	3	time taken to get prototypes	1	poor motivation	3	lack of defined procedures	3	selling what we do not make	1
no clear plan	2	ideas not being brought into action	4	poor communication between designers and shop floor	1	company structure	1	implementing manufacturing systems	1	lack of continuity in workforce	2	time management	1	reluctance to consider diversification	2
project control	1	poor job designs	1	inconsistent communications	1	desire to change	1	need to maintain production facilities	1	lack of technical people	1	over-complicated procedures	2	narrow product focus	1
time wasted- not knowing what has gone before	1	poor finishing	1	lack of team briefing	1					lack of understanding of individual talents and skills	1	roles and responsibilities not defined	2	marketing	1
deadlines - too short	1	*reluctance of management to devolve power/ responsibility*	4	not enough communication between design staff	1					training needs	1			lack of continuos improvements	2
things take too long at all levels	1	over-burden management	1												
lack of attention to detail	1	poor manufacturing procedures	1												
new ideas implemented have way - lack of support	1														

Focus Group
Perceptions and Attitudes
Company 15

PERCEIVED COMPANY STRENGTHS [GENERAL]

ISSUES

ENGINEERING		PRODUCTION		PRODUCTS		IDEAS		MARKETING		USER ISSUES		INSTALLATION / AFTER SALES		MANAGING PEOPLE	
No. of Responses	14	No. of Responses	8	No. of Responses	9	No. of Responses	3	No. of Responses	4	No. of Responses	7	No. of Responses	5	No. of Responses	11
functional product	3	making lifts	2	product quality	1	producing ideas	1	external links	1	identifying needs	1	servicing, installation & repairs	1	staring things	1
technical innovation	2	assembling parts	1	products that work well	2	problem solving	2	promoting image	1	meeting customer needs	2	inspection	1	working together	1
drive systems	1	sourcing suppliers	2	safe products	3			selling lifts	1	making products which do the job	1	after sales service	1	management skills	1
electronics	1	producing quality products	1	*comply with standards and regulations*	3			sales	1	looking for product opportunities	1	installing products	1	getting things done on time	1
mechanisms	1	production	1							*listening to customers*	2	distribution	1	finishing the job	1
adapting standard components	3	planning	1											T.Q.M.	2
mechanical engineering	2													*interaction between different job areas*	3
material selection	1													promoting good working environment	1

Focus Group
Perceptions and Attitudes
Company 15

SOLUTIONS TO PROBLEMS

ISSUES

STRATEGIC PLANNING		PRODUCT MANAGEMENT		PRODUCT DESIGN		PROJECT MANAGEMENT		RESOURCE MANAGEMENT		COMMUNICATION	
No. of Responses	27	No. of Responses	0	No. of Responses	21	No. of Responses	13	No. of Responses	14	No. of Responses	16
determination to improve	2	well defined schedules and deadlines	0	better quality product design specifications	2	establish what others are doing	2	delegation of responsibility with appropriate authority	3	improve communications at all levels	4
develop managerial hierarchy	3	someone responsible for managing each product area	0	better selection procedures [criteria]	2	team based system [cross functional]	4	create cross functional teams	5	listen to what people say	2
adopt T.Q.M.	2	better understanding and clarification of product life cycle[s]	0	involvement of all disciplines within design process	4	determine realistic timescales	3	training for staff in new product development	3	create forums / sessions were teams can discuss ideas and issues openly	1
clear objectives and strategies	4	more accurate product costing information	0	*consider all ideas properly*	2	introduce project management system	3	define roles and responsibilities	1		4
clearly defined company structure	4	better quality product design specifications	0	introduce and develop design for manufacture and assembly strategies	4	more attention to detail	1	more appropriate skilled staff [design (eng.), N.P.D.]	1		3
develop short, medium and long term strategies	3	better selection procedures		understand and utilise suppliers capabilities and knowledge	4			introduce just in time principles	1		1
launch new products more effectively	3	*develop project briefing system*		isolate R&D from day to day problems - idea generation	2						1
communicate strategies to organisation	1	more attention to detail		integrate CAD throughout company	1						
broaden product range	1										
be prepared to make changes	1										
invest in new production equipment and systems	2										
make more decisions at the right time	1										

Focus Group
Perceptions and Attitudes
Company 15

OVERALL ISSUES

- COMPANY REACTIVE NOT PRO-ACTIVE WITHIN MARKET PLACE
- LACK OF COMMUNICATION WITHIN NPD PROCESS
- NEED TO IDENTIFY ACTUAL SKILLS WITHIN WORKFORCE
- NEED TO MANAGE RESOURCES MORE EFFECTIVELY [HUMAN + EQUIPMENT]
- NEED TO UNDERTAKE MORE MARKET RESEARCH & BE MORE CUSTOMER ORIENTATED
- NEED TO DEVELOP & INTRODUCE A NEW "NPD' PROCESS WHICH ENCOURAGES COMMUNICATION & INTERACTION BETWEEN ALL FUNCTIONS
- TOO MUCH TIME / MONEY BEING SPENT ON MAKING PRODUCTS RIGHT IN PRODUCTION
- INSUFFICIENT TIME & RESOURCES SPENT ON DEVELOPING IDEAS TO A POINT WERE APPROPRIATE RISK ASSESSMENT CAN TAKE PLACE

Focus Group
Perceptions and Attitudes
Company 14

PERCEIVED COMPANY WEAKNESSES

ISSUES

MARKETING

No. of Responses	9
identifying customer needs	4
PR / promotion	2
market penetration	2
sales team too flexible	1

DESIGN FOR MANUFACTURE

No. of Responses	21
mistakes in design due to panic	1
working conditions	1
design not production friendly	5
lead times on large orders	1
quality of finishing	5
wrong material / new materials	3
quality management procedures	5
too much product handling	1
need to up-date tools	1
ability to make to original cost	1
lack of production capacity	1
lack of production planning	1

PRODUCT RANGE

No. of Responses	17
lack of innovation / unique product features	3
need for specific new products / ranges	9
old product range	1
reluctance to speculate	1
need for 'cast iron' sales prior to product launch	1
slow to respond to competitors	1
new product ideas not fulfilling return on investment criteria	1

LEVEL & RANGE OF STOCK

No. of Responses	5
anticipating / coping with demand	1
capacity / delivery	1
accurate stock figures / system	1
level of stock	1
storage of stock	1

Focus Group
Perceptions and Attitudes
Company 14

PERCEIVED COMPANY STRENGTHS

ISSUES

SERVICE		**MARKETING**		**PRODUCTION**		**DESIGN**		**DELIVERY / DISTRIBUTION**		**OTHERS**	
No. of Responses	14	No. of Responses	9	No. of Responses	14	No. of Responses	16	No. of Responses	3	No. of Responses	7
competitive	2	knowing market	1	design	2	complimentary products	2	quick response	3	working environment	1
respected in market	1	identifying market	1	quality products	2	flexibility	2			financial control	1
personal touch	1	product knowledge	1	quality manufacturing	2	aesthetic appeal	5			internal communication	1
friendly	1	competitive pricing	1	*problem solving in production*	4	user friendly	1			people skills	1
reliability	1	customer orientated	5	flexibility	2	design variations / personalised	3			*new products*	1
honesty	1	*reacting to need*	5	innovation	1	*reactive / copy designs*	2			*problem solving*	2
integrity	1			product to market	1	quality	1				
good team	1					price	1				
customer loyalty	1					early response to problems	1				
customer relations	1					functionality	1				
customer service	1										
reacting to customer problems	1										
customer communication	1										

Focus Group
Perceptions and Attitudes
Company 14

SOLUTIONS TO PROBLEMS

ISSUES

MARKETING / PROMOTION		MARKET RESEARCH		RETURN ON INVESTMENT		INTERNAL COMMUNICATION		DESIGN [GENERAL]		HUMAN RESOURCE MANAGEMENT	
No. of Responses	18	No. of Responses	22	No. of Responses	6	No. of Responses	14	No. of Responses	18	No. of Responses	6
pro-active marketing	2	identify new markets	9	communicate criteria for ROI	2	more communication between sales and production	3	need for design team	4	give credit for new ideas	1
up-date literature	4	*ask customers more questions*	7	realistic risk analysis	1	*more interaction between all relevant functions*	5	invest in design more	4	acknowledge source of ideas at all levels	1
more mail shots to existing markets	5	attend more exhibitions	1	*criteria: market size at least 20 x cost of design and tooling*	1	forums for debate	3	less paper change regarding new products	1	provide incentives - rewards	1
do more market research	4	determine market size	3	source products externally	1	get ideas from everyone	1	involve production in design process	4	provide training in all parts of company	1
overall direction needed	1	justify why products should go into production	2	provide more accurate data on demand / volume	1	discussions on "new ideas product/ feasibility"	1	investigate new methods / materials	3	devolve responsibility	1
overall marketing plan needed	1					more interaction between design and production	1	design for customisation	1	all staff to accept responsibility within their roles	1
launch new products more effectively	1							get designers to do their jobs properly	1		

Focus Group
Perceptions and Attitudes
Company 14

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